Difference in Stress Response and Aggressive Thoughts Between Regular and Non-Gamers After Playing a Violent Video Game

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Submitted in partial fulfilment of the requirements of the BA Hons in Psychology at Dublin Business School, School of Arts, Dublin.

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March 2016

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ACKNOWLEDGEMENTS

First and foremost I would like to thank my parents, Enrique Gonzalo and Arantzazu Gonzalo, for their constant support, understanding, and love throughout these years. I also like to thank Noris Rosas, Jesús Morales, Luis Pedroza, Cruz Rosas, and Carlos Kuzatko for their trust, motivation, inspiration and help.

Additionally, I would particularly like to thank my supervisor Rosie Reid, for her valuable guidance, and Michael Nolan, for his help in the conduction of the experiment.

Finally, I would like to express my gratitude for all those who took the time to participate in this study.

ABSTRACT

The aim of this study was to further explore if there were any significant differences between regular gamers and non-gamers regarding the physiological stress response composed of skin conductance and heart rate variability responses, as well as propensity to aggressive thoughts (using Anderson's "Word Completion Task"). Gender differences in relation to the same variables were taken into consideration. A total of (N = 34; males = 17, females = 17) participants partook in this experiment; gaming classification was made based on the number of hours played per week. Independent samples t-test and Mann-Whitney analyses found that there was no significant difference in relation to physiological stress response between regular gamers and non-gamers. No significant differences were observed in aggressive thoughts neither between regular gamers and non-gamers, nor between males and females. The overall stress response between males and females differed slightly, with males' scores being higher than those of females.

INTRODUCTION

1.1 The History of the Video Game Industry

The use of video games has increased dramatically since its appearance into society in the 1972's with "Magnavox Odyssey" created by Ralph Baer. Baer's creation was referred to as the first home video game console; beating sales record with over 100,000 units in that same year (Winter, 2013). With the launch of "Magnavox Odyssey" console the video game era officially began, giving rise to video game mass production in the following years, including the still favourites "PONG" and "Space Invaders" (Hadzinsky, 2014).

"PONG" was first produced by the company Atari in 1973; becoming the sensation of the moment and, leading to the creations of multiple versions of the game not only by Atari but by other companies (Hadzinsky, 2014; Langlotz, Rhode & Whaley, n. d.). Over the next few years, the popularity of the game remained and "PONG" consolidated itself as a social and familiar game. It could be found in bars, homes and arcades (Hadzinsky, 2014). However, around 1977 due to the lack of innovation, the repetitiveness of "PONG" and the oversaturation of the market led to a crash in the videogame industry (Hadzinsky, 2014). It was thanks to Toshihiro Nishikao who released in 1978 "Space Invaders" that the industry was able to emerge once again. According to Hadzinsky (2014) "Space Invaders" generated $-2 billion in sales by 1982.

Nevertheless, the low quality of the games and the overwhelming increase of personal computers, specially in 1984 when consumers were able to purchase a computer at the same price of the latest video game console, were the causes that lead to another crash in the video game industry from 1983 through 1985 (Hadzinsky, 2014; Langlotz et al. n. d.). An example worthy of mentioning which gives an insight of the crash was the overproduction of the game

"E.T." by Atari that only managed to sell 1.5 million copies out of a total of 5 million copies (Hadzinsky, 2014).

It is only when Nintendo released a new home console, the Nintendo Entertainment System (NES), and its video game Super Mario Brothers that the industry was revitalized. The highly immersive game play, speed and graphic improvements turned Super Mario Brothers into a hit that even nowadays is considered as one of the greatest successes of the video game era (International Center of the History of Electronic Games, 2015; Langlotz et al. n. d.).

The video game industry was dominated by Nintendo until 1996 when Sony took over with the release of PlayStation, a new video game console with a 32 bit processor. In an attempt to compete with Sonny, Nintendo released their new console with a 64 bit processor. Nevertheless, in 2000 the Nintendo 64 was left behind by Sony's PlayStation 2 and the introduction of the Xbox by Microsoft in 2001. Since then Microsoft, Sony and Nintendo have evolved, producing new generations of consoles and leading to the current fourth generation of video game consoles (International Center of the History of Electronic Games, 2015; Hadzinsky, 2014).

1.2 Prevailing Research

The study of potential harmful effects due to the media violent contents has been one of the most relevant topics of research for over six decades, with researches mostly focusing on violent television, films, and music. Since the popular emergence of video games took place around 1985, it could be said that video games are a new subject of research regarding media violence. According to Anderson et al. (2010) it is due to the relatively new development of

video game technology that there are fewer empirical studies in the field of video game violence when compared to the violent contents in television, films and music.

Most of the research conducted regarding the use of video games is focused on the harmful effects that both short-term and long-term exposure to violent video games causes, especially in relation to aggression levels (Sherry, 2001; Anderson, 2004; Anderson & Bushman, 2001; Carnagey & Anderson, 2005; Anderson et al., 2004; see Anderson et al., 2010 for a meta-analytic review). It is worth mentioning that current research is mostly grounded on the theory of General Aggression Model proposed by Anderson & Bushman (2002), which suggests that aggression is influenced by two types of input variables: personal and situational. Personal variables are related to the individual genetic predisposition, personality traits, attitudes, values, etc. On the other hand, situational variables include all the external factors that may induce or influence aggression such as alcohol, violent videogames, frustration, etc.

Another topic of research that has been carried out relates to the basic demographic factors of online game players (Griffiths, Davies, & Chappell, 2004; Yee, 2006). Findings showed that the mean age for gamers was 28 years and approximately 81% of them were males. In relation to the amount of hours spent in video game playing, it was found that 4% of players spent over 70 hours per week.

Research in relation to social aspects and personal experiences of gamers has also been addressed. Cole & Griffiths (2007) and Hussain & Griffiths (2008) investigated in depth relevant patterns of social interactions of online gamers in massively multiplayer online role-playing games (MMORPG). Among significant observations made, it was stated that 21%, representing approximately 1 in 5 gamers, claimed to be more eager in socializing online than offline. This may be due to the fact that virtual gaming allows players to express themselves

and interact with others in a less personal or physical way. Without the stressors of appearance, gender, sexuality or even age, the interaction process is achieved easily. In relation to attitudes, feelings and experiences of online gamers, a qualitative study by Hussain and Griffiths (2009), concluded that gamers used MMORPGs as a coping method for negative feelings such as stress, anger, and frustration, as well as a regulator for changes in mood states. Furthermore, research regarding other social aspects has also been carried out such as social anxiety (Lo, Wang, & Fang, 2005), and social inadequacy and development (Griffiths & Naughton, 2001).

1.3 Aggressive Thoughts and Video Game Playing

According to the Oxford University Press (2016), aggression can be defined as "Feelings of anger or antipathy resulting in hostile or violent behaviour; readiness to attack or confront". Propensity of aggressive thoughts is one of the most researched areas in relation to aggressive cognition. Before delving into the topic, it is worth clarifying the difference between factors that increase the emergence of aggression from those that inhibit it (Anderson et al., 2010; Anderson & Huesmann, 2003).

According to Anderson et al. (2010) some of the facilitating factors that may increase the emergence of aggression in an immediate situational context are aggression cues, such as weapons or violent media, and unpleasant events in everyday life which may have an effect in mood, such as hot temperatures, loud noises, odours, pain, etc. On the other hand, inhibiting factors consist of moral beliefs opposing violence, fear of punishment or revenge, unfavourable emotional reactions to images and thoughts of violence, and pleasant situational events which positively affect mood (e.g. good weather) (Anderson et al., 2010).

A considerable amount of research, related to aggressive behaviour and cognition, attempted to identify the effects that exposure to violent video games has in short and long term periods. Bushman and Huesmann (2006) suggest that, short-term effects are developed by previous and recent priming knowledge structures such as several types of schemata and scripts. Priming processes require only two elements to occur: a person who already has a few aggression scripts and a brief exposure to an aggressive stimulus that requires a violent action (e.g. video game). By contrast, long term effects are associated with permanent changes of personality and other related person factors such as beliefs, expectations, attitudes, scripts, etc. (Bushman & Huesmann 2006; Anderson et al. 2010; Carnagey & Anderson, 2005).

Research has been conducted to further understand the possible effects that violent video games have on the person's internal state such as aggressive thoughts, aggressive feelings and physiological arousal (Anderson, Carnagey, & Eubanks, 2003; Carnagey & Anderson, 2005; Yang et al., 2014; Anderson et al. 2010).

A consistent body of evidence suggests that playing video games primes aggressive ideas and behaviour (Yang, Huesmann, & Bushman, 2014; Huesmann & Bushman, 2006; Anderson et al., 2004; see Anderson et al., 2010 for a meta-analytic review). According to Yang et al. (2014) the human mind can be referred to as an associative network consisting of both nodes and links. The former stands for concepts and the latter for associations among concepts (Yang et al., 2014). Exposure to stimulus prime or activates concepts in memory. Therefore, playing violent video games will increase the activation or prime of concepts associated with aggression. Furthermore, thoughts are linked to spreading activation not only to other thoughts but also to emotional reactions and behavioural tendencies (Yang et al., 2014, p. 538).

The meta-analysis study conducted by Anderson et al. (2010) regarding violent video game effects on aggression, which encompasses behaviour, cognition, affect, psychological arousal, empathy, prosocial behaviour, and desensitisation, revealed that there were significant effects for all the six measured variables.

1.4 Physiological Stress Response and Video Game Playing

One of the earliest theories in stress research was conducted by Selye in 1963, the General Adaptation Syndrome (GAS), it suggests that several different stimuli such as cold, pain, toxic agents, etc. will elicit or lead to similar physical consequences, including degeneration of lymphatic structures, increase in the activity of the adrenal cortex, and gastric ulceration. Selye proposed that all these responses were universal and non-specific (Oldehinkel et al., 2011). Nevertheless, in the following years, Selye's assumption of a universal stress response was harshly criticized for two main factors: non-inclusion of psychological variables, that is, the emotional response to the stressor produces the stressful phenomena rather than the stressor itself (Mason, 1971; Mikhail, 1981) ,and specification of stress phenomena, which implies that stress systems may respond in different ways and in different combinations to stressors depending on the nature of the stressor (Ulrich-Lai & Herman, 2009). Due to the previous research, it was concluded that the study of stress needed to be divided into several areas because generalisation of the subject was not possible.

Physiological stress response, which refers to the body's reaction to a potential stressor, is one of the most recorded measures of stress nowadays. In relation to video games, previous research has shown that video games may induce physiological arousal such as skin conductance, also referred to as galvanic skin response, blood pressure and heart rate (Anderson et al., 2010). In violent video games players are put in extremely stressful situations

where they feel they are in danger because enemies are trying to kill them repeatedly. Although nobody dies, players still experience high level of stress while playing violent video games which can have negative effects on the body. According to Weiten, Dunn, & Hammer (2011), constant exposure to stress may lead to cardiovascular disease.

Recent research suggests that cardiac coherence, which is a measure of reduced stress, is a mediator of the link between exposure to violent video games and aggression (Hasan, Bègue, & Bushman, 2013). Cardiac coherence could be defined as "the synchronization of the rhythm of breathing to the rhythm of the heart" (Hasan et al., 2013, p. 65). By measuring cardiac coherence Hasan et al. findings revealed that there was a negative correlation between cardiac coherence and stress levels, suggesting that those who played violent video games had a lower cardiac coherence response and higher stress levels in comparison to those who played non-violent video games.

Previous research has proposed the presence of a positive correlation between exposure to violent video games and increased heart rate variability (Anderson et al., 2010; Hérbert, Béland, Dionne-Fournelle, Crête, Lupien, 2010). According to Hasan et al. heart rate variability is a strong indicator of greater autonomic nervous system balance, and it reflects how the autonomic nervous system may influence the fluctuations of the heart.

As previously mentioned, skin conductance levels, also referred to as galvanic skin response (GSR) or electrodermal activity (EDA), has been frequently used for measuring physiological arousal in the body. One of the major advantages of skin conductance recording is that the response is completely enervated by the sympathetic nervous system (SNS), therefore, results are interpretatively unambiguous (Dawson, Schell, & Filion, 2000), which cannot be said for heart rate since it is dually enervated by both the SNS and the

parasympathetic nervous system (PNS) (Ravaja, 2004). Skin conductance responses can be defined as follows: an increased in sweat gland activity due to the activation of the SNS in response to a stressor.

1.5 Gender differences

Gender differences in relation to aggressive personality, behaviour, and cognition, has been a relevant topic of investigation. Human aggression is the result of any behaviour that is carried out with the proximate or immediate intent to cause harm towards another individual. Furthermore, the perpetrator must believe that the action will cause harm to the target and that the target, due to instinctive behaviour or common sense, is motivated to avoid such action (Bushman & Anderson 2001).

According to Bettencourt & Miller (1996) several experimental studies of adult aggression suggest that men are more aggressive than females. One of the predictors of gender differences in aggression is the social role approach, which states that, aggression is like any other social behaviour and therefore can be regulated by the specific social norms that apply to people based on the roles they occupied within the society (Eagle & Steffen, 1986). The roles of males and females in relation to aggression differ significantly, males are supposed to be tough and violent, whereas females are supposed to be patient and calm. Moreover, according Eagle & Steffen (1986) gender stereotype research has shown that qualities such as physical power, tough and violent personality are more desirable in men than women. Nevertheless, the conditions under which genders' responses differ in aggressiveness are not completely understood (Eagle & Steffen, 1986). Different factors may interfere or regulate aggression in individuals. The meta-analysis conducted by Bettencourt & Miller (1996) revealed that

provocation dramatically reduces gender differences in aggression, which suggests that personal interpretation does have an effect in aggressive response.

In relation to aggressive thoughts and violent video game playing, most of the research conducted addressing gender differences have not found any significant difference between males and females (Anderson et al. 2010; Anderson et al. 2004; Anderson & Bushman 2002). Similarly, no significant difference has been found in relation to physiological stress response and gender (Hasan et al. 2013; Anderson et al. 2010; Lin, 2013).

1.6 Purpose of This Study

A consistent body of research has been carried out regarding both video games and aggression levels and the effects that regular exposure to video games produces (e.g. stress). Nevertheless, there is a gap in the literature regarding non-gamers responses. In other words, the research is focused on gamers only, forgetting the importance of the effects that video game exposure may have in non-gamers. This study aims to make a contribution to this field of research by focusing on non-gamers responses regarding physiological stress response and propensity to aggressive thoughts. In addition, gender differences in physiological stress response and aggressive thoughts will also be measured. By doing so, this study may enhance our knowledge with respect to video game exposure, providing professionals and the public in general with a different perspective of the topic.

1.7 Hypotheses

With this goal in mind, several hypotheses will be examined in this study. Formally, the experimental hypotheses are:

1. Non-gamers will show a higher physiological stress response than regular gamers after playing a violent game. For this purpose physiological arousal which consists on the effects of stress in the body is going to be measured, specifically heart rate variability and skin conductance (HRV & SC). In other words, non-gamers will elicit a higher physiological arousal response than regular gamers.
2. It is hypothesised that non-gamers will present higher levels of aggressive thoughts than regular gamers.
3. There will be a significant difference in the stress response with regard to the gender of participants.
4. There will be a significant difference in aggressive thoughts with regard to the gender of participants.

Overall, the results of this study will contribute to the literature regarding video game usage, physiological arousal as a result of video game playing, the influence of video games on aggressive thoughts, and gender differences in relation to stress and aggressive thoughts. Furthermore, this study will fill the gap in the literature regarding non-gamer's response when they are introduced to a new stressful stimulus.

METHODS

2.1 Participants

For the purpose of recruiting participants for this study an adequate sample technique was used. A total of (N=34) participants were tested, the sample consisting of psychology colleagues from the Dublin Business School (DBS), students of the Dublin Institute of Technology (DIT) , members of the DBS and DIT game societies', students from other colleges of the Republic of Ireland, friends, and family. The sample was divided into two groups regular and non-gamers (RG=17; NG=17), and gender (M=17; F=17).

Participants were contacted either verbally, via email or using the following social networks: WhatsApp, Facebook Messenger and the Societies' Facebook profiles. All participants were tested under the same conditions and performed the same tasks. Participation in this study was completely voluntary and was not subject to any type of reward. Inclusion and exclusion criteria for this experiment were outlined in the information sheet and consent form which were given to all participants upon starting the experiment. Participants were required to read thoroughly the information sheet and sign the consent form before proceeding with the experiment. In order to participate in this study all participants had to be over eighteen years of age, and free of any heart conditions.

2.2 Design

Based on the aim of this study, which is to establish significant differences in physiological stress response and aggressive thoughts between regular gamers and non-gamers, as well as gender difference. A quantitative research approach using a quasi-experiment design, specifically a cross-sectional design was selected. The independent variables (IV) in this study

consist of two categorical, independent groups: gaming status (regular gamers and non-gamers) and gender (males and females). The dependent variables (DV) were aggressive thoughts scores and physiological stress results, consisting of heart rate variability (HRV) and skin conductance (SC) results. Aggressive thoughts scores were based on the "Word Completion Task" by Anderson (1999).

Participants were categorized or classified into two groups: regular gamers (N=17; 13 males and 4 females) and non-gamers (N=17; 4 males and 13 females). This classification was based on the amount of hours playing video games per week. Participants playing an average of 6.5 hours per week were classified as regular gamers. It is important to mention that the average hours of play was established based on previous research in this field (Bean, 2015; Entertainment Software Association, 2015; Griffiths, Davies, & Chappell, 2004; Simons, de Vet, Brug, Seidell, & Chinapaw, 2014).

2.3 Materials

This experiment required the participants' to complete two tasks: a video game playing task and a "Word Completion Task" (Anderson, 1999). The purpose of the first task was to induce a physiological stress response in participants. In order to measure this, heart rate variability and skin conductance were assessed. The second task had as primary objective to measure the levels of aggressive thoughts in participants after being exposed to a violent stimulus.

For the video game task participants were required to play a video game for thirty minutes in single-player mode. The video game selected for this study was the fighting game Mortal Kombat X playable both in single-player and multi-player modes. This game was

developed by NetherRealm Studios and published by Warner Bros. Interactive Entertainment the 7th of April 2015 for the following platforms: Android, iOS, Microsoft Windows, PlayStation 4, and Xbox One. (Reference needed)

Aggressive thoughts were assessed using the "Word Completion Task" by Anderson (1999), which is a list of 98 word fragments with missing letters. In this list the majority of words have several possible correct completions. Fifty of them can be completed using letter combinations resulting in aggression-related words -e.g. kill, behead, burn, strike, etc.-. All participants were required to complete this task in a time period of thirty minutes. Participants were instructed to create the first word that came to their mind. A coding key booklet designed for the Word Completion Task by Anderson was utilised for the scoring of this task. This booklet provides a full list of possible word completions of all fragments in the task and it is coded into four word categories: neutral, ambiguous, aggressive and non-words. Scores on Anderson's task were calculated by dividing the number of words that were completed as aggressive by the total of word completions (98). A copy of the word completion task, coding key booklet, and other relevant documentation such as the information sheet and consent form can be found in the appendix section.

2.4 Apparatus

To conduct the first task, a personal pc specialist laptop model: WN7- 00822, which is a specialized gaming computer, was used to play the video game Mortal Kombat X in a Microsoft Windows platform. An Xbox 360 controller model: E-C015-05-4542 (B) was connected to the computer to play the video game.

LabChart hardware was used for recording the participants' physiological stress response. For the recording, it was necessary to attach two foam electrodes to the anterior region of the elbow, an electrode clip to the earlobe, and two galvanic skin response (GSR) electrodes to the toes. The collection and further analysis of the data were performed with the PowerLab data acquisition software.

2.5 Procedure

2.5.1) Invitation to Participate and Study Overview

As previously mentioned, this study used a convenience sample method to gather participants. Invitations to participate were given verbally and through the following social networks: WhatsApp, Facebook Messenger and the Societies' Facebook profiles. A time to take part in the experiment was assigned to each participant at their convenience after confirming they were willing to partake in the experiment. Biofeedback laboratory appointments were made through the DBS Moodle page link provided in the "Research Project" module (A8RS102). The experiment took place in the DBS Balfe Street building, all participants being tested in the third floor laboratory 3.3.

The experiment began with an introduction of the research project. All variables, measures and tasks were discussed in detail with all the participants, as well as the time commitment of the study. A booklet with an information sheet providing further details of the nature of the study, a gamer classification sheet and a consent form were giving to the participants. In order to proceed with the experiment, all participants were required to read the booklet carefully. By signing the consent form the participants' acknowledgment that they were over eighteen years of age and free form any heart conditions, they understood the nature of the study completely,

and all the queries of the study were properly answered. In addition, all participants were informed that data collected was going to be kept confidential and that, to ensure the participants' anonymity, a personal code was going to be matched with the data.

2.5.2) Completion of the Tasks

After providing an overview of the study, participants were required to complete the first task of the experiment, which was the Mortal Kombat X video game playing task. The total duration of this task was thirty minutes. Before starting to play the video game, all electrodes necessary for the recording of the physiological stress response were attached to the participants' bodies. All participants were required to play in single-fight mode, with a medium level of difficulty. Selection of the fighting character and opponents were completely optional to the participants' personal preferences. In addition, switching fighting characters and opponents throughout the experiment was allowed.

The second task of the experiment was the "Word Completion Task" by Anderson (1999). Participants were informed that the duration of this task was also of thirty minutes. All participants were instructed to fill the missing letters of the 98 word fragments, and complete them with the first word that came to their mind. Upon completion of this task the experiment was concluded.

2.6 Ethical Considerations

Participants were warned through the information sheet that there was a possibility that they might experience some level of distress due to the graphical and violent content of the video game. Mortal Kombat X has an entertainment software rating board (ESRB) rating of M,

which stands for mature audiences. For this reason, underage participants (or under 18 years of age) were not allowed to partake in the experiment.

RESULTS

3.1 Descriptive Statistics

A total of (N=34) participants partook in this experiment; all of them being exposed and tested under the same conditions. The classification of participants into groups was as follows: regular gamers (N=17; 13 males and 4 females) and non-gamers (N=17; 4 males and 13 females). Descriptive statistics including mean, standard deviation, etc. were run for all of the dependent variables of this experiment. In addition, mean and standard deviation comparisons between groups as well as gender were done in order to provide more details with respect to the variables and differences between groups.

The score of skin conductance response (SC) for regular gamers was (M = 9.24, SD = 10.81), while the score for non-gamers was (M = 3.62, SD = 10.10) (see, table2.). By contrast, the score of skin conductance response for males was (M = 9.46, SD = 10.88), whereas for females was (M = 3.40, SD = 9.88) (see, table2.), which suggests that the total score for skin conductance response was (M = 6.43, SD = 10.69) (see, table1.).

Heart rate variability (HRV) score for regular gamers was (M = 78.61, SD = 16.52), while the score of heart rate variability for non-gamers was (M = 80.97, SD = 17.50) (see, table2.). In comparison, heart rate variability score for males was (M = 85.04, SD = 17.37), whereas for females was (M = 74.54, SD = 14.85) (see, table2.), which suggests that the total score for heart rate variability was (M = 79.79, SD = 16.78) (see, table1.).

The score of aggressive thoughts for regular gamers was (M = .15, SD = .06), while the score for non-gamers was (M = .20, SD = .14) (see, table2.). By contrast, aggressive thoughts scores for males was (M = .16, SD = .03), whereas for females was (M = .19, SD = .15) (see,

table2.), suggesting that the total mean score for aggressive thoughts was (M = .18, SD = .11) (see, table1.).

All the dependent variables were assessed for normal distribution using a skewnees and kurtosis analysis in SPSS in order to validate the use of parametric testing. Two of the dependent variables did not meet the criteria for parametric testing. Therefore the non-parametric alternative "Mann-Whitney U Test" was utilised. The variables mentioned above were skin conductance and aggressive thoughts. Skin conductance was non-normally distributed, with a skewnees of 1.29 (SE = .40) and a kurtosis of 1.99 (SE = .79). Similarly, aggressive thoughts was non-normally distributed, with a skewnees of 3.35 (SE = .40) and a kurtosis of 15.88 (SE = .79). In relation to the variable of heart rate variability, which met all the criteria for parametric testing and was normally distributed, with a skewnees of .21 (SE = .79) and a kurtosis of .03 (.40), an independent samples t-test was utilised (see, table1.).

Table 1. *Descriptive Statistics of the Total Scores of Physiological and Psychological Measures*

Variable	Mean	Standard Deviation	Skewnees		Kurtosis	
			Statistic	Std. Error	Statistic	Std. Error
Total Skin Conductance Response	6.43	10.69	1.29	.40	1.99	.79
Total Heart Rate Variability Response	79.79	16.78	.21	.40	.03	.79
Total Aggressive Thoughts	.18	.11	3.35	.40	15.88	.79

Table 2. *Mean and Standard Deviation Comparisons Between Groups and Gender*

Variable	Group	Mean	Standard Deviation
Skin Conductance Response	Regular Gamers	9.24	10.81
	Non-Gamers	3.62	10.10
Heart Rate Variability Response	Regular Gamers	78.611	16.52
	Non-Gamers	80.97	17.47
Aggressive Thoughts	Regular Gamers	.15	.06
	Non-Gamers	.14	.14
Variable	Gender	Mean	Standard Deviation
Skin Conductance Response	Males	9.46	10.88
	Females	3.40	9.88
Heart Rate Variability Response	Males	85.04	17.37
	Females	74.54	14.85
Aggressive Thoughts	Males	.16	.03
	Females	.19	.15

3.2 Inferential Statistics

3.2.1) Regular Gamers and Non-Gamers Skin Conductance and Heart Rate Variability Responses

In order to measure the difference in skin conductance response between regular gamers and non-gamers a Mann-Whitney U Test was conducted, indicating that the skin conductance

response was higher for regular gamers (Md = 8.64) than for non-gamers (Md = 2.10), U = 79, p = .024, r = .39.

An independent sample T-test was implemented to compare heart rate variability scores for regular gamers and non-gamers. There was no significant difference between the scores of regular gamers (M = 78.61, SD = 16.52) and non-gamers (M = 80.97, SD = 17.47) (t (32) = -.40, p = .973, Cl (95%) -14.23 – 9.52). Therefore the null could not be rejected.

3.2.2) Overall Physiological Stress Response (SC and HRV) of Regular Gamers and Non-Gamers

In this study the physiological stress response of participants is assessed based on the results in skin conductance (SC) and heart rate variability (HRV). Following the statistical analysis of the two variables it can be observed that there was a significant difference in skin conductance between regular gamers and non-gamers. Regular gamers did elicit a higher skin conductance response (Md = 8.64) than non-gamers (Md = 2.10). Nevertheless, it was not found any significant difference in heart rate variability response between regular gamers and non-gamers and the Levene's test probability value was not significant (.97 > .05). Despite the fact that there is no significant difference in heart rate variability it is important to mention that non-gamers did elicit a higher heart rate variability response with a mean of 80.97 (SD = 17.47) than regular gamers with a mean of 78.61 (SD = 16.52) (see figure 1.).

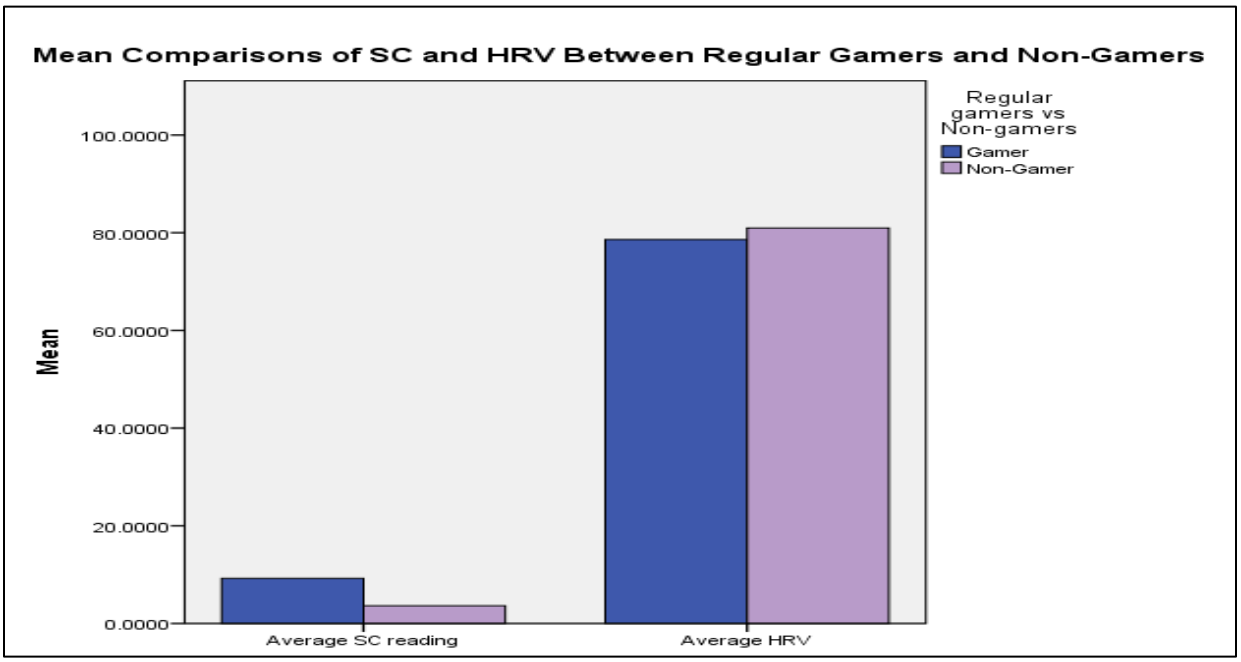

Figure 1. Bar chart showing a comparison of the mean scores of skin conductance and heart rate variability between regular gamers and non-gamers.

3.2.3) *Gender Difference in Skin Conductance and Heart Rate Variability Responses*

For measuring the differences in skin conductance response between males and females a Mann-Whitney U Test was used, showing that the skin conductance response was higher in males (Md = 8) than in females (Md = .81), U = 75, p = .017, r = .41.

To compare the heart rate variability scores between males and females an independent-samples t-test was performed, indicating that there was no significant difference between heart rate variability of males (M = 85.03; SD = 17.37) and females (M = 74.54, SD = 14.85) (t (32) = 1.90, p = .427, Cl (95%) -.79 – 21.79). Therefore the null could not be rejected.

3.2.4) Overall Gender Difference in Relation to Physiological Stress Response (SC and HRV)

As mentioned above the method for assessing the physiological stress response of the particopants is by comparing the scores in skin conductance (SC) and heart rate variability (HRV). The statistical analysis suggests that there was a significant difference in the skin conductance of males and females. Male skin conductance responses were higher (Md = 8) than in females (Md = .81). Whereas, there was no significant difference found between males and females in relation to heart rate variability response, the Levene's test probability value was not significant (.43 > .05). Despite the fact that there is no significant difference in heart rate variability, it is important to mention that males did elicit a higher heart rate variability response with a mean of 85.04 (SD = 17.37) while for females the mean was of 74.54 (SD = 14.85) (see figure 2.). Therefore, analysing both skin conductance and heart rate variability it is plausible to assume that the overall physiological stress response was higher in males than in females.

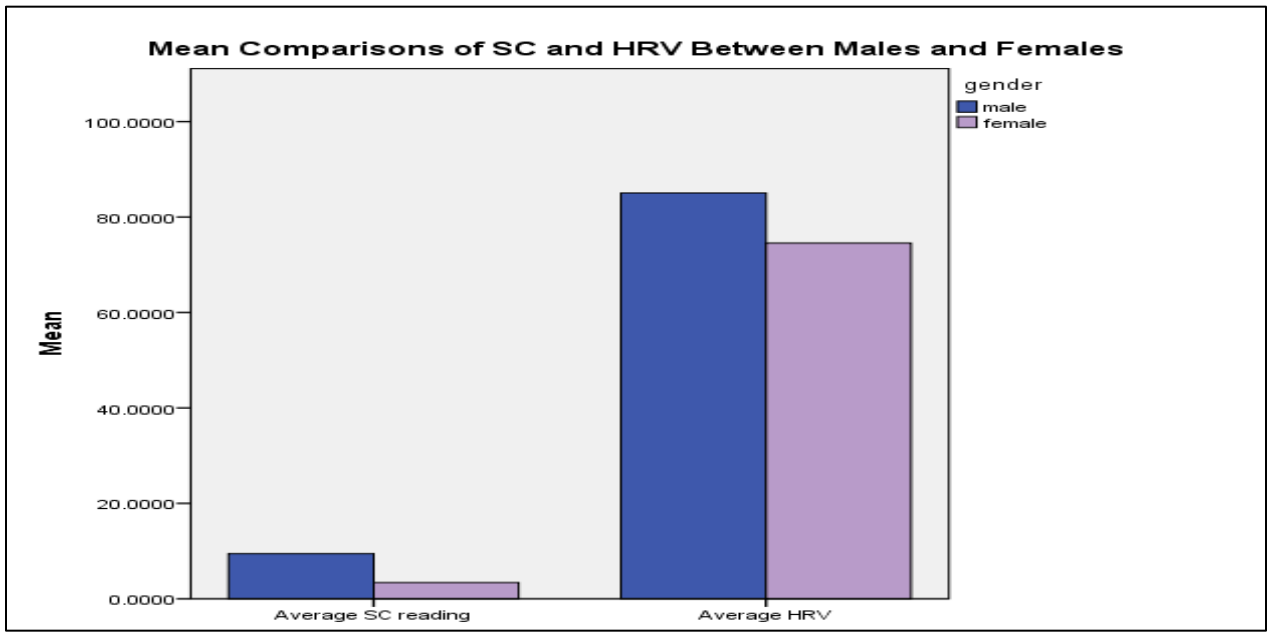

Figure 2. Bar chart showing a comparison of the mean scores of skin conductance and heart rate variability between females and males.

3.2.5) Regular Gamers and Non-Gamers Responses in Relation to Aggressive Thoughts

In order to determine the differences in aggressive thoughts between regular gamers and non-gamers using the "Word Completion Task" by Anderson (1999), a Mann-Whitney U Test was utilised, revealing that there was no significant difference in aggressive thoughts between regular gamers (mean rank = 15.91) and non-gamers (mean rank = 19.10), $U = 117.50$, $p = .933$, $r = .16$.

3.2.6) Gender Difference in Relation to Aggressive Thoughts

A Mann-Whitney U Test was applied in order to assess the difference in aggressive thoughts between males and females, suggesting that there was no significant difference between males (mean rank = 17.32) and females (mean rank = 17.68), $U = 141.50$, $p = .917$, $r = .02$.

DISCUSSION

The aim of the current study was to further explore if there were any significant differences in the physiological stress response and propensity to aggressive thoughts of non-gamers when compared to regular gamers. Gender differences in relation to the same variables were taken into consideration. Instead of focusing in gamers reactions as the majority of previous research has done, the approach of this study was mainly focused on non-gamer responses. Several measures were established in order to arrive to a conclusion. The overall physiological stress response of participants was obtained through skin conductance and heart rate variability recording. Propensity for aggressive thoughts was measured using the Anderson's Word Completion Task (1999). Participants were exposed and tested under the same conditions for this experiment and all the variables measured were compared between gaming groups (regular gamers and non-gamers) and gender.

4.1. Revision of Hypotheses

Hypothesis one stated that non-gamers would have elicited a higher physiological stress response than regular gamers after playing a violent game. In order to establish this, two variables were combined. These consist of skin conductance and heart rate variability response. For the recording of the variables mentioned above electrodes were attached to the anterior region of the elbow, earlobe and toes. However, the findings of this study revealed that there was no significant difference in the overall physiological stress response. These findings were surprising since previous research (Anderson, et al., 2010; Lin, 2013; Hérbert et al., 2010; Hasan et al., 2013) suggested that violent video games will significantly increase physiological stress response. It is worth mentioning that there was a significant difference found in the skin conductance response of regular gamers compared to non-gamers. Nevertheless, heart rate

variability was not significant, and in this case non-gamers' responses were slightly higher than those of regular gamers. Therefore, the overall physiological stress response was considered as not significant and the null hypothesis was accepted.

Hypothesis two stated that non-gamers would have presented higher levels of aggressive thoughts than those of regular gamers. In order to measure this, the "Word Completion Task" by Anderson (1999) was utilised. Following the statistical analysis it was found that there was no significant difference in relation to aggressive thoughts between regular gamers and non-gamers, therefore the null hypothesis was accepted. Again, contradicting previous research, the findings of this hypothesis suggests that the exposure to the violent video game did not significantly increase the aggressiveness in participants (Anderson & Bushman, 2002; Yang et al, 2013). Nevertheless, it was observed that non-gamers' responses were slightly higher than those of regular gamers; this may be due to the fact that regular gamers are habituated to the stressor stimulus. Therefore, part of the intensity of the effect is lost. This is not the case for non-gamers.

Hypothesis three stated that there would be significant difference in the physiological stress response with regards to the participant's gender. Findings of this study suggested that there was a difference in the physiological stress response between males and females. Males' skin conductance response was significantly higher than those of females. However, no significant difference was found for heart rate variability, this finding would correspond to those from (Hasan et al, 2013). Furthermore, the fact that male scores in hear rate variability were higher than those in females will correspond to Lin's findings (2013).

Despite the fact that of the two variables just one has a significant difference, it is observable that physiological responses of males were higher in both skin conductance and heart rate variability. Therefore, a difference in response can be proposed.

Finally the fourth hypothesis stated that there would be a significant difference in aggressive thoughts with regards to the gender of participants. Following analysis, it was found that there was no significant difference in relation to aggressive thoughts and gender. Therefore, the null hypothesis was accepted. This result corresponds to those from (Anderson, et al., 2010; Carnagey & Anderson, 2005). However, this study revealed that female's scores were slightly higher than those in males, contradicting the findings of Carnagey & Anderson (2005) which were the opposite.

4.2. Limitations of the Study

Several limitations were present during the conduction of this experiment. It was observed that the difficulty level of the "Word Completion task" by Anderson (1999) was challenging and a cause of distress for the majority of participants. The stipulated time commitment for this task was thirty minutes but the majority of participants took between thirty-five to fifty minutes to complete the task, due to its level of difficulty. In addition several participants could not entirely finish the 98 word fragments of the task. Participants expressed their inability to find the appropriate letters to complete some of the words, leaving an average of 10 word fragments unanswered. Moreover, due to the laboratory demand by other students who were carrying out researches and the time required for the experiment, some participants were forced to finish the Anderson's task in the corridors outside the laboratory. The noise in the corridors may have affected the participant's performance in the task.

Further limitations were found in relation to the sample. A larger sample size would be ideal for the conduction of this experiment. However, due to the time consuming nature of the experiment and the accessibility to participants, this was not possible. The limited size of the sample may be one of the reasons why the scores in two of the dependent variables (skin conductance and aggressive thoughts) were non-normally distributed. Furthermore, a number of participants within this experiment were from other countries within the European Union and South America. Therefore, since English was not their mother tongue, it might have hindered or affected the completion of the Anderson's Word Task and increase as well the possibility of misspelling words and creating non-existent words.

Another relevant limitation of this experiment was due to the equipment. Firstly, with the Galvanic Skin Response (GSR) electrodes, since they showed signs of wear and previous damage. Better optimized equipment would have been ideal for the collection of data, but due to the actual condition of the electrodes skin conductance, data collection was not optimal. Technical repairs had to be made to the electrodes several times during the conduction of this experiment, even while the participants were being tested. For that reason physiological recordings had to be stopped and the experiment restarted. This may have caused distress or some level of anxiety in participants, which might have compromised the data. Secondly, technical difficulties with the gaming equipment were experienced occasionally. The technical difficulties were the following: computer freezes while playing, lack of audio, game crashes, drops in frames per second (display device performance), and slow controller response. Similarly, this may have also caused in participants distress and distraction from the gaming task, possibly affecting the data.

4.3. Implications of the Study and Future Research

The main implication of this study is that it fills the gap existing in literature regarding non-gamers physiological and psychological reactions to aggressive video game stimuli. Instead of focusing in a gamer perspective as the majority of the previous researches, this study seeks to further explore the differences in physiological stress response (SC and HRV), and aggressive thoughts of non-gamers. The inconsistency observed among results of aggressive thoughts and physiological stress response between regular gamers and non-gamers in the current study emphasise the need for further research in that area.

Future research should consider measuring more demographic variables such as age, nationality, ethnicity and religion in order to gain a deeper understanding of the effects that video playing have in priming aggressive ideas. Similarly, differences in physiological stress response due to video game playing and ethnicity could be an interesting area for future research. Considering the physiological factors that differ between ethnics groups it would we worthy to observe if the stress response differs between them.

4.4. Conclusion

This study has broadened the knowledge in relation to video game playing and the differences in physiological stress response as well as aggressive thoughts between both groups. A significant difference was observed in the physiological stress response with respect to gender, with male's responses being higher than females. Nevertheless, some of the results of this study have shown some inconsistencies regarding the differences in the physiological stress response and aggressive thoughts scores of regular gamers and non-gamers.

A significant difference was found in the skin conductance response of regular gamers in comparison to non-gamers. However, even though no significant difference was found for heart rate variability, non-gamers elicit a higher response than regular gamers. Likewise, no significant difference was found in the scores of aggressive thoughts, but again the scores for non-gamers were higher than for regular gamers, contradicting previous researches. Another inconsistency was observed in aggressive thoughts scores related to gender. Despite the fact that the results were not significant, scores for females were higher than for males. Limitations such as sample size and the difficulty of the word completion task by Anderson were previously addressed in order to explain the inconsistency of the findings. Notwithstanding the limitations of the study, its relevance for future research in relation to physiological and psychological reactions of non-gamers to aggressive video game playing was proposed.

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APPENDIX

Participant's Information Sheet

Difference in stress response and aggressive thoughts between regular and non-gamers after playing a violent video game

Dear Participant,

My name is Valeria Morales Gonzalo and I am in the final year of my BA (Hons) Psychology degree at Dublin Business School. I would like you to take part in the research project I am conducting which will look at the differences in physiological stress response, specifically heart rate variability (HRV) and skin conductance (SC), and aggressive thoughts between regular gamers and non-gamers after playing a violent video game.

Please take a few minutes to read the following information carefully before you decide to take part in the study.

In this research, participants will be subjected to heart rate and skin conductance monitoring while playing a violent video game for 30 minutes. The process will be as follows: Electrodes will be attached to the participant's wrist and the anterior region of the elbow to measure heart pulse and a clip will be attached to the toe to measure skin conductance. Afterwards you will be required to play a violent game (Mortal Kombat X). In addition, participants will be required to complete a word task within 30 minutes where a list of 98 word fragments with missing letters need to be filled.

Participant's time commitment to the study will be of one session of approximately 60 minutes. All participants must be over 18 years old and should not suffer from any heart condition.

This study has a minimum risk for participant's wellbeing; unfortunately there is a possibility that participants may feel distressed because of the violent content of the video game. Participation in this study is completely voluntary and all participants have the right to withdraw at any time.

All the data collected for the purpose of this research will be kept confidential. To ensure confidentiality the data is going to be matched with a private code which will be stored on a password protected computer when not in use. All data will be stored for a period of a year, after this period of time it will be destroyed.

If you have any further questions about the study please do not hesitate to contact me or my supervisor via email: xxxx@xxxxx

Consent Form

Difference in stress response and aggressive thoughts between regular and non-gamers after playing a violent video game

This research project is examining the differences in stress response, specifically heart rate variability (HRV) and skin conductance (SC), and aggressive thoughts between regular gamers and non-gamers after playing a violent video game.

Please be aware that by signing below, you are agreeing that:

(1) You have read and understood the Participant's Information Sheet.

(2) Questions about your participation in this study have been answered satisfactorily.

(3) You are aware of minimum risk of the study.

(4) You are taking part in this research voluntarily (without coercion).

I hereby confirm that I have read carefully all of the above information and I agree in taking part of this study.

Signature:_____ Date:_____

If you have any further questions about the study please do not hesitate to contact me or my supervisor via email: xxxxx@xxxxx

Participant Code:

Participant's Classification Sheet

Please answer the question below by ticking the correct box.

Do you play video games at least six and a half hours a week?

Yes ☐ No ☐

If you have any further questions about the study please do not hesitate to contact me or my supervisor via email: /

Coding Key for the Word Completion Task

Item #	Neutral	Ambiguous	Aggressive	Non-Words
1)	behind		behead	
	behave			
	Bahama			
	behold			
	behalf			
	behest			
2)	insure		injure	infere
	ensure			indure
	endure			
3)	exceed			expell
	expect			
	extent			
	extend			
	except			
	excess			
	expert			excell
	expend			
	extern			
	excels			
4)	mutter		murder	muller
	muster		mugger	mudder
				multer
				murmer
5)	pride			prode
	prime			prise
	prize			
	prude			
	prove			
	price			
	prune			
	prose			
	probe			
6)	speak		spear	
7)	flipper			
	flitter			
	flicker			
	flirter			
	flivver			
8)	explore		explode	

Item #	Neutral	Ambiguous	Aggressive	Non-Words
9)	warm		wham	
	worm			
	whim			
	whom			
10)	kite		kick	
	kiss		kill	
	kilt			
	king			
	kids			
	kind			
	kiwi			
	kink			
	kilo			
11)	tape			topo
	type			tups
	tips			
	tops			
	taps			
	tope			
	typo			
12)	hare	hurl	hurt	
	hire		harm	
	hard			
	here			
	hers			
	hero			
	have			
	horn			
	hark			
13)	after			
	alter			
	aster			
	actor			acter
	altar			
14)	chore		choke	
	chose			
15)	sample			
	simple			
	simply			
	simper			
16)	attach		attack	

attics

Item #	Neutral	Ambiguous	Aggressive	Non-Words
17)	Compact	complot		compeat
	Compost			compart
	comport			
18)	dessert	deserts	destroy	despire
	desires		despise	deshell
	deserve			desiree
	destiny			
	desired			
	designs			
	despair			
	despite			
	descent			
	descend			
	desktop			
19)	shale			shole
	shall			
	shelf			
	shell			
	shalt			
	shill			
20)	short		shoot	
			shout	
21)	repeat		rapist	
	report			
	repent			raport
22)	strife		strike	
	stroke			
	stripe			
	strive			
	stride			

Item #	Neutral	Ambiguous	Aggressive	Non-Words
23)	line	lure		
	lyre			
	lore			
	love			
	live			
	lose			
	lone			
	like			
	life			
	lake			
	lane			
	lime			
	lope			
	laze			
	lace			
	lame			
	lice			
	late			
24)	born		burn	
	barn			
25)	stereo			
	sterno			
26)	person		prison	
			poison	
27)	poster	pester		
	pastor			
28)	mingle		mangle	
	muggle			
29)	blind			
	blond			
	blend			
	bland			
30)	snore		snare	
31)	bye			
	bee			
32)	hat		hit	
	hut			
	hot			

Item #	Neutral	Ambiguous	Aggressive	Non-Words
33)	grape	gripe		
	grope			
34)	smock		smack	smuck
35)	smile		smite	smere
	smoke			smore
36)	kneel	knave	knife	
	known	knock		
	knits			
	knees			
	knack			
	kneed			
37)	tone	tine		
	tune			
38)	saab	snob	stab	
	slab	slob	snub	
	scab			
	stub			
39)	short	shark		
	shore	sharp		
	share			
	shirt			
	shirk			
40)	drain		drown	
	drawn			
41)	plane			
	prone			
	prune			
	phone			
42)	angel		anger	
	angle		angry	
	anglo			
43)	flirt			
	fleet			
	float			
	flint			
44)	first		fight	
	filet			

Item #	Neutral	Ambiguous	Aggressive	Non-Words
45)	pack pick puck peck			
46)	hare have hale	haze	hate	
47)	ant act art apt			
48)	cat cot		cut	
49)	won win wan			
50)	ate ale are age ace aye awe	ape		axe ave
51)	try cry dry fry wry	pry		
52)	was way wax wad wag wan		war wap	wat
53)	fame		fume	
54)	slip slop		slap	

Item #	Neutral	Ambiguous	Aggressive	Non-Words
55)	book	bark		
	back	balk		
	beak			
	buck			
	bank			
	bunk			
56)	ripe		rape	
	rope			
57)	forest		foment	
58)	offset		offend	
	offers			
	office			
59)	lemon			licon
	logon			
60)	crawl		cruel	
61)	create			
62)	starry	stormy		
	sturdy			
63)	match			
	mitch			
64)	furry		force	faves
	forty	fires	fired	firey
	farms			
	first			
	forks			
	forge			
	forms			
	forth			
	fares			
	ferry			
	farts			
	forum			
	forgo			
	farse			
	forte			
65)	taste			teste
	trite			

Item #	Neutral	Ambiguous	Aggressive	Non-Words
66)	nifty ninth nutty nests newts north		nasty	ninty
67)	window			
68)	winked worked walked		wicked	
69)	vision			
70)	engage		enrage	
71)	screen			
72)	hotrod		hatred	
73)	telephone			telophase
74)	dismissed discussed	disgusted		disensued
75)	central control			
76)	provide		provoke	provise
77)	pinball			
78)	outcome outside outline outdate	outdone	outrage	
79)	call	cell		
80)	rode ride		rude	
81)	manage			

Item #	Neutral	Ambiguous	Aggressive	Non-Words
82)	insect	insist	insult	
	insure			
	inside			
	insert			
	insane			
	insole			
	instep			
83)	side			sade
	soda			
	suds			
84)	bolt	boot		
	bait	butt		
	boat		beat	
	bunt	belt		
	blot	bust		
	beet	brat		
	bout			
	best			
85)	bronze			
	breeze			brouse
86)	revert	revolt		revent
87)	cool			
	cook			
	coon			
	coop			
88)	sony		slay	
	stay			
	sway			savy
	sexy			
	spry			sasy
89)	deer			
	door			
	dear			
	dour			
90)	smock		smack	smuck
91)	fruit			
	front			
	frost			

Item #	Neutral	Ambiguous	Aggressive	Non-Words
92)	lunch		punch	
	munch			
	bunch			
	hunch			
93)	shore			
	share			
94)	amuse		abuse	acuse
95)	clear			
96)	hint	hunt		
97)	water			
98)	stash		slash	
	swash		smash	

Code#_____

1 b _ h _ _ _

2 i n _ _ r e

3 e x _ e _ _

4 m u _ _ e r

5 p r _ _ e

6 s p e a _

7 f l i _ _ e r

8 e x p l _ _ e

9 w _ _ m

10 k i _ _

11 t _ p _

12 h _ r _

13 a _ t _ r

14 c h o _ e

15 s _ m p _ _

16 a t t _ c _

17 c _ m p _ _ t

18 d e s _ _ _ _

19 s h _ l _

20 s h o _ t

21 r _ p _ _ t

22 s t r _ _ e

23 l _ _ e

24 b _ r n

Code#_____

1 b _ h _ _ _

2 i n _ _ r e

3 e x _ e _ _

4 m u _ _ e r

5 p r _ _ e

6 s p e a _

7 f l i _ _ e r

8 e x p l _ _ e

9 w _ _ m

10 k i _ _

11 t _ p _

12 h _ r _

13 a _ t _ r

14 c h o _ e

15 s _ m p _ _

16 a t t _ c _

17 c _ m p _ _ t

18 d e s _ _ _ _

19 s h _ l _

20 s h o _ t

21 r _ p _ _ t

22 s t r _ _ e

23 l _ _ e

24 b _ r n

25 s t _ r _ o

26 p _ _ s o n

27 p _ s t _ r

28 m _ _ g l e

29 b l _ n d

30 s n _ r e

31 b _ e

32 h _ t

33 g _ _ p e

34 s m _ c k

35 s m _ _ e

36 k n _ _ _

37 t _ n e

38 s _ _ b

39 s h _ r _

40 d r _ _ n

41 p _ _ n e

42 a n g _ _

43 f l _ _ t

44 f i _ _ t

45 p _ c k

46 h a _ e

47 a _ t

48 c _ t

49 w _ n

25 s t _ r _ o

26 p _ _ s o n

27 p _ s t _ r

28 m _ _ g l e

29 b l _ n d

30 s n _ r e

31 b _ e

32 h _ t

33 g _ _ p e

34 s m _ c k

35 s m _ _ e

36 k n _ _ _

37 t _ n e

38 s _ _ b

39 s h _ r _

40 d r _ _ n

41 p _ _ n e

42 a n g _ _

43 f l _ _ t

44 f i _ _ t

45 p _ c k

46 h a _ e

47 a _ t

48 c _ t

49 w _ n

50 a _ e

51 _ r y

52 w a _

53 f _ m _

54 s l _ p

55 b _ _ k

56 r _ p e

57 f o _ e _ t

58 o f f _ _ _

59 l _ _ o n

60 c r _ _ l

61 c _ e _ t e

62 s t _ r _ y

63 m _ t c _

64 f _ r _ _

65 t _ _ t e

66 n _ _ t _

67 w _ _ d _ w

68 w _ _ k e d

69 v i s _ _ n

70 e n _ a g e

71 s c r _ _ n

72 h _ t r _ d

73 t _ l _ p h _ _ _

74 d i s _ _ s _ e d

50 a _ e

51 _ r y

52 w a _

53 f _ m _

54 s l _ p

55 b _ _ k

56 r _ p e

57 f o _ e _ t

58 o f f _ _ _

59 l _ _ o n

60 c r _ _ l

61 c _ e _ t e

62 s t _ r _ y

63 m _ t c _

64 f _ r _ _

65 t _ _ t e

66 n _ _ t _

67 w _ _ d _ w

68 w _ _ k e d

69 v i s _ _ n

70 e n _ a g e

71 s c r _ _ n

72 h _ t r _ d

73 t _ l _ p h _ _ _

74 d i s _ _ s _ e d

75 c _ n t _ _ l

76 p r o v _ _ e

77 p _ n b _ l l

78 o u t _ _ _ e

79 c _ l l

80 r _ d e

81 m _ n _ g e

82 i n s _ _ _

83 s _ d _

84 b _ _ t

85 b r _ _ z e

86 r e v _ _ t

87 c o o _

88 s _ _ y

89 d _ _ r

90 s m _ c k

91 f r _ _ t

92 _ u n c h

93 s h _ r e

94 a _ u s e

95 c l _ _ r

96 h _ n t

97 w _ t _ r

98 s _ a s h

75 c _ n t _ _ l

76 p r o v _ _ e

77 p _ n b _ l l

78 o u t _ _ _ e

79 c _ l l

80 r _ d e

81 m _ n _ g e

82 i n s _ _ _

83 s _ d _

84 b _ _ t

85 b r _ _ z e

86 r e v _ _ t

87 c o o _

88 s _ _ y

89 d _ _ r

90 s m _ c k

91 f r _ _ t

92 _ u n c h

93 s h _ r e

94 a _ u s e

95 c l _ _ r

96 h _ n t

97 w _ t _ r

98 s _ a s h