The Thrill of the (Virtual) Kill: The Psychophysiological Impact of Violent Video Game Experience

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Videogames are BIG Business!!

Can New Consoles Revive the Ailing Gaming Industry

Video games sales in the United States (new physical retail; excl. PC games)

Source: NPD Group
Videogames are BIG Business!!

**Worldwide Console Sales** (millions of units)

- **Wii**
- **PS3**
- **Xbox 360**

Sources: Microsoft, Sony, Nintendo

GeekWire.com
The Evolution of Mario

Evolution of Video Games
Does Playing Videogames Cause Violence?

• What do these individuals all have in common?
  – Dylan Klebold and Eric Harris (Columbine H.S. Massacre, 1999)
  – James Holmes (Aurora Movie Theatre Shooting, 2012)
  – Adam Lanza (Sandy Hook Elementary School Shootings, 2012)
  – Aaron Alexis (Navy Yard Shootings, 2013)
Does Playing Videogames Cause Violence?

• Does this allow us to conclude that playing videogames caused these tragedies??
  – Messages in the media routinely report that videogames are (at least partially) to blame
Does Playing Videogames Cause Violence?

**VIOLENT CRIME VS VIDEO GAME REVENUE (1995-2010)**

- Violent Crimes
- Video Game Revenue

The chart shows a comparison between violent crimes and video game revenue from 1995 to 2010. The data indicates a trend where violent crimes generally decrease over time, while video game revenue shows an increase, peak, and then a decline.
Does Playing Videogames Cause Violence?

Video Game Sales Data and Youth Violence Rates

- Video Games Units Sold (millions)
- Youth Violence (Serious Violent Crimes)
Empirical Research

• Anderson et al. (2010): Meta-Analysis of 136 studies, involving 130,000+ participants
  – Exposure to violent video games:
    • Increases aggressive thoughts and behaviors, angry feelings, and physiological arousal
    • Decreases helping behavior and feelings of empathy
    • Effects did not differ by gender or culture

• Whitaker & Bushman (2012): Experience with violent games increases accuracy with real* gun
Death with a Story: How Story Impacts Emotional, Motivational and Physiological Responses to First-Person Shooter Games
(Schneider, Lang, Sin, & Bradley, 2004)

• Comparison of videogames that did and did not possess a storyline (narrative vs. non-narrative)
  – Narrative games -- those where character advances in name of solving mystery/saving the world...violence = means to an end
  – Non-narrative games -- those where player advances levels (may gain strength and/or face greater challenges)...violence is goal (e.g., “shoot as many aliens as you can”)

• Hypothesized that playing narrative games leads to:
  – Greater identification with character
  – Greater feelings of presence within game
  – More positive affective reactions
  – Greater physiological arousal
Death with a Story:
How Story Impacts Emotional, Motivational and Physiological Responses to First-Person Shooter Games
(Schneider, Lang, Sin, & Bradley, 2004)

• Participants: 30 undergrads (experienced gamers)
• Procedure:
  – All participants played 4 games (8 minutes each)
    • 2 games were Narrative: Half-Life and Outlaws
    • 2 games were Non-Narrative: Doom and Quake
  – After each game, participants completed
    • Identification: “I was interested in my character’s goals in this game”
    • Presence: “I feel like I am in a real place”
    • Positive Affect: How much they enjoyed the game
    • Physiological Arousal: skin conductance (sympathetic nervous system activation)
Death with a Story: How Story Impacts Emotional, Motivational and Physiological Responses to First-Person Shooter Games (Schneider, Lang, Sin, & Bradley, 2004)

• Hypothesized that playing narrative games leads to:

  – Greater identification with character being played  **Supported**
  – Greater feelings of presence within the game  **Supported**
  – More positive affective reactions  **Supported**
  – Greater physiological arousal  **Supported**
Death with a Story: How Story Impacts Emotional, Motivational and Physiological Responses to First-Person Shooter Games (Schneider, Lang, Sin, & Bradley, 2004)

• What are the implications? Why does this matter??
  – Narrative leads to justification of violence (i.e., advancing character’s goals); therefore, violence seems appropriate.
  – Narrative increases physiological arousal, which has been shown to increase learning from media (Lang, 2000); makes violence concepts more accessible and facilitates violent behavior.
  – Narrative increases positive affect; we like the violence and the characters that commit it; this may desensitize us towards violent behavior.
What is Psychophysiology?

• Psychophysiology is the study of psychological manipulations and the resulting physiological responses.
The Nervous System
Facets of Emotions

- Emotions often consist of three components:
  - Subjective experience (i.e., feeling elated)
  - Expressive experience (i.e., frowning or smiling)
  - Physiological component (i.e., sympathetic arousal)
Psychophysiology of Violent Games

• Different video games bring about different psychophysiological changes
• Violent games tend to have a significant impact on:
  – Electrodermal activity
  – Muscular activity
  – Heart rate
  – Systolic blood pressure
Electrodermal Activity

• Electrodermal activity (EDA) is a direct measure of sympathetic activation
• When emotional arousal increases, there is an immediate increase in EDA
• In the game “Relax-to-Win,” you have to reduce your EDA to decrease the dragon’s pace
• In other words, you have to relax in order to win the game
Electrodermal Activity

[Graphs showing electrodermal activity, respiration, heart rate, and saturation over time.]
Facial Electromyography

- Electromyography (EMG) measures the activity of striated muscles
- Specifically, EMG of the facial muscles can provide information about the expression of certain emotions
Electromyography

[a) sEMG

Carrier: 500Hz

Time (ms)

0 10 20 30 40 50 60 70 80 90

[b) sEMG

Carrier: 1900Hz

Time (ms)

0 10 20 30 40 50 60 70 80 90
Corrugator Supercilli

• An increase in the activity of the corrugator supercilli, which draws the brow down and together into a frown, is associated with negative emotions
Corrugator Supercilli

- An increase in the activity of the corrugator supercilli, which draws the brow down and together into a frown, is associated with negative emotions
Zygomaticus Major

- An increase in the activity of the zygomaticus major pulls the corners of the mouth back and up into a smile, which is associated with positive emotions.
Repeatability of facial electromyography (EMG) activity over corrugator supercilli and zygomaticus major on differentiating various emotions

Jun-Wen Tan · Steffen Walter · Andreas Scheer · David Hrabal · Holger Hoffmann · Henrik Kessler · Harald C. Traue

Received: 3 February 2011 / Accepted: 24 September 2011 © Springer-Verlag 2011

Abstract Recent affective computing findings indicated that effectively identifying users’ emotional responses is an important issue to improve the quality of ambient intelligence. In the current study, two bipolar facial electromyography (EMG) channels over corrugator supercilli and zygomaticus major were employed for differentiating various emotional states in two dimensions of valence (negative, neutral and positive) and arousal (high and low) while participants looked at affective visual stimuli. The results demonstrated that corrugator EMG and zygomaticus EMG efficiently differentiated negative and positive emotions from others, respectively. Moreover, corrugator EMG discriminated emotions on valence clearly, whereas zygomaticus EMG was ambiguous in neutral and negative emotional states. However, there was no significant statistical evidence for the discrimination of facial EMG responses in the dimension of arousal. Furthermore, correlation analysis proved significant correlations between facial EMG activities and ratings of valence performed by participants and other samples, which strongly supported the consistency of facial EMG reactions and subjective emotional experiences. In addition, the repeatability of facial EMG indicated by intraclass correlation coefficient (ICC) were provided, in which corrugator EMG had an excellent level of repeatability, and zygomaticus EMG grasped only a poor level of repeatability. Considering these results, facial EMG is reliable and effective to identify negative and positive emotional experiences elicited by affective visual stimuli, which may offer us an alternative method in building a basis for automated classification of users’ affective states in various situations.

Keywords Repeatability · Facial electromyography · Emotion · Affective visual stimuli · Valence

1 Introduction

The human face abounds with numerous information of one’s subjective experience of emotion. Spontaneous facial expressions are temporally revealing emotional states of their host, much like a mirror. In recent decades, researchers have been endeavoring to seek the essential features of human facial expressions and to identify emotions by behavioral measures (e.g., self-report, rating systems, video analysis) or by electrophysiological approaches (e.g., electromyography (EMG), electroencephalogram (EEG), galvanic skin response (SCR)) (Mauss and Robinson 2009). The approach used in the current study is facial EMG because it is non-invasive but sensitive to capture fleeting and subtle facial muscle changes in an ongoing emotional process, and wherein visual observation is unavailable or ambiguous (Natu et al. 2009; Tassinary et al. 2007).

EMG responses over facial muscle regions like corrugator supercilli which draws the brow downward and medially to form a frown and zygomaticus major which elevates the corner of the mouth superiorly and posteriorly to produce a smile (Ekman et al. 1980) can effectively discriminate the valence (pleasure) and intensity of emotional states (Cacioppo et al. 1986). In other words, facial EMG is a prominent “tool” to infer mood situations (Cacioppo and Petty 1981; van Boxel 2016) and has been employed commonly to examine emotional responses...
• “Considering these results, facial EMG is reliable and effective to identify negative and positive emotional experiences elicited by affective visual stimuli...” (Tan, et al., 2011, p. 3)
Brain, Emotions and Video Games

• Demonstration
The Effect of Violent and Nonviolent Video Games on Heart Rate Variability, Sleep, and Emotions in Adolescents With Different Violent Gaming Habits

MALENA IVARSSON, BA, MARTIN ANDERSON, MD, TORBJÖRN ÅKERSTEDT, PHD, AND FRANK LINDBLAD, MD

Objective: To study cardiac, sleep-related, and emotional reactions to playing violent (VG) versus nonviolent video games (NVG) in adolescents with different gaming habits. Methods: Thirty boys (aged 13–16 years, standard deviation = 0.9), half of them low-exposed (≤1 h/d) and half high-exposed (≥3 h/d) to violent games, played a VG/NVG for 2 hours during two different evenings in their homes. Heart rate (HR) and HR variability were registered from before start until next morning. A questionnaire about emotional reactions was administered after gaming sessions and a sleep diary on the following mornings. Results: During sleep, there were significant interaction effects between group and gaming condition for HR (means [standard errors] for low-exposed: NVG 63.8 [2.2] and VG 67.7 [2.4]; for high-exposed: NVG 65.5 [1.9] and VG 62.7 [1.9]; F(1,28) = 9.22, p = .005). There was also a significant interaction for sleep quality (low-exposed: NVG 4.3 [0.2] and VG 3.7 [0.3]; high-exposed: NVG 4.4 [0.2] and VG 4.4 [0.2]; F(1,28) = 3.51, p = .036, one sided), and sadness after playing (low-exposed: NVG 1.0 [0.0] and VG 1.4 [0.2]; high-exposed: NVG 1.2 [0.1] and VG 1.1 [0.1]; F(1,27) = 6.29, p = .009, one sided). Conclusions: Different combinations of the extent of (low versus high) previous VG and experimental exposure to a VG or an NVG are associated with different reaction patterns—physiologically, emotionally, and sleep related. Desensitizing effects or selection bias stand out as possible explanations. Key words: children, heart rate variability, emotion, sleep quality, violent video game, desensitization.

HR = heart rate; HRV = heart rate variability; HF = high frequency; LF = low frequency; VLF = very low frequency; LF/HF = low-frequency/high-frequency ratio; VG = violent video game; NVG = nonviolent video game; SCAS = The Swedish Core Affect Scales; SQ = sleep quality index; SNS = sympathetic nervous system; ANS = autonomic nervous system; PSNS = parasympathetic nervous system.

INTRODUCTION

Playing violent video games (VG) can induce aggressive behavior (1) and increase antagonistic emotions such as the short-term effects differ in time between activation and inhibition (i.e., cycle time). These cycle times can be extracted into different frequency bands, which have been found to correspond to different autonomic regulatory systems.

Frequency domain HRV analyses commonly involve three primary intervals: the high-frequency (HF) band (0.15–0.40 Hz) with the shortest cycle time of approximately 2.5 to 6.7 seconds that is vagally mediated, with breathing rate as the main contributing factor (15). The low-frequency (LF) band (0.04–0.15 Hz) corresponds to a cycle time of 6.7 to 25.0 seconds, has traditionally been used as a marker of sympathetic nervous system.
Ivarsson et al. (2013)

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**Table:**
- **Type of Game:** Violent, Non-violent
- **Duration of Play:** Short, Long
- Significant elevation in arousal during and after the game
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So, What Do You Think?

• Violence/Aggression in real life is caused by MANY factors... playing violent videogames may or may not contribute

• BUT...you may want to think about how early you let your kids start to play these games, or else they may end up with this: