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Pre-Experimental Study

THE EFFECTS OF ONE-HOUR GAMING ON BLOOD PRESSURE AND SELF-REPORTED STRESS, ANXIETY IN COLLEGE STUDENTS

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ABSTRACT

Objective. Video games have emerged as a potential tool for alleviating stress and anxiety, effects that can be reflected in reductions in blood pressure—a physiological marker closely associated with mental health. The present study shows preliminary findings of video game genres affect measurable changes in blood pressure, focusing on the impact of stress and anxiety among university students. **Methods.** Through non-probability sampling, 38 participants were recruited and randomly assigned to one of four video game genres: action, horror, casual, and simulation. Participants completed a questionnaire with sociodemographic information, gaming habits, and the Generalized Anxiety Disorder Scale (GAD-7). systolic blood pressure (SBP), diastolic blood pressure (DBP), and pulse rate (PR) were measured before and after the one-hour session, as well as a 10-point self-assessment of anxiety and stress. **Results.** The results showed significant reductions in SBP [$t(19) = 3.40$, $p = 0.003$] and PR [$t(19) = 2.44$, $p = 0.025$], while DBP showed no significant changes [$t(19) = 0.51$, $p = 0.618$]. These findings suggest that certain video games can induce positive physiological effects associated with stress and anxiety reduction by decreasing markers such as SBP and PR. **Conclusions.** Although further research with larger samples is required and control group is suggested, this study highlights the potential of video games as an innovative and accessible strategy for managing mental well-being in university settings, offering a complementary alternative to traditional interventions.

Keywords: blood pressure, anxiety, stress, video games, college students

RESUMEN

Objetivo. Los videojuegos han surgido como una herramienta potencial para aliviar el estrés y la ansiedad, efectos que pueden reflejarse en reducciones de la presión arterial, un marcador fisiológico estrechamente asociado con la salud mental. El presente estudio investigó si diferentes géneros de videojuegos generan cambios medibles en la presión arterial, centrándose en el impacto del estrés y la ansiedad en estudiantes universitarios. **Método.** Mediante un muestreo no probabilístico, se reclutaron 38 participantes que fueron asignados aleatoriamente a uno de cuatro géneros de videojuegos: acción, horror, casual y simulación. Los participantes completaron un cuestionario con información sociodemográfica, hábitos de juego y la escala de Trastorno de Ansiedad Generalizada (GAD-7). Se midieron la presión arterial sistólica (PAS), la presión arterial diastólica (PAD) y la frecuencia cardíaca (FC) antes y después de una sesión de una hora, además de una autoevaluación de 10 puntos sobre ansiedad y estrés. **Resultados.** Los resultados mostraron reducciones significativas en la PAS $t(19) = 3.40$, $p = 0.003$ y en la FC $t(19) = 2.44$, $p = 0.025$, mientras que la PAD no presentó cambios significativos $t(19) = 0.51$, $p = 0.618$. Estos hallazgos sugieren que ciertos videojuegos pueden inducir efectos fisiológicos positivos asociados con la reducción del estrés y la ansiedad, al disminuir marcadores como la PAS y la FC. **Conclusiones.** Aunque se requiere más investigación con muestras más amplias, este estudio resalta el potencial de los videojuegos como una estrategia innovadora y accesible para el manejo del bienestar mental en entornos universitarios, ofreciendo una alternativa complementaria a las intervenciones tradicionales.

Palabras clave: presión arterial, ansiedad, estrés, videojuegos, universitarios

INTRODUCTION

In recent years, Puerto Rican college students have faced a series of compounding adversities that have adversely affected their physical and mental health. Major catastrophic events—including the devastation left in the wake of Hurricane Maria, earthquakes, and the COVID-19 pandemic—alongside reduced higher education funding, have intensified stressors already present in university students' lives, such as academic demands and financial strain. Additional factors frequently reported in the literature, such as poor sleep quality, family conflict, excessive social media use, limited access to mental health services, and uncertainty about the future, further exacerbate these difficulties. Collectively, these conditions have been associated with increased prevalence of stress, anxiety, and depression in Puerto Rican college student populations. (American College Health Association, 2022; Beiter et al., 2015; Chevres-Pérez et al., 2023; Sánchez-Cardona et al., 2022).

Over the past several decades, a substantial body of literature has examined the mental health of college students in Puerto Rico. Reyes-Rodríguez et al. (2012) and colleagues reported that approximately 9% of Puerto Rican college freshmen experienced moderate to severe depression, with female students disproportionately affected compared to their male counterparts. Another study found that nearly 40% of university students in Puerto Rico exhibited symptoms of depression or anxiety, attributing these elevated rates largely to the combined effects of the COVID-19 pandemic, hurricanes, and other ongoing public health challenges (Díaz-Pérez et al., 2024). Academic stress also remains a critical factor, showcasing negative associations with performance and increasing during transitions such as the shift to virtual learning (Pacheco Castillo, 2021; Vilca-Pareja et al., 2022). Collectively, these findings underscore a persistently and escalating mental health burden among Puerto Rican college students.

Beyond psychological outcomes, anxiety has significant physiological implications. Chronic anxiety is associated with increased blood pressure through heightened sympathetic nervous systems and stress-related hormonal pathways (Chalmers et al., 2014). Over time, these physiological responses can contribute to sustained hypertension and vascular injury. In a large meta-analysis, Pan et al. (2015) reported that individuals with anxiety had a significantly higher risk of developing hypertension (HR = 1.40), underscoring the strong link between anxiety and long-term cardiovascular risk. Similarly, data from the Hispanic Community Health Study (2008-2011) indicated that elevated anxiety was associated with greater increases in both SBP and DBP over 6 years, as well as a 22% higher incidence of hypertension among initially participants with normal blood pressure (Llabre, 2021).

Given the high prevalence of anxiety among college students — estimated at up to 50% in some samples taken from studies conducted (American College Health Association [ACHA], 2017; Li et al., 2022). Despite the limited capacity of campus resources or short staffing for mental health services, there is growing interest in scalable and accessible interventions (Novotney, 2014). Therapeutic and "serious" video games, designed to promote psychological well-being, have shown potential in reducing anxiety symptoms through mechanisms such as cognitive behavioral therapy-based gameplay, relaxation training, and biofeedback (Li et al., 2022; Pallavicini & Pepe, 2020). Moreover, evidence suggests that commercial video games may support mood regulation and reduce loneliness when used intentionally (Vuorre et al., 2021). Given the accessibility, engagement potential, and scalability of such interventions, therapeutic video games represent a promising adjunct to traditional mental health services for college students.

Blood Pressure as a Physiological Indicator of Anxiety and Stress

Stress and anxiety are well-established contributors to physiological dysregulation, particularly elevated blood pressure (Pan et al., 2015; Llabre, 2021). These emotional states activate the sympathetic nervous system, triggering the release of stress hormones such as cortisol and adrenaline, which in turn elevate blood pressure (Chalmers et al., 2014) and therefore serve as an objective marker of the body's integrated physiological response to both physical and psychological stressors. Understanding the hemodynamic mechanisms underlying this relationship is critical for clarifying how stress-related processes influence cardiovascular functioning.

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Arterial pressure is determined by cardiac output, arterial elasticity, and peripheral blood flow of the arterial system (Magder, 2018). Research consistently shows that individuals exposed to acute or chronic stress or anxiety exhibit elevated increased blood pressure responses (Chalmers et al., 2014; Esler et al., 2000; Gerin et al., 2000; Llabre, 2021; Pan et al., 2015; Spruill, 2010). Magder (2018) established that arterial pressure is primarily determined by the distensibility of the arterial walls in response to blood volume. Together, this literature supports the use of blood pressure as a reliable physiological indicator of stress and anxiety.

Exploring Video Game Interventions to Address Mental Health Challenges in College Students

Effective management of physiological stress responses is essential to reduce the long-term risk of hypertension and cardiovascular disease (Balzer, 2025; Chu, 2024). Recent research indicates that video game–based interventions may serve as effective tools for stress and anxiety management in young adult populations. Empirical evidence indicates that both active and commercial video games can reduce stress, alleviate anxiety and depressive symptoms, and promote psychological well-being among college students (Pallavicini et al., 2021; Zhao et al., 2024). These findings suggest that video games may represent a scalable, engaging, and cost-effective adjunct to traditional stress-reduction interventions for college students.

Building on this evidence, video games may also influence physiological outcomes. The use of video games provides a state of attentional distraction and promotes relaxation, potentially reducing stress-related physiological activation. For instance, in a recent study, Desai et al. (2021) found that short video games sessions produced stress reductions comparable to mindfulness-based interventions. However, despite growing evidence of psychological benefits, relatively few studies have incorporated objective physiological measures, such as blood pressure, alongside self-report data (Kühn et al., 2014; Russoniello et al., 2009). Monitoring blood pressure in relation to stress and anxiety provides objective insight into physiological responses by utilizing digital video games as coping strategies for emotional and mental distress (Chalmers et al., 2014; Magder, 2018).

Given the traditional methods for managing feelings of stress and anxiety, such as a costly therapy session or the need for prescription medication, while valuable, are not always the most accessible or feasible for everyone. As such, numerous studies have been published highlighting the effectiveness of various stress-reducing techniques, including meditation (Desbordes et al., 2015), yoga-based programs (Pascoe et al., 2017), counseling services (Cuijpers et al., 2014), listening to music (Witte et al., 2020), adult coloring (Flett et al., 2017), nature therapy (Bratman et al., 2019), and pet therapy (Beetz et al., 2012). Realizing these limitations, there is an increasing amount of recognition towards alternative, accessible and non-invasive approaches to managing the strains of mental health.

Despite the scarcity of studies, existing research indicates that video games show promise in reducing stress and anxiety (Pallavicini et al., 2021; Pine et al., 2020; Russoniello et al., 2009). Similarly, systematic reviews report that a majority of studies (approximately 70–82%) find significant reductions in stress and anxiety symptoms, particularly with short sessions of 20–30 minutes (Pallavicini et al., 2021; Pine et al., 2020; Russoniello et al., 2009). These findings provide consistent evidence supporting the effectiveness of video games in reducing stress and anxiety.

While alternative methods for managing stress have proven effective, younger, digitally native populations may benefit more from technological approaches. According to Pine et al. (2020), approximately 75% of gamers report using video games to cope with stress and anxiety in everyday life. However, there is limited literature on the impact of video games on mental and physical well-being, particularly among Latino populations.

THEORETICAL FRAMEWORK

The theoretical framework for this study is based on the Compensatory Internet Use Theory (Kardefelt-Winther, 2014) and Flow Theory (Csikszentmihalyi, 1990). Compensatory Internet Use Theory posits that individuals often turn to digital technologies, such as video games, as coping mechanisms to manage negative emotions, life stressors, or psychological discomfort. Rather than being driven purely by entertainment or habit, game use can function as a purposeful strategy to escape or regulate emotional distress, providing users with a sense of relief or distraction from everyday problems (Kardefelt-Winther, 2014). Flow Theory complements this perspective by explaining the psychological mechanism through which video games may provide such relief. Flow refers to a mental state of deep immersion and optimal engagement that occurs when individuals are involved in tasks that are both challenging and matched to their skill level. In this state, players experience heightened concentration, intrinsic motivation, and reduced self-awareness (Csikszentmihalyi, 1990). Notably, the experience of flow is associated with a sense of control and mastery, which can reduce anxiety and promote emotional stability (Csikszentmihalyi, 1975). Video games are uniquely structured to facilitate flow by offering immediate feedback, clear goals, and progressive difficulty (Nacke & Lindley, 2008). When players enter this immersive state, they can temporarily disconnect from external stressors and shift their focus entirely to the task at hand. This process not only reduces psychological stress but may also produce measurable physiological benefits, such as lower heart rate and reduced blood pressure (Desai et al., 2021; Russoniello et al., 2009), highlighting the potential of video games as effective tools for managing stress and anxiety.

One key factor is the state of flow and deep engagement that video games can induce, characterized by focused attention, a balance of challenge and skill, and immersion, which allows players to disconnect from the pressures of the real world temporarily. This detachment from everyday concerns may play a crucial role in reducing stress and anxiety, at least in the short term. Furthermore, video games may serve as an adaptive coping mechanism, providing individuals with a way to regulate negative emotions and restore emotional equilibrium. In addition, the positive emotional responses elicited by gameplay, such as enjoyment, surprise, and satisfaction, may contribute to overall psychological well-being. Together, these findings provide growing empirical support for the effectiveness of video games in reducing stress and anxiety.

Video games can influence subjective self-reports and objective physiological indicators of stress and anxiety, such as blood pressure and heart rate (Pallavicini et al., 2021) with recent research signaling which types or genres of games are most effective in this influence. Action games are one of the most popular video game genres for its high production quality and accessibility, with these being defined as games that require quick action and an emphasis in physical challenges, such as hand-eye coordination and reaction time (2021). They often elicit a high physiological arousal response, noted to increase stress or arousal more than other genres of video games (Pallavicini et al., 2022). Similarly, horror games, often grouped as a subgenre of action games given their reliance on the same physical skills, are designed to scare its players while providing an immersive experience. Studies have found that the horror genre of video games reduced stress and anxiety in young adults, with one indicating that a horror video game reduced stress at a faster rate when combined with biofeedback techniques (Pallavicini et al., 2021).

Other genres of video games are popular for their low cognitive load, such as casual video games: quick, straightforward games with little to no plot that can be played in short sessions (2021). This genre has been particularly studied as it represents a useful type of game for reducing stress, anxiety, depression or low mood. (Pallavicini et al., 2021; Pine et al., 2020). Simulation games also focus on immersion, rather than rapid physical responses, as they simulate aspects of real life or fictional reality, often serving as substitutes for daily activities. Players of this genre tend to self-report lower levels of loneliness and anxiety (Lewis et al., 2021).

The gaming genres previously mentioned can be divided into active or passive categories of video games, their distinctions made based on the interactivity and cognitive demand they require, as well as the different physiological responses they can evoke. Active games can be composed of genres like action and horror games, where players must constantly engage in rapid-paced environments (Possler et al., 2023). Due to its high interactivity, it has an elevated cognitive and physical demand, characterized by an intense arousal response, increased cardiovascular stress, and improvement in cognitive skills (Bediou et al., 2023; Lisón et al., 2015; Pallavicini et al., 2021; Possler et al., 2023). Passive games, on the other hand, are made up of genres such as casual and simulation, that involve lower interactivity and cognitive demand. These games don't generate high arousal responses, associated with heart rate and blood pressure reduction, as well as psychophysiological alterations in heart rate variability (Fish et al., 2018; Pallavicini et al., 2022).

The distinction between active and passive video games is central to the theoretical framework of this study. Within this context, the Compensatory Internet Use Model suggests that different game genres may function as coping mechanisms, with players utilizing active games for heightened arousal and distraction, while passive games may help regulate emotional distress by fostering positive emotions (Kardefelt-Winther, 2013; Pallavicini et al., 2022). This distinction also supports the integration of Flow Theory, as variations in game interactivity and engagement influence the likelihood of achieving immersive, flow-like states. Specifically, flow is conceptualized as the sensation of influencing the activity through motor execution, inherently tied to the high interactivity demands of active video games. In contrast, passive video games best align with the concept of presence, that provides a sense of being in the virtual world without necessarily requiring physical or mental efforts characteristic of the flow state (Michailidis et al., 2018).

Research on the relationship between video games and blood pressure regulation remains limited, and the available findings suggest mixed results. For instance, Ballard et al. (2006) found that repeated exposure to video game play led to reductions in both DBP and SBP. In contrast, Siervo et al. (2013) reported a progressive increase in DBP among participants exposed to violent video games, highlighting the potential variability in physiological responses based on game content. These conflicting results suggest that the effects of video games on blood pressure remain inconclusive. Furthermore, as with self-report measures of stress and anxiety, the genre of video games appears to play a critical role in shaping both psychological and physiological outcomes. This gap in literature motivates the current study, which aims to explore the potential of video games to reduce blood pressure in college students by comparing four different game genres, categorized into active and passive formats.

METHODS

The present study employs mixed-methods sequential explanatory design, with an emphasis on the quantitative component. The quantitative phase follows a pre-experimental pre-test and post-test design without a control group (Creswell & Creswell, 2018). This means participants completed physiological assessments before and after a single video game session. Participants were randomly assigned to one of four video game conditions, each representing a different genre: action, casual, horror, or role-playing. This structure was implemented to further examine active (action, horror) and passive (simulation, casual) video games based on their level of cognitive, emotional, and physiological arousal.

Despite the presence of multiple conditions, the primary analyses focused on within-subject changes (pretest vs. posttest) in systolic blood pressure (SBP), diastolic blood pressure (DBP), and pulse rate (PR), using paired samples t-tests. Additional stratified analyses were conducted to examine whether these pre–post changes varied as a function of game type (active vs. passive). As such, the study does not constitute a fully controlled experimental design, as no non-intervention control group or direct between-group comparisons were included. The results presented in this article correspond to preliminary analyses from the quantitative phase of a larger study investigating the potential of video games to reduce blood pressure among college students. The study was approved by the University of Puerto Rico, Río Piedras Campus Institutional Review Board (IRB #2223-067) and is being conducted at the Emerging Technologies Research Laboratory, which is part of the Social Research Center at the University of Puerto Rico, Río Piedras Campus. Data collection is ongoing and is expected to be completed by December 2025.

Participants

The total sample for this study comprised 38 participants. However, the sociodemographic description was based on 36 cases, because 2 participants could not be matched to their corresponding Phase 1 data. Based on the available Phase 1 records, most participants were enrolled in a bachelor's program ($n = 32$, 88.89%), whereas 4 participants (11.11%) were enrolled in a master's program. Participants ranged in age from 18 to 31 years ($M = 21.22$, $SD = 3.17$). Most identified their sex at birth as women ($n = 26$, 72.22%) and their gender as female ($n = 26$, 72.22%). The most common academic year was second year ($n = 9$, 25.00%), and the largest proportion reported being enrolled in 13 to 15 academic credits ($n = 17$, 47.22%). Most participants were affiliated with the Faculty of Social Sciences (n = 20, 55.56%), followed by Natural Sciences (n = 9, 25.00%). Regarding video game use, the most frequently reported weekly playtime categories were 1 to 2 hours and 3 to 4 hours (n = 7, 19.44% each). Among participants with available GAD-7 data (n = 33), the most common anxiety category was moderate anxiety (n = 18, 54.55%), followed by severe anxiety (n = 15, 45.45%).

Table 1

Descriptive Statistics and Frequency Distributions for Sociodemographic and Clinical Variables

Variable	*M*	*SD*	*Range*
Age (years)	21.22	3.17	18–31
	n	*%*	
Degree program			
Bachelor's	32	88.89	
Master's	4	11.11	
Sex at birth			
Female	26	72.22	
Male	10	27.78	
Gender identity			
Woman	26	72.22	
Man	10	27.78	
Academic year			
First year	7	19.44	
Second year	9	25.00	
Third year	5	13.89	
Fourth year	5	13.89	
Fifth year	7	19.44	
Sixth year	1	2.78	
Seventh year or more	1	2.78	
Prefer not to answer	1	2.78	
Academic credits enrolled			
10–12	14	38.89	
13–15	17	47.22	
16–18	5	13.89	
Faculty/School			
Social Sciences	20	55.56	
Natural Sciences	9	25.00	
Business Administration	3	8.33	
Communication	1	2.78	
Humanities	1	2.78	
Electrical Engineering	1	2.78	
Mechanical Engineering	1	2.78	

Note. The total study sample comprised 38 participants. However, sociodemographic characteristics are reported for 36 cases because 2 participants could not be matched to their corresponding Phase 1 data. Percentages in the table are based on n = 36. For anxiety level, a missing-data row is included because 3 participants had incomplete GAD-7 data.

Table 2

Frequency Distribution of Weekly Video Game Use

Variable	*n*	*%*
Weekly video game use		
Less than 1 hour	6	16.67
1 to 2 hours	7	19.44
3 to 4 hours	7	19.44
5 to 6 hours	5	13.89
6 to 7 hours	2	5.56
8 to 9 hours	1	2.78
More than 10 hours	2	5.56
No video game use	6	16.67
Anxiety level (GAD-7)		
10–12	Moderate	18
13–15	Severe	15
16–18	Missing	3

Note. Note. The total study sample comprised 38 participants. However, sociodemographic characteristics are reported for 36 cases because 2 participants could not be matched to their corresponding Phase 1 data. Percentages in the table are based on n = 36. For anxiety level, a missing-data row is included because 3 participants had incomplete GAD-7 data.

Participants who scored within the moderate to severe range on the Generalized Anxiety Disorder Scale (GAD-7) were considered eligible for the study. Exclusion criteria included prior experience with any of the video games used in the intervention, as well as auditory or visual impairments. These criteria were implemented to ensure that each participant's interaction with the games was novel and uninfluenced by familiarity or practice effects, and to avoid potential sensory barriers that could interfere with the gaming experience.

Procedure

This study followed a two-phase procedure as part of a mixed-methods sequential explanatory design, with an emphasis on the quantitative experimental phase.

Phase 1: Recruitment and Screening

Phase I consisted of an online screening survey developed using the Google Forms platform. Recruitment was conducted through multiple strategies, including email, printed flyers, and digital outreach. The survey was promoted to undergraduate and graduate students through social media platforms (e.g., Facebook, Instagram), messaging apps (e.g., WhatsApp, Telegram), and was also promoted through university-affiliated communication channels, including departmental mailing lists and student organization networks. In-person recruitment was carried out primarily at the University of Puerto Rico, Río Piedras Campus, where trained student collaborators conducted on-campus rounds to inform peers about the study and encourage participation. Several faculty members supported recruitment efforts by offering time during their classes to promote the study, and in some cases, permitted students to complete the screening survey during class time.

The survey included items assessing sociodemographic information (e.g., age range, sex, gender identity, language proficiency), hours of video game use, and the Generalized Anxiety Disorder Scale (GAD-7) to determine anxiety levels. Participants with moderate to severe anxiety, defined as a GAD-7 score of 10 or higher, were included in the study. Individuals with prior experience playing any of the intervention video games (Halo: Infinite, Plague Tale: Requiem, My Time at Portia, or Peggle) were excluded. Eligible participants were contacted by research assistants and invited to participate in the intervention phase.

Phase II: Experimental Procedure

The second phase of the study took place at the Emerging Technologies Research Laboratory, part of the Social Research Center at the University of Puerto Rico, Río Piedras Campus. Pre-test: Upon arrival, participants were welcomed by research assistants, provided written informed consent, and completed a brief survey assessing baseline mood, anxiety, and stress. A five-minute resting-state period was then conducted to collect baseline physiological data. Blood pressure was measured by one of the research assistants using a digital Omron monitor, applied to the left arm by trained student researchers. Intervention: Participants were then randomly assigned to play one of four video games, each representing a different genre: Halo Infinite (action), Plague Tale: Requiem (horror), Peggle (casual), or My Time at Portia (role-playing). These games were selected by the researchers for their diverse genres that would elicit different levels of cognitive demand and emotional involvement, allowing for a nuanced comparison of their genre-specific effects on blood pressure and physiological reactivity, as well as their availability through the membership “Xbox GamePass” on the Xbox console. Participants played their assigned game in an uninterrupted 60-minute session.

Research assistants were present to assist only when needed, ensuring that gameplay remained immersive and minimally interrupted. Post-test: After the session ended, participants completed a second five-minute resting-state period while still connected to the physiological monitoring devices. A second blood pressure measurement was taken using the same procedure, equipment and research assistant as in the pre-test. Participants then completed a follow-up survey assessing mood, anxiety, and stress post-intervention. In total, each participant spent approximately 75 minutes in the lab: 5 minutes for pre-test rest, 60 minutes of gameplay, and 5 minutes for post-test rest, plus time for setup and survey completion. At the conclusion of the session, participants received a copy of the informed consent form and a $10 Amazon gift card as compensation for their time.

Instruments

Gaming Habits Survey

Prior to the intervention, participants completed a brief online survey via Google Forms to report on their general video game habits. This included items on gameplay frequency (e.g., hours per week), preferred genres, and prior experience with the specific video games used in the study. This information was used for eligibility screening and descriptive analyses.

Self-Report Psychological Scales

Participants assessed their anxiety, stress, and mood levels before and after the gaming session using three custom 10-point Likert-type self-report items. Items included: “On a scale of 1 to 10, how anxious do you feel right now?", "How stressed do you feel right now?", and "How tense do you feel right now?". These subjective measures were used to evaluate short-term emotional changes associated with the intervention.

Brief Mood Introspection Scale (BMIS)

To further assess participants' affective states, the Spanish version of the Brief Mood Introspection Scale (BMIS) was administered pre- and post-intervention. This open-source instrument consists of 16 adjectives describing mood and affective states. It measures pleasantness, arousal, and four composite mood profiles: positive-high arousal, positive-tired, negative-high arousal, and negative-calm (Mayer & Gaschke, 1988).

Generalized Anxiety Disorder Scale (GAD-7)

The Spanish version of the Generalized Anxiety Disorder Scale (GAD-7) was used during the screening phase to determine participant eligibility. The GAD-7 is a 7-item self-report instrument based on DSM-IV criteria, designed to assess generalized anxiety symptoms over the past two weeks. Each item is rated on a 4-point Likert scale ranging from 0 ("not at all") to 3 (nearly every day), for a total score between 0 and 21. Participants with a score of 10 or higher, indicating moderate to severe anxiety, were included in the study. This version has been validated in Puerto Rican populations, demonstrating excellent internal consistency ($\alpha = .92$) and acceptable construct validity (Trifilio-Martínez et al., 2020).

Blood Pressure Monitor (Omron)

Blood pressure was measured before and after gameplay using a digital Omron automatic blood pressure monitor. Trained student researchers followed standardized procedures, placing the cuff on the participant's left arm to record SBP and DBP during both pre-test and post-test resting-state periods.

Gaming Equipment

The gameplay sessions were conducted using a single Xbox console and displayed on a 30.6-inch VIZIO SV32220XVT high-definition television. Participants used wireless Xbox One controllers with ergonomic design and Xbox-compatible headsets to enhance auditory immersion during gameplay. All video games were reset prior to each session, allowing participants to begin from the start of the game, including tutorial segments, ensuring that each player had an equal opportunity to learn basic controls and engage with the game mechanics regardless of prior experience.

Video Games

The video games selected for this study belonged to the horror, action, simulation, and role-playing categories. All games were played offline to maintain a consistent, controlled environment across sessions. The horror game was *A Plague Tale: Requiem* (published by Focus Entertainment), set in plague-ridden 14th-century France. The game follows siblings Amicia and Hugo as they evade soldiers and disease, emphasizing stealth, evasion, and puzzle-solving to deliver a tense and immersive experience with emotional depth. The action game was *Halo Infinite* (published by Xbox Game Studios), a first-person shooter that continues the story of Master Chief in a science-fiction universe. The game features fast-paced, combat-heavy gameplay that requires sustained attention, quick reflexes, and real-time decision-making across ground and vehicular scenarios. The casual game was *Peggle* (published by PopCap Games), a light-hearted puzzle game in which players launch balls to clear orange pegs from the screen. It's simple and accessible mechanics, driven by timing and chance, make it ideal for casual and relaxing engagement. The simulation/role-playing game was *My Time at Portia* (published by Pathea Games and Team17), set in a vibrant post-apocalyptic town where players manage a workshop, farm, craft, and build relationships with non-playable characters. The game's slow pace and open-ended structure offer creative engagement and emotional detachment from real-world stressors. Each of these games were selected to elicit different levels of cognitive demand and emotional involvement, allowing for a nuanced comparison of their genre-specific effects on blood pressure and physiological reactivity, as well as their availability through the Xbox membership called "Xbox GamePass".

For analysis purposes, the video games were grouped into two broader categories based on their level of cognitive and emotional engagement. Peggle (casual) and My Time at Portia (simulation) were considered passive games due to their relaxed pacing, low-pressure environments, and minimal demands on reflexes or rapid decision-making. These characteristics align with a lower engagement profile, making them suitable for assessing the effects of gentler, more immersive gameplay on physiological responses. In contrast, Halo Infinite (action) and A Plague Tale: Requiem (horror) were categorized as active games, given their higher levels of interactivity, fast-paced or suspenseful gameplay, and cognitive demand. These games typically require continuous attention, quick reactions, and emotional involvement, reflecting a higher level of engagement.

RESULTS

Sample Description

Researchers conducted a series of paired samples *t*-tests to assess whether there were significant differences in participants within-subject differences in participants' systolic blood pressure (SBP), diastolic blood pressure (DBP), and pulse rate (PR) following one hour of gameplay. Participants were assigned to one of four video game genres: horror (high-arousal, fear-inducing environments), action (fast-paced, reflex-dependent gameplay), simulation (slower-paced, task-oriented experiences), and casual (low-demand, recreational games). Given the pre-experimental design, analyses focused on pretest–posttest changes, and any differences observed across game types should be interpreted as exploratory.

Statistical Assumptions for Overall Analyses

Assumptions for paired samples *t*-tests were evaluated and adequately met in the overall sample. The normality of the difference scores between pre- and post-measures was assessed using the Shapiro-Wilk test. For SBP, the test was not significant, $W(38) = 0.97$, $p = 0.411$, indicating that the assumption of normality was met. Similar results were found for DBP, $W(38) = 0.95$, $p = 0.080$, and PR, $W(38) = 0.95$, $p = 0.078$. Normality was further supported by the inspection of Q-Q scatterplots, which showed no major deviations from theoretical quantiles. The assumption of homogeneity of variance was assessed with Levene's test. Results were non-significant across all measures—systolic: $F(1, 74) = 0.95$, $p = 0.334$; diastolic: $F(1, 74) = 0.07$, $p = 0.786$; pulse: $F(1, 74) = 0.17$, $p = 0.682$—indicating that the distributions of pre- and post-scores had comparable variances. Since all statistical assumptions were met, paired samples *t*-tests were deemed appropriate for analyzing mean differences in physiological indicators.

Overall Pre-Post Physiological Changes

First analysis was performed without dividing participants into groups. The paired sample t test results for the general sample ($n = 38$), revealed a significant decrease in SBP, from pre-test ($M = 108.53$, $SD = 15.76$) to post-test ($M = 100.08$, $SD = 12.07$), $t(37) = 5.00$, $p < 0.001$, with a large effect size ($d = 0.81$). A significant reduction was also found for the PR, which declined from pre-test ($M = 80.55$, $SD = 12.25$) to post-test ($M = 75.97$, $SD = 10.82$), $t(37) = 2.42$, $p = 0.021$, with a small-to-moderate effect size ($d = 0.39$). In contrast, the difference in DBP did not reach statistical significance, $t(37) = 1.68$, $p = 0.101$, $d = 0.27$.

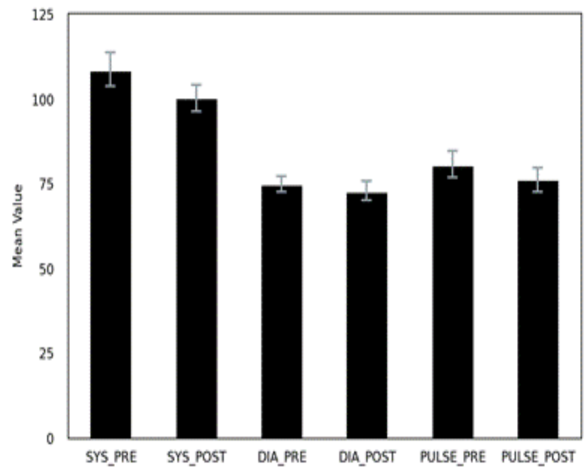
Table 3

Comparison of Blood Pressure Before and After One Hour of Gaming

Measure	N	*M* (Pre)	*SD* (Pre)	*M* (Post)	*SD* (Post)	*t*	*p*	*d*
Systolic BP	38	108.53	15.76	100.08	12.07	5.0	< 0.001	0.81
Diastolic BP	38	74.68	7.58	72.74	9.0	1.68	0.101	0.27
Pulse	38	80.55	12.25	75.97	10.82	2.42	0.021	0.39

Figure 1

Comparison of Blood Pressure Before and After Playing Video Games for One Hour



Note. SYS = systolic blood pressure; DIA = diastolic blood pressure; PULSE = pulse rate; PRE = measurement taken before the intervention; POST = measurement taken after the intervention.

Statistical Assumptions for Game-Type Comparisons

Assumptions were also verified for game type comparisons. For the analysis stratified by game type (active vs. passive). Some violations of normality were observed in subgroup analyses; however, paired samples *t*-tests are robust to moderate deviations from normality in samples of this size. In the passive group, the Shapiro-Wilk test indicated non-normality in the difference scores for SBP, $W(21) = 0.89$, $p = 0.027$, and DBP, $W(21) = 0.90$, $p = 0.043$. Additionally, in the active group, the assumption was violated for PR, $W(17) = 0.89$, $p = 0.040$. However, paired samples *t*-tests are known to be robust against moderate violations of normality, especially with sample sizes greater than 15 and approximately symmetric distributions (Blanca et al., 2017; Maxwell et al., 2008). Q-Q scatterplots supported the absence of extreme nonlinearity. Homogeneity of variance was verified using Levene's test, which was non-significant across all subgroup comparisons—systolic: $F(1, 40) = 0.35$, $p = 0.556$ (passive); $F(1, 32) = 0.78$, $p = 0.383$ (active); diastolic: $F(1, 40) = 1.10$, $p = 0.300$ (passive); $F(1, 32) = 0.35$, $p = 0.561$ (active); pulse: $F(1, 40) = 0.00$, $p = 0.984$ (passive); $F(1, 32) = 0.52$, $p = 0.476$ (active). These results suggest that the assumption of equal variances was upheld. Given the robustness of *t*-tests to normality violations and the fulfillment of homogeneity, the use of paired samples *t*-tests in game-type comparisons was considered methodologically sound (Glass et al., 1972; Lumley et al., 2002). Additional analyses were conducted to examine differences in physiological outcomes by game type (passive vs. active).

Classification of Active and Passive Games

Active games were defined as those that elicit high levels of cognitive, emotional, and physiological arousal due to their fast-paced, intense, and immersive content. This category included *horror* and *action* games, which often require quick reflexes, decision-making under pressure, and exposure to emotionally stimulating scenarios such as fear or combat. In contrast, passive games were characterized by lower intensity and reduced emotional engagement. This category included *simulation* and *casual* games, which typically involve slower-paced tasks such as resource management, routine-based progression, or leisurely exploration, and are associated with lower sensory stimulation.

Physiological Changes by Game Type

When analyzed by game type (see Table 4), both passive and active game conditions showed significant reductions in SBP. In the passive group, systolic pressure decreased from $M = 108.19$ (SD = 17.86) to $M = 97.67$ (SD = 13.00), $t(20) = 4.54$, $p <$

0.001, d = 0.99. In the active group, it declined from M = 108.94 (SD = 13.25) to M = 103.06 (SD = 10.43), $t(16)$ = 2.46, p = 0.026, d = 0.60. For diastolic pressure, a significant reduction was observed only in the passive condition, $t(20)$ = 2.19, p = 0.041, d = 0.48, while no significant change was detected in the active group, $t(16)$ = 0.22, p = 0.826, d = 0.05. Regarding PR, a significant decrease was found in the active group, from M = 79.71 (SD = 9.99) to M = 74.76 (SD = 7.18), $t(16)$ = 2.14, p = 0.048, d = 0.52. However, the reduction in PR in the passive group did not reach statistical significance, $t(20)$ = 1.47, p = 0.158, d = 0.32.

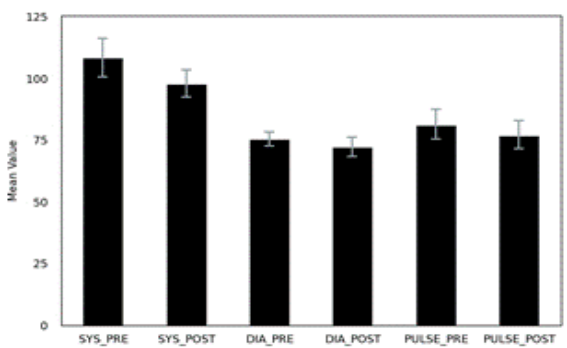
Table 4

Comparison of Blood Pressure Before and After One Hour of Gaming by Game Type

Measure	*N*	*M* (Pre)	*SD* (Pre)	*M* (Post)	*SD* (Post)	*t*	*p*	*d*
Systolic BP (Passive)	21	108.19	17.86	97.67	13.0	4.54	< .001	0.99
Systolic BP (Active)	17	108.94	13.25	103.06	10.43	2.46	.026	0.6
Diastolic BP (Passive)	21	75.29	6.57	72.1	8.86	2.19	.041	0.48
Diastolic BP (Active)	17	73.94	8.82	73.53	9.38	0.22	.826	0.05
Pulse (Passive)	21	81.24	14.03	76.95	13.15	1.47	.158	0.32
Pulse (Active)	17	79.71	9.99	74.76	7.18	2.14	.048	0.52

Figure 2

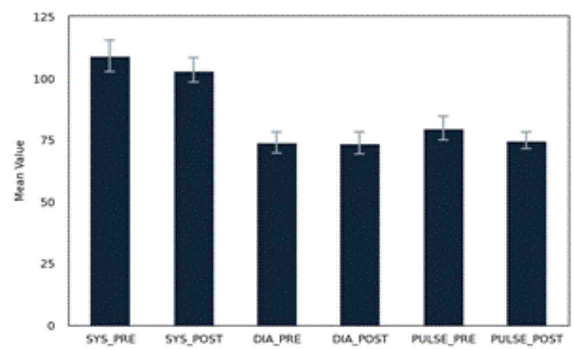
Comparison of Blood Pressure Before and After Playing Passive Video Games for One Hour



Note. SYS = systolic blood pressure; DIA = diastolic blood pressure; PULSE = pulse rate; PRE = measurement taken before the intervention; POST = measurement taken after the intervention.

Figure 3

Comparison of Blood Pressure Before and After Playing Active Video Games for One Hour



Note. SYS = systolic blood pressure; DIA = diastolic blood pressure; PULSE = pulse rate; PRE = measurement taken before the intervention; POST = measurement taken after the intervention.

DISCUSSION

The current study investigated the acute physiological effects of engaging with various genres of video games, with a particular focus on SBP and DBP as well as PR. Results from paired samples t-tests revealed that, in the general sample, there was a statistically significant reduction in both SBP and PR following a one-hour gameplay session, while DBP showed no significant change. These findings suggest that video gameplay, regardless of genre and associated arousal intensity, could elicit short-term calming effects on cardiovascular activity. The results present consistency with an expanding body of research demonstrating that video games can attenuate physiological markers of stress and anxiety, including reductions in SBP and PR. Prior work has similarly shown that both casual and immersive video games promote relaxation and decrease stress-related physiological arousal (Desai et al., 2021;

Russoniello et al., 2009). In line with our results, Pine et al. (2020) and Pallavicini et al. (2021) observed significant reductions in self-reported anxiety and stress following brief gaming sessions, particularly with casual game formats. Notably, our findings extend this literature by demonstrating that active games, including those in higher-arousal genres such as horror and action, also produced significant decreases in SBP and PR. This suggests that even high-arousal, immersive gameplay may contribute to physiological stress regulation. However, unlike passive game conditions, no significant changes were observed in DBP, indicating a more selective effect on specific cardiovascular parameters.

In the analysis by video game category, we found mixed results. Consistent with previous studies on passive games, including those by Russoniello et al. (2009) and Pine et al. (2020), participants exhibited significant reductions in both SBP and DBP, suggesting a potential physiological relaxation response associated with low-arousal, task-oriented gameplay. The large effect size for systolic pressure and moderate effect for diastolic pressure indicate that these game genres might help alleviate stress-induced cardiovascular activation. Although PR also declined, the change was not statistically significant, which may be due to the limited sample size rather than a true absence of effect.

These results suggest that passive games might serve as accessible tools for stress reduction, especially among college students, though further research with larger samples is needed to confirm these effects (Desai et al., 2021; Pallavicini et al., 2021). Similarly, active games (horror and action genres) produced a significant reduction in SBP and PR, suggesting that high-arousal, immersive gameplay might still promote physiological stress regulation. Unlike passive games, however, no significant changes were observed in DBP, indicating a more selective effect on cardiovascular markers. These findings suggest that while active games may not produce the same broad relaxation response as passive games, they might still support stress reduction.

These results align with the theory of flow, which posits that engaging in optimally challenging and immersive activities could induce a flow state. It is possible that participants entered such a state during gameplay, facilitating activation of the parasympathetic nervous system and the concurrent inhibition of sympathetic activity (Peifer et al., 2014). This psychophysiological shift may promote autonomic balance and a homeostatic state, thereby reducing stress-related physiological markers such as elevated heart rate and blood pressure. Peifer et al. (2014) further demonstrated that individuals experiencing higher levels of flow are linked to activations of the parasympathetic system which might help explain during lower blood pressure reactivity, even under highly engaging scenarios in videogames. These findings suggest that immersive gameplay may help downregulate physiological arousal, leading to reduced cardiovascular strain through parasympathetic dominance and dampened sympathetic responses, which could explain the observed reduction in blood pressure among participants.

Similar results have been reported in previous research. For example, Ballard et al. (2006) observed reductions in SBP and DBP reactivity over a 3-week intervention period. They attributed these changes to repeated exposure to video game stimuli, leading to physiological desensitization, not to be confused with boredom or habituation to the laboratory environment. While differences in methodologies between both studies, such as measurement timing, session length, number of sessions, types of games used, and theoretical explanations, may make the similarity of results seem unexpected, one possibility is that both participant groups experienced the same psychological processes, (e.g., immersion and cognitive involvement) that with time, or even within a session—could promote changes from sympathetic arousal to parasympathetic regulation and then to cardiovascular relaxation.

In contrast, Siervo et al. (2013) found no significant physiological changes across most groups, except for significant increases in DBP among participants exposed to violent video games. However, a key explanation likely lies in the nature of the violent games themselves. While Siervo et al. (2013) employed a violent game involving disorganized, unpredictable, and emotionally threatening scenarios (Grand Theft Auto: San Andreas), the present study utilized violent action games (Halo and A Plague Tale: Requiem) that were organized, goal oriented, and followed a narrative. Due to this, the organized emotional experience possibly enabled better emotional control among players, such that less sympathetic activation and a lack of DBP increases occurred during gameplay. This is important because even among action video game genres the narrative seems to be an essential component driving player engagement.

From these results, it becomes clear that changes in blood pressure, whether increases or decreases, are highly dependent on multifaceted factors, including session length, number of sessions, the type of games used, and individual characteristics such as age, gender, and prior gaming experience. It is crucial that future studies take these variables into account when interpreting and explaining physiological responses to video game exposure.

Limitations

There were some limitations in the production of this study. For example, there was insufficient literature on the relationship between video games, anxiety, stress and blood pressure. Therefore, this limits the amount of validity that we can give the results of the studies since there is not enough literature to see if there is a significant relationship between blood pressure, anxiety, stress and the video game's ability to reduce these variables. Additionally, there was limited geographic diversity, as the sample consisted primarily of university students from the University of Puerto Rico, Río Piedras Campus.

In consequence, the sparse geographic diversity restricts the generalizability of the findings conducted for this particular study. Although the study measured physiological outcomes before and after gameplay, it only captured immediate short-term changes within a single session. Therefore, it remains unclear whether the reductions in blood pressure and heart rate observed immediately after gameplay would persist over longer periods or with repeated exposure.

The present study has several limitations to consider. Firstly, the absence of a control group limits the ability to attribute observed changes in physiological measures specifically to the video game intervention. It is possible that participants experienced elevated blood pressure during the pretest due to initial nervousness or anticipatory anxiety, which may have naturally subsided as the session progressed. Additionally, a potential habituation effect to the testing environment may have contributed to reductions in physiological arousal over time, independent of gameplay. Future studies should include a control group engaged in a passive activity, such as reading or watching a movie, to better isolate the specific effects of video game exposure.

Second, the relatively small sample size increases the likelihood of statistical error and limits the generalizability of the findings. This limitation is particularly relevant in subgroup analyses by game type, where uneven group sizes may affect the stability and reliability of the results. Furthermore, the sample consisted primarily of university students with varying levels of familiarity with video games. Differences in prior gaming experience may have influenced levels of engagement, with less experienced participants potentially experiencing difficulty interacting with the games, thereby affecting both psychological and physiological responses.

Finally, several potentially influential variables were not controlled. Factors such as environmental temperature, participant posture during measurement, baseline stress levels, recent physical activity, caffeine intake, and sleep quality may have affected cardiovascular responses. These variables introduce additional sources of variability that may confound the interpretation of the results. Taking these limitations suggests that the findings should be interpreted with caution. Future research employs larger, more diverse samples, controlled experimental designs, and greater standardization of measurement conditions is needed to better insulate the effects of video games on physiological indicators of stress.

Strengths

This study possesses several notable strengths. First, it addresses a significant gap in the literature by examining the psychophysiological effects of video games on stress management among Puerto Rican college students, a population that remains underrepresented in psychological research. This focus contributes to the diversification of the field and provides culturally relevant insights into how digital interventions may function within specific sociocultural contexts.

Second, the study employed objective physiological indicators—specifically SBP, DBP and PR—to assess stress responses. The inclusion of these biometric measures enhances the empirical rigor of the study, offering more reliable and quantifiable evidence of physiological change compared to self-report measures alone, which are more susceptible to bias.

Third and lastly, by distinguishing between active and passive video game genres, the study allows for a more nuanced examination of how varying levels of interactivity, arousal, and cognitive-emotional engagement influence autonomic regulation. This differentiation provides valuable insight into the mechanisms through which video games may impact stress responses and highlights the importance of game characteristics in shaping both psychological and physiological outcomes.

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Conflict of Interests: The authors have no conflicts of interest to disclose.

Institutional Review Board (IRB): The study was approved by the Institutional Review Board of the University of Puerto Rico, Río Piedras Campus (IRB Protocol #2223-067).

Informed Consent: All participants were presented with an informed consent form prior to participating in the study.

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