Human TECHNOLOGY

ISSN: 1795-6889

https://ht.csr-pub.eu Volume 21(3), December 2025, 474–510

NEUROSOCIOLOGICAL PERSPECTIVES ON VIDEO GAMES: A NARRATIVE REVIEW

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Abstract: *This research explores the neurosociological dimensions of video games, focusing on their evolution, social impact, and neurological effects. Using a narrative review, we first examine their progression from playful activities to digital and connected experiences. We assess potential risks such as youth vulnerability, excessive screen time, lack of physical presence, gaming disorder, and aggressiveness. Conversely, we highlight positive aspects, including self-expansion, social play, flow states, excitement and relaxation, neurophysiological and psychological effects, and mental health applications. We further analyze gaming's role in socialization, high-stimulation environments, disembodied interactions, and as a source of fun in modern society. Finally, we synthesize these themes through three key perspectives: the allure of screen flow among youth; the balance between digital and physical play for healthy development; and the importance of understanding both the risks and benefits of video games. This study frames video games as a cultural and cognitive technological force shaping human development.*

Keywords: *video games, gaming, neurosociology, mental health, digital society, culture*

DOI: https://doi.org/10.14254/1795-6889.2025.21-3.1

INTRODUCTION

Here, we investigate the flourishing field of neurosociology to explore the interplay between the brain and culture in analyzing the social phenomenon of video gaming.

The Nexus of Two Sciences: A Neurosociological Perspective

Neurosociology highlights the interaction between neurosciences and sociology, showing how social experiences shape neuroplasticity and influence neural processes (Kalkhoff et al., 2016; Tang & Tang, 2015). Neurosociology operates on two levels: micro, focusing on brain functions during interpersonal dynamics; and macro, involving collective frameworks like ideologies and class awareness (TenHouten et al., 2023). The emerging field exploring the social and cultural dimensions of neuroscience offers valuable insights into how societies differ in their value systems and the underlying mechanisms that drive these differences (Shkurko, 2024). Neurosociology bridges neuroscience's experiments with sociology's field research on sociocultural phenomena (Lende et al., 2021). Neuroscientific tools like functional magnetic resonance imaging (fMRI) and electroencephalography (EEG) analyze brain function (Dong et al., 2018), while sociological methods (e.g., surveys, interviews, and ethnography) examine the impact of social factors on behavior (Pearce, 2012). In neurosociology, innovative methods like hyperscanning measure brain activity (e.g., EEG) during real-time multiple social interactions (Czeszumski et al., 2020; TenHouten et al., 2023), virtual reality (VR) creates environments for behavior studies (Auriemma, 2023), and neurostimulation modulates brain activity to examine social cognition (Bell & DeWall, 2018). Video games also simulate social interactions in controlled research settings (Kourtesis et al., 2020; Parsons, 2015).

Thus, we aim to examine, through a neurosociological lens, how the social phenomenon of video gaming influences and is influenced by the brain and how it shapes and is shaped by culture and society.

Social Phenomenon of Video Gaming

Social phenomena encompass collective behaviors and interactions among individuals, forming key events for scientific analysis (Sampaio & Andery, 2010). The social phenomena of video games involve examining behaviors that both shape and are shaped by video games. With the advancement in digital culture, analog games have been transformed into digital formats, particularly video games (Esposito, 2005). Human development has been mediated by the new digital media (Kyshtymova & Skorova, 2024), and modern leisure now includes the integration of digital gaming into daily life worldwide (Muriel & Crawford, 2018). By 2022, video gaming reached nearly 3.2 billion players globally, with the majority in Asia, followed by regions such as the Middle East, Africa, Europe, Latin America, and North America (Newzoo, 2023). A North American study found the average gamer age to be 33, with three-quarters under 44, and players spending an average of 13 hours per week gaming (Entertainment Software Association, 2022). As video games have become central to modern culture, understanding their impact on the brain and society is crucial, and the focus of this research.

THE TRANSFORMATION OF GAMES

Games differ from other forms of play (Caillois, 2001) and have evolved into video games through digitalization (Esposito, 2005) and connectedness (Wijman, 2018).

Playful Activities

Discussion of games dates back to 1938 with historian Johan Huizinga, who emphasized the significance of play in human civilizations and its ludic role in fostering voluntary joy (Huizinga, 1980; Şentuna & Kanbur, 2016). However, Huizinga blurred the lines between play and games, a distinction later clarified by Roger Caillois (Caillois, 2001; Encheva et al., 2023). Caillois categorized play into two types: "paidia," which is spontaneous and imaginative (e.g., doll play), and "ludus," which involves disciplined, rule-governed activities (e.g., board games).

From a contemporary perspective, despite efforts to define games, their growing diversity in type and context has made them more complex (Arjoranta, 2019). A review of over 60 game definitions highlighted recurring themes like rules, purpose, separation from reality, interconnectedness, player engagement, competition, and goals (Stenros, 2017). However, one simplified definition from a game designer describes games as playful activities occurring in a pretended ludic reality, where participants aim to achieve nontrivial goals by following rules (Adams, 2014).

Digitalization

Advances in digital culture and audiovisual technology transformed analog games into digital formats, notably video games (Esposito, 2005). With technological growth and video game commercialization, the gaming industry has evolved rapidly. The debut of Pong in 1972 and Space Invaders in 1979 signaled the rise of video games (McKernan, 2013). As technology evolved, new forms of leisure emerged, including television, radio, personal computers (PCs), gaming consoles, and later smartphones and tablets (Pizzo, 2023). Video games emerged, leading to the "ludification" of culture, where gaming surpassed traditional film and music industries (Carvalho & Coelho, 2022; Raessens, 2006). However, video games have not always been the same.

Before the mid-2000s, gaming was mainly offline, played solo or in local multiplayer on consoles and computers, but the rise of online play and open-world gaming in the mid-2000s allowed people to connect with both friends and strangers in virtual environments (Dale & Shawn Green, 2017). Initially, gaming sessions were confined to leisure time and space, separated from social obligations like work or school (Brooks et al., 2016). Old portable consoles, like Gameboy, allowed gaming mobility but were rarely used in structured settings like schools (Angell, 1998). A Brazilian study revealed that 67% of youth aged 12-15 played in LAN (Local area network) houses (i.e., connected computers within a localized area, typically sharing a central internet connection), but the spread of broadband internet and smartphones eventually shifted gaming to home and mobile environments (Trammel, 2019). Post-2000s, fast internet, and smartphones reshaped global digital consumption and behavior (Naughton, 2016).

Connectedness

After the 2000s, online video games gained widespread popularity, and by 2012, some markets, such as the Japanese online game market, surpassed traditional home video games (Koizumi, 2016). Still, according to the gaming research, by 2014, online games captured 64% of Japan's total video game market, reaching $5.527 million, while conventional games remained at $3.112 million. Players could now connect with virtual friends or strangers online, without needing in-person interactions (Lou et al., 2019).

Fast internet allowed global connectivity, while smartphones and tablets expanded this by enabling gaming anywhere, anytime (S. Choi, 2016). Unlike gaming on consoles or computers, which required specific locations, smartphones made gaming more mobile. By 2018, mobile video games had become the top segment in the gaming industry, reflecting a market shift (Wijman, 2018). While portable consoles focused solely on gaming, smartphones performed multiple functions, like communication and media consumption, alongside gaming (Hjorth & Richardson, 2017; McCrea, 2011). By 2023, nearly 7 billion smartphones were in use globally (Ericsson, 2023), highlighting their integration into daily life. Mobile gaming, though not replacing PC or console gaming, complements it (Cai et al., 2022). The spread of smartphones and the fast internet allowed people to game anytime, anywhere, whether solo or with others worldwide, blurring the distinction between leisure and responsibilities, like work (Pink et al., 2018) and school (Allaby & Shannon, 2020). Figure 1 summarizes this section.

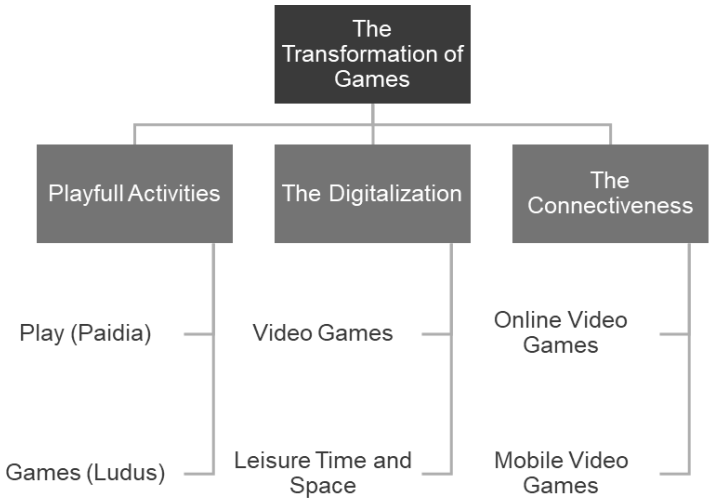

Figure 1: The Transformation of Games

THE DARK SIDE OF GAMING

Video games can pose risks to neurodevelopment and society, particularly through problematic behaviors like addiction, with children and adolescents being especially vulnerable due to their ongoing brain development (Darvesh et al., 2020; Marzola et al., 2023).

The Generation of Virtual Bonds and Human Gaps

In today's fast-paced world, technology and digital environments deeply shape culture. Cyberculture, driven by digital technology and internet use, erases traditional boundaries between individuals, communities, and information, fostering creativity and new social structures within cyberspace (Lévy, 2001). Virtual environments, like social media and video games, facilitate globalized interactions, integrating diverse cultures into daily life and forming a global cultural structure (Durmus, 2021). The spectacle society highlights media and consumer culture's influence, where life becomes appearance (Debord, 2021). This blurring of physical and virtual realms expands entertainment (Davies & Innocent, 2017). Hypersociety theory points to digital connectivity's transformative impact, keeping people constantly connected yet disconnected from true human interactions (Castells, 2011). Screen use has shifted communication from face-to-face bonding to mediated exchanges via technologies like smartphones (Ball et al., 2019). Video games blend spectacle and cyberculture, immersing players, such as children and adolescents, in immersive screen experiences.

Youth Vulnerability in a Digital Age

Neurodevelopment is a highly orchestrated process during which the nervous system forms complex networks of neurons and synaptic connections through the interplay of genetic programming and environmental stimuli (Chakraborty et al., 2021). Neuroplasticity is the nervous system's natural response to environmental changes, enabling the functional restructuring of nerve cells and forming new, stable neural connections (Spytska, 2024). Neuroplasticity is crucial during childhood and adolescence (Lende et al., 2021). While neuroplasticity remains present in adulthood, it is most malleable during early developmental windows, shaping cognitive, motor, and sensory functions, and is significantly influenced by external experiences that can either strengthen or prune neural pathways (Chakraborty et al., 2021; Marzola et al., 2023). As individuals age, neuroplasticity declines, as neuroplasticity is tightly controlled by cellular and molecular processes, which tend to decline over time (Voss et al., 2017). During childhood and adolescence, socialization plays a significant role in shaping cultural identity by instilling societal norms and values (Checkel, 2017). Media and information and communication technologies (ICT) now mediate socialization, creating environments where individuals engage in work, school, leisure, and communication (Kellner, 2004, 2020). Technological advances have brought about new cyberspaces, reshaping culture and centralizing information control (Kellner & Share, 2019), and video games, as a form of media and activity within ICT environments, serve as mediators of culture

The industry uses these games for surveillance, gathering player data for behavioral insights, and monetization (Deleuze, 2017). Video games, seen as cultural artifacts, reflect this consumer data-driven approach (Švelch, 2022). These games, while offering joy or escape, often create an illusion of freedom, as players may have the freedom to make decisions within a game, but only within the constraints of a system deliberately designed by the industry. In a postmodern context, capitalism fuels consumerism and globalization (Harvey, 2020). Hyperconsumption fuels a relentless pursuit of material goods and experiences for fleeting happiness, ultimately leading to dissatisfaction (Lipovetsky, 2009; Lipovetsky et al., 2002). The video game industry, like many others, is thus driven by consumer data to maximize

revenue through fleeting pleasures (Marchand & Hennig-Thurau, 2013). This poses a potential societal risk for youth, whose habits developed during this key period of neuroplasticity may lead to addiction or harmful behaviors (Kim et al., 2022).

Screen Time and Video Gaming

Excessive video game use leads to increased screen time, raising mental health concerns. Studies show that extended screen exposure at age two can harm neurodevelopment (Sugiyama et al., 2023). Both the American Academy of Pediatrics (AAP) and the World Health Organization (WHO) recommend limiting screen time to one hour per day for 2-5-year-olds (McArthur et al., 2022). Meanwhile, the Australian Government recommends a maximum of two hours of recreational screen time daily for young people aged 5–17 years, excluding school-related activities (Joshi & Hinkley, 2021). However, 3–6-year-old children now average almost four hours daily on screens, including TVs, phones, and computers (Konca, 2022). For children aged 8-12, screen time often exceeds five hours daily (Nagata et al., 2022). Adolescents aged 17-18 average six hours per day (Twenge et al., 2019). A Canadian study of nearly 30,000 adolescents, averaging 14.9 years old, found that from 2019 to 2022, daily screen time increased by 129 minutes, rising from 320 minutes (5.3 hours) to 449 minutes (7.5 hours), with adolescents in 2022 spending almost equal time on screens as they did sleeping (Poirier et al., 2024). Research shows players spend an average of 13 hours per week gaming, with 70% playing on smartphones (Entertainment Software Association, 2022). Over 90% of children aged two and older play video games, with 75% of American households owning a console, and children aged 8-17 spend around 1.5 to 2 hours per day gaming (Alanko, 2023). Boys typically spend more time than girls playing video games, especially on consoles or computers, while girls engage more with social media (Leonhardt & Overå, 2021).

A Swedish study linked high smartphone screen time (over 4 hours daily) with increased mental health problems in adolescents, while TV and computer screen time showed no significant impact (Lundin-Emanuelsson, 2021). This suggests that smartphones, which allow constant content consumption, contribute more to mental health issues. The International Classification of Diseases (ICD-11) recognizes both online and offline video games as potential sources of gaming disorder (Paschke et al., 2020), while the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) highlights only the risks of online gaming (Luo et al., 2022), emphasizing how the proliferation of smartphones and the internet (Ericsson, 2023) has led to increased concerns.

Diminished Physical Presence and Dark Participation

In today's digital society, long parental work hours push children toward digital escapes, fostering family-work conflicts and digital abuse behaviors, while leisure activities may offer essential breaks from screens, providing face-to-face interactions (Abreu, 2022). Digital media serves as a modern pacifier for young children, with parents using screen time as a coping strategy to alleviate parenting stress (Brauchli et al., 2024). In today’s stressful society, people turn to the comfort of digital media, and parents often rely on digital babysitters to entertain their children (Abreu, 2023; Bar Lev et al., 2018). Free play supports socio-emotional, cognitive, linguistic, and self-regulation skills, aiding stress management and healthy

development (Yogman et al., 2018). Leisure activities like outdoor walking and conversation also positively impact mental health (Weng & Chiang, 2014). However, youth now prioritize digital media, including video games and social media, over nature-based play (Larson et al., 2019). A study highlights a generational decline in children's connection to nature, replaced by a preference for digital media, and this shift from physical to virtual experiences has reduced free play and led to more sedentary lifestyles (R. C. Edwards & Larson, 2020). The transition to smartphones has further diminished genuine social connections, fostering self-alienation and constant consumption (Harmon & Duffy, 2022). Additionally, dark participation (i.e., toxic online behaviors like harassment and fake news) is rampant in gaming environments, with over half of gamers experiencing harassment (Kowert, 2020). A study even found that online gaming is viewed as more toxic than social media, posing risks, particularly for minors (Alanko, 2023; Cook et al., 2023).

The Gaming Generation Grows Up

A 12-year longitudinal analysis of individuals from ages 6 to 18 revealed that those raised in pro-environmental contexts were more likely to engage in similar behaviors as adults, illustrating how childhood socialization influences later adult behavior (G. W. Evans et al., 2018). Similarly, due to socialization, those raised in highly digital environments, marked by extensive screen time and video games, may display similar behaviors in adulthood, seeking more digitized experiences (Yun, 2023). Video games popularly surged in the 1980s (McKernan, 2013), potentially influencing those born during or after. This helps explain why nearly three-quarters of U.S. players are under 44, with an average age of 33 (Entertainment Software Association, 2022). As these generations mature, video games may drive the gaming industry and cultural "ludification" from leisure (Carvalho & Coelho, 2022; Raessens, 2006), extending different formats (e.g., serious games and gamification) into education (Coelho et al., 2024; Coelho, Rando, et al., 2025; Sailer & Homner, 2020), work (Coelho & Abreu, 2023), and healthcare (Coelho, Gonçalves, et al., 2025; Damaševičius et al., 2023). In today’s hyperconnected world (Castells, 2011), digital habits have become global, and it is crucial to understand the risks of excessive childhood gaming for the generation born into video games.

Pathological Behaviors

The constant pursuit of digital excitement, like video games, can become habitual and potentially lead to health issues such as addiction and gaming disorder (Darvesh et al., 2020), together with increased stress and aggressive behavior (Mitsea et al., 2023).

Addiction and Gaming Disorder

While video games often provide fleeting pleasure, they can also pose risks of addiction, as during gameplay, brain regions such as the ventral striatum, nucleus accumbens, and cingulate cortex activate, correlating with habit and reward-related behavior, similar to addiction patterns (Benady-Chorney et al., 2018, 2020; Koepp et al., 1998). Gaming and substance addiction share similar neurobiological mechanisms (A. M. Weinstein, 2010), involving dopamine release, which is also seen in gambling and drug abuse (A. Weinstein & Lejoyeux, 2015). The

addictive nature of video games may stem from the brain's reward system, as dopamine plays a role in learning and motivation, with habitual gaming engaging this neurotransmitter (Wise & Jordan, 2021). Repeated gaming behaviors can form habits that risk addiction (van Elzelingen et al., 2022).

Dopamine also influences risk-taking, with interactions between the prefrontal cortex and limbic system playing a role in addiction (Kohno et al., 2015). The prefrontal cortex is crucial for managing emotional, cognitive, and behavioral changes related to addiction, particularly in areas such as response inhibition, self-control, and decision-making (Ceceli et al., 2022). Video games can disrupt dopamine balance, impairing the interaction between the prefrontal cortex and limbic system, which may lead to addiction and impaired emotional regulation (A. Weinstein & Lejoyeux, 2015). Adolescents are especially vulnerable due to ongoing prefrontal cortex development, given a peak in dopaminergic innervation and receptor density in this brain region (Chini & Hanganu-Opatz, 2021).

Gaming disorder, now recognized as a mental health condition, primarily affects children and adolescents (Darvesh et al., 2020) and has serious negative consequences (Feng et al., 2017). Introduced in DSM-5 in 2013 as Internet Gaming Disorder (Luo et al., 2022), it was expanded in ICD-11 in 2018 to include both online and offline gaming (Paschke et al., 2020). A meta-analysis reported a 3.3% prevalence of disordered gaming, with higher rates among adolescents aged 8-18 (6.7%) and young adults (12-40 years) at 6.3% (Kim et al., 2022). Gaming disorder, as defined by the ICD-11, involves a persistent gaming habit lasting at least 12 months, leading to impaired control, prioritization over other activities, and negative effects on personal, occupational, and social life (Xiang et al., 2020).

Gaming addiction, particularly in adolescents, is associated with issues like social anxiety, depression, loneliness, and poor mental health (J.-L. Wang et al., 2019; S. Zhu et al., 2021). It can also affect sleep quality, stress levels, and physical activity, and increase the risk of obesity (Handayani et al., 2021). Excessive gaming may delay verbal intelligence development (Takeuchi et al., 2016), impair academic performance (S. Das et al., 2023), increase distractibility and difficulty in sustaining attention (Alho et al., 2022), and affect working memory and decision-making (Billieux et al., 2020; Irak & Soylu, 2023).

Nonetheless, it is important to differentiate recreational gamers from those with gaming disorder, as the latter exhibit weakened connections in reward and executive control systems (greater inhibition of the putamen-middle frontal gyrus-insula pathway), leading to heightened cravings and diminished executive control (M. Wang et al., 2020). Another study with EEG also suggests potential biomarkers for identifying gaming disorder, especially in visuospatial processing, i.e., activation of the right parieto-occipital area (Hosseini et al., 2021). Thus, addiction affects executive functions and visuospatial processing, with the striatum-prefrontal cortex pathway potentially serving as a biomarker for addiction risk.

Stress and Aggressive Behavior

Aggressive behavior is linked to disruptions in the frontolimbic region, which controls emotions (Klasen et al., 2019). While aggression is often associated with violent video games, studies frequently mix violence with competitiveness, difficulty, and intensity, complicating interpretations (Adachi & Willoughby, 2011). Meta-analyses consistently suggest that violent video games increase aggression, aggressive thoughts, and emotions while reducing empathy

and prosocial behavior (C. A. Anderson et al., 2010; Greitemeyer & Mügge, 2014). Another meta-analysis found violent video games linked to physical aggression modulated by cultural factors, with Eastern cultures emphasizing social responsibility, mitigating negative effects, while Western cultures promoting individualism heighten desensitization (Prescott et al., 2018). A longitudinal meta-analysis showed a U-shaped curve for violence-related aggression, peaking in early adolescence (Burkhardt & Lenhard, 2022). Game addiction has also been linked to aggressive behavior (Uçur & Dönmez, 2023), likely due to frontolimbic dysfunction and serotonin imbalance affecting emotion regulation and impulsivity (Çetin et al., 2017; Klasen et al., 2019). Beyond violent content, video game addiction correlates with impulsive behaviors, including aggression and emotional eating (Caner & Evgin, 2021).

Stress and cortisol levels can be associated with aggressive behaviors (Figueiredo et al., 2020), and they can be enhanced by exposure to violent content in video games (Mitsea et al., 2023). Even background music, such as pop/techno, can raise cortisol (Hébert et al., 2005). An increase in cortisol and alpha-amylase, both involved in the stress circuit (Tammayan et al., 2021), and a decrease in oxytocin, which is associated with empathic behavior (Barchi-Ferreira & Osório, 2021), have also been observed in response to games with scary content (Aliyari et al., 2023). The amygdala and hypothalamus activate during stressful gameplay, triggering fear and anger responses (Aliyari et al., 2018). Figure 2 summarizes this section.

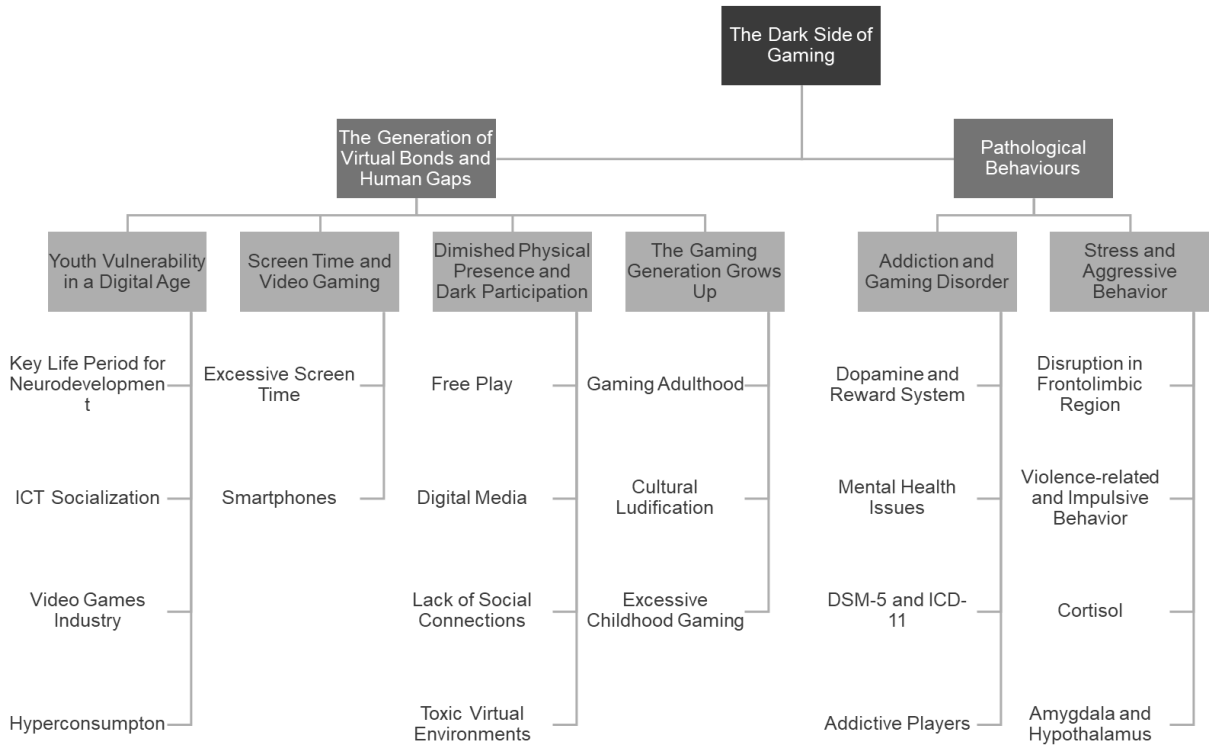

Figure 2: The Dark Side of Gaming

THE BRIGHT SIDE OF GAMING

Video games have evolved from non-digital to widespread digital, online, and mobile experiences (Cai et al., 2022; Esposito, 2005), posing risks, but also offering benefits when played healthily during leisure moments (Stenseng et al., 2021).

Gameful Leisure Experiences

Stress is widespread in modern society, making effective coping strategies vital, with leisure activities playing a key role by evoking positive emotions, well-being, and overall quality of life and offering a constructive escape from daily pressures (Auger, 2020; Denovan & Macaskill, 2017). Leisure, essential for health and well-being, provides restorative moments of excitement (Elias & Dunning, 1986; Thing, 2016). Technology has transformed leisure activities (López-Sintas et al., 2017), elevating video games to the same cultural status as film and music (Carvalho & Coelho, 2022; Raessens, 2006).

Self-Expansion and Coping Activities

Leisure activities, often viewed as escapism, can be positive when they involve self-expansion (linked to mastery and self-growth, promoting psychological well-being), but self-suppression (which seeks to avoid negative emotions, often in response to life stressors) is prejudicial to long-term mental health (Stenseng et al., 2012). Although gaming for self-suppression is strongly related to pathological gaming, gaming for self-expansion positively correlates with intrinsic psychological needs like autonomy and competence (Stenseng et al., 2021), being associated with well-being and intrinsic motivation in self-determination theory (Ryan & Deci, 2020). Gaming can also serve as a coping mechanism, offering distraction through interactive, manageable challenges, which, though not solving problems, can provide a sense of progress and purpose (Iacovides & Mekler, 2019).

Research comparing screen activities found that while weekday television time was linked to poorer academic performance, video gaming, and weekend television were not (Sharif & Sargent, 2006). Video games engage the fronto-parietal networks, enhancing attention and associative learning, unlike passive media like television, which primarily activate the default mode network, related to mind-wandering and resting (D. R. Anderson & Davidson, 2019). Thus, considering the recommended daily screen time and the range of digital leisure activities, such as television, video games can be a more active and less harmful option compared to other forms of screen media. However, we must be alert for those using games to escape real-life issues (Prinsen & Schofield, 2021).

Playing Together, Having Fun Together

Engaging in digital leisure activities like watching films or playing video games can strengthen family bonds, improve communication, and foster mutual respect (Belmonte et al., 2021). Data from the National Statistical Institute (NSA) shows that families commonly engage in digital leisure, with video games playing a significant role (de Los Dolores Gil García et al., 2024). "Couch co-op" games, where players collaborate or take turns in multiplayer or single-player

(i.e., tandem play) games, encourage social interaction and teamwork, particularly when experienced players guide novices (Consalvo, 2017). Nonetheless, the gaming industry has transitioned from traditional "couch co-op" play, where players gather in the same room, to online and mobile gaming, where people can connect to others from different places and time zones (Koizumi, 2016; Wijman, 2018).

Online games now create global networks, enabling social connections and a sense of belonging through virtual interactions and gaming communities (Saldanha et al., 2023). Gaming has given rise to entrepreneurial streamers who broadcast live gameplay on platforms like Twitch, where viewers can financially support them, fostering dynamic online gaming communities (Bingham, 2020). Participating in online gaming can reduce isolation and foster a sense of belonging by creating social connections through gameplay and gaming communities, but virtual interactions do not replace physical ones, offering an additional opportunity to initiate conversations and connect with others (Iacovides & Mekler, 2019). Gaming also promotes real-world connections through events like E-sports and gaming meetings, reflecting its cultural impact (Reitman et al., 2020). E-sports fosters emotional bonds among team members, providing social support through friendships or romantic relationships within the community (Freeman & Wohn, 2017). Similarly, gaming jams - meetings where participants collaborate to create video games - promote belonging, offering work opportunities, and fostering friendships (Saldanha et al., 2023).

Gaming also encompasses metagame activities, i.e., those connected to the game but not part of playing it directly, that foster social connection, including off-screen interactions like organizing gaming sessions with friends, discussing and seeking information with peers, creating and sharing content, or engaging in game-related outdoor play (Kahila et al., 2021). Additionally, as the gaming industry grows, it shapes unique consumption patterns, creating online networks and communal identities like cosplay (Aljanahi & Alsheikh, 2021). Cosplay, where individuals dress as characters from popular media, has become a mainstream fan activity with the rise of the internet, offering support and socio-emotional connections while fostering collaboration and friendships (Vardell et al., 2022). In Japan, cosplay reflects a deep cultural heritage, while otaku culture has spread globally, influencing the consumption of Japanese cultural goods (Ito & Crutcher, 2014; Kam, 2013).

Flow and Immersion

Flow is a state of deep concentration and enjoyment often experienced during gaming (Caroux et al., 2015; Csikszentmihalyi, 1975). Video games promote flow through immersive experiences, balancing the player's skills with the game's challenges, resulting in intense focus, a loss of time perception, and reduced self-awareness (Brown & Cairns, 2004). Flow is closely linked to narrative engagement and enjoyment in games, as all these psychological states involve emotional immersion (Sherrick, 2021). Flow is associated with reduced self-referential processing and increased arousal, with participants experiencing greater absorption and perceiving time as passing more quickly (Khoshnoud et al., 2022). This state is linked to mindfulness, and both states foster relaxation, concentration, improved mood, and reduced stress (Cruea, 2020). Nonetheless, during the COVID-19, quarantine was associated with poorer well-being, but flow moderated this effect, with those experiencing high levels of flow

showing little or no decline in well-being, whereas mindfulness did not moderate well-being (Sweeny et al., 2020).

Flow deactivates the default-mode network, which is typically active in passive states (Ulrich et al., 2014). Optimal game difficulty enhances flow, increasing oxygenated hemoglobin in the frontoparietal network, and personal autonomy in choosing game challenges further enhances activation of the frontoparietal regions, highlighting the connection between flow, attentional resources, and personal autonomy (de Sampaio Barros et al., 2018). A study found that intermittent rewards in gaming were associated with lower hippocampal GABA levels (the brain's inhibitory neurotransmitter), compared to consistent or no rewards, suggesting that intermittent rewards may induce a flow state, balancing skill and challenge, and boosting hippocampal activity (Prena et al., 2020). This suggests a link between intermittent rewards, flow, and improved in-game learning through hippocampal activation (Adcock et al., 2006; S. Li et al., 2003; Ostrovskaya et al., 2014).

Exciting and Relaxing Moments

Excitement-based flow occurs when challenges exceed player skills, while relaxation-based flow arises from easier, controllable challenges (Chang et al., 2020). As noted in the previous research, goal-oriented players prefer relaxation flow for results and confidence, while behavior-oriented players seek excitement during the process to apply advanced skills. Exciting gameplay can raise heart rates through cardiovascular responses involving adrenaline release (Behnke et al., 2020). A study found a positive relationship between game rewards and arousal, with more rewards increasing arousal, measured by skin conductance and heart rate (Ravaja et al., 2006). Conversely, puzzle games can reduce cortisol and stress levels (Mitsea et al., 2023), while immersive games, i.e., making use of virtual reality, boost alpha and theta brain activities, promoting relaxation (Beitle, 2021; GomezRomero-Borquez et al., 2023). After gameplay, individuals may feel deep calm and well-being, likely from endorphin release (Snodgrass et al., 2011). Research shows casual gaming can improve mood more effectively than meditation or guided relaxation (Stanhope et al., 2016), similar to the endorphin-driven relaxation found in exercise, yoga, and meditation (Suri et al., 2017).

Brain Boosters

Video games offer diverse audiovisual stimuli that require user interaction (D. (D. R. Anderson & Davidson, 2019), and engage the brain (Bateman & Nacke, 2010; Siviy, 2016).

Neurophysiological and Psychological Benefits

Video games activate the prefrontal cortex, facilitating decision-making, problem-solving, attention, memory, spatial reasoning, and visuomotor tasks (Buelow et al., 2015; Y. Li et al., 2018). They also engage the somatosensory cortex and superior parietal lobule, aiding hand movement, coordination, and motor learning by integrating sensory stimuli (Momi et al., 2018). The limbic system, including the ventral striatum, nucleus accumbens, and anterior cingulate cortex, is activated during gameplay, influencing habit and behavior development through rewards and pleasure (Benady-Chorney et al., 2018, 2020; Koepp et al., 1998). This leads to

excitement, pleasure, and dopamine release (Benady-Chorney et al., 2018, 2020; Koepp et al., 1998; Phan-Hug et al., 2011). Experienced action video game players (who play regularly each week) compared to individuals with little or no experience show higher gamma waves during motor imagery, linked to improved memory and perception (Sepúlveda et al., 2014), while extended gaming sessions elevate beta waves, associated with focus and cognitive processing (S. S. and J. K. Das, 2017). Video games can lower cortisol levels, reducing stress (Mitsea et al., 2023), and immersive video games promote relaxation through endorphin release and enhanced alpha and theta brain activity (Beitle, 2021; GomezRomero-Borquez et al., 2023; Snodgrass et al., 2011).

In social gaming, video games can promote prosocial behavior, linked to oxytocin release, which fosters trust and cooperation (Annett & Berglund, 2015; De Dreu & Kret, 2016). Cooperative play enhances sociocognitive processes like attention orientation, agency perception, self-other discrimination, and perspective-taking (Liu et al., 2021). Additionally, male participants in the intergroup competition showed increased testosterone levels, suggesting that multiplayer games simulating cooperative competition are particularly appealing to young men, as they replicate male–male competition (Oxford et al., 2010).

A positive association between video game play and cognitive enhancement has been demonstrated, but generalizing these findings is limited by variability in game genres and individual player experience (E. Choi et al., 2020). Video games improve attention and working memory (Huang et al., 2017). Video games enhance coordination and motor learning, and integrate sensory information (Momi et al., 2018). They also improve the perception and manipulation of visual stimuli (Palaus et al., 2017) and promote probabilistic learning by encouraging efficient problem-solving (Schenk et al., 2017; Shute et al., 2015). Additionally, video games can be set up in a foreign language, providing immersive environments for second language acquisition (Zhang et al., 2017) and activating memory for versatile knowledge (Schenk et al., 2017). Video games are positively associated with well-being (Johannes et al., 2021), with studies showing that playing for up to two hours daily is correlated to higher life satisfaction (Yamaguchi, 2023), although not showing direct causal effects.

Most of the experimental research on video games discussed here has been conducted in controlled settings and lacks long-term real-life analysis, yet the data still suggest potential benefits. Additionally, video games have also been used as treatments and interventions to improve mental health in clinical settings (Schuurmans et al., 2018).

Mental Health Buffer and Treatments

Depression and anxiety are the most common mental health disorders globally, and video games, with their controlled scenarios and engaging features, can complement traditional therapies by enhancing cognitive skills like attention and information processing, offering an accessible, affordable, and stigma-free way to tackle mental health issues (Kowal et al., 2021).

Concerning anxiety, research found that specific video games reduce symptoms, alleviate social anxiety, and support anxiety prevention (Zayeni et al., 2020). Another study showed that web-based video games reduced anxiety in adolescent boys (Ohannessian, 2018). Casual video games, when prescribed, have been effective in lowering both state and trait anxiety in individuals with depression and anxiety (Fish et al., 2014). A comparison study found that playing Plants vs. Zombies four times a week (30-45-minute sessions) resulted in greater

anxiety reduction than traditional anxiolytic medication (Fish et al., 2018). Additionally, a study showed that video games can help reduce children's anxiety during preoperative preparation for day-case surgery in hospitals (Dwairej et al., 2020).

Regarding depression, controlling working memory is key to preventing rumination of persistent negative thinking, common in individuals with depression (Joormann, 2010). Action games like Boson X improve cognitive abilities and help reduce rumination (Kühn et al., 2018). Casual games like Bejeweled 2 have been shown to lower depression and anxiety symptoms with just short daily sessions (Pine et al., 2020). Video games also offer adaptive coping strategies, enhance well-being, and foster social engagement, helping manage moods and alleviate depressive symptoms (Colder Carras et al., 2018). Video games like Animal Crossing: New Horizons reduce loneliness and depressive symptoms by maintaining social interaction (L. Zhu, 2021), while World of Warcraft fosters emotional regulation by allowing players to manage various avatars with unique skills and social roles, helping them develop flexibility and reappraisal strategies (Granic et al., 2014). Also, the video game Mario Kart has been shown to improve mood among adolescents by boosting positive emotions and reducing negative feelings (Rieger et al., 2014).

Video games show therapeutic potential, particularly for children and the elderly with health or neurodiverse conditions (Yang et al., 2021). Video games can improve cognition, including reading skills, attention, and planning in typically developing children from 8-12 years old (Pasqualotto et al., 2022). For the elderly, video games enhance cognitive function, slow age-related decline, and improve quality of life (Abd-alrazaq et al., 2022). They also benefit those with neurodiverse conditions, aiding in general health promotion, rehabilitation, cognitive therapy for disorders like Alzheimer’s, and influencing health behaviors in mental disorders such as autism (Damaševičius et al., 2023). For physical health, video games help children with obesity improve exercise adherence and cardiovascular health (Comeras-Chueca et al., 2022). They also match traditional therapies like Constraint-Induced Movement Therapy in stroke rehabilitation, reducing the need for therapist involvement (Gauthier et al., 2022). Figure 3 summarizes this section.

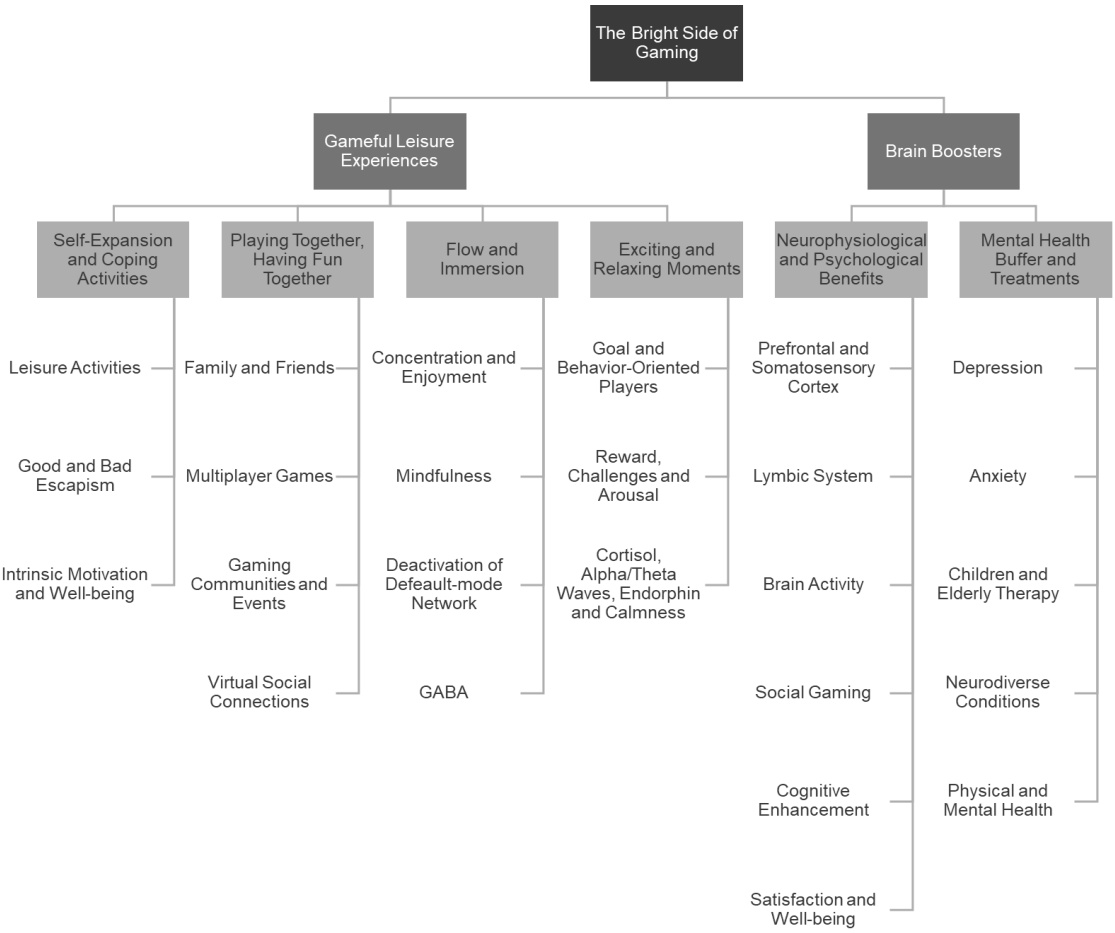

Figure 3: The Bright Side of Gaming

THE RISE OF GAMING IN EVERYDAY LIFE

Video games have become a significant part of everyday life (Muriel & Crawford, 2018), mediating socialization as they integrate media and ICT into modern culture (Kellner, 2004, 2020; Raessens, 2006). Socialization involves the interplay between individual actions and social structures, shaping cultural identity through internalizing societal norms, values, and behaviors (Bourdieu, 1990; Checkel, 2017; Costa & Murphy, 2015; Roksa & Robinson, 2017). Socialization influences neuroplasticity, affecting thoughts, behaviors, and emotions (Colagè & d'Errico, 2020). Neuroplasticity allows the brain to adapt and grow, while culture influences the stimuli that affect cognitive abilities such as literacy and tool use (Lende et al., 2021). Cultural differences impact neural patterns and brain structures (Domínguez Duque et al., 2010). The literature suggests viewing society and individuals through phylogenetic, ontogenetic, and cultural lenses to understand the ongoing interaction between biology, individual development, and society (Fabry, 2020; Gelfand & Kashima, 2016; Han & Ma, 2015; Kashima, 2016), as shown in Figure 4. Understanding this interaction is key to recognizing how and why video games have become integral to daily life.

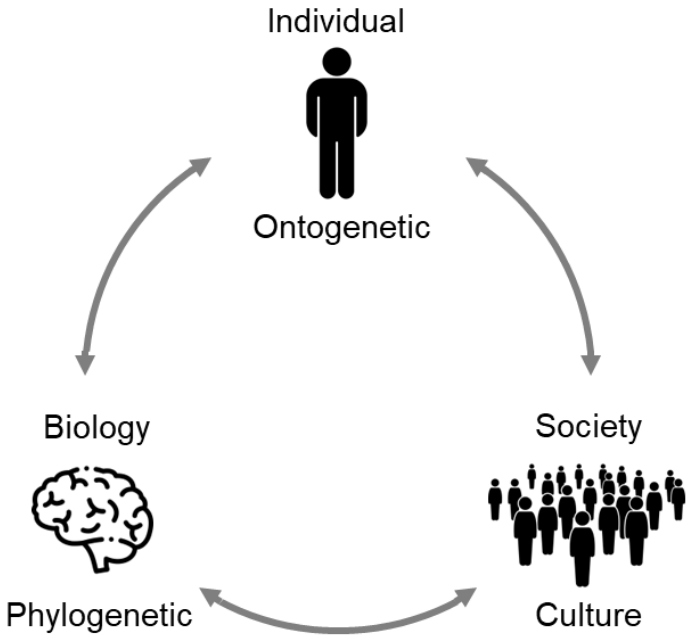

Figure 4: The Socialization Process

Boredom in a High-Stimulation Society

Neuroplasticity peaks during childhood and adolescence, making the brain highly sensitive to external stimuli (Lende et al., 2021). Immersive activities like video games engage the brain's dopamine system, crucial for reward processing and motivation (A. Weinstein & Lejoyeux, 2015). Dopamine regulates functions like locomotion, attention, and cognition, and changes in its availability during childhood can harm neurodevelopment, impacting brain structure and behavior (Areal & Blakely, 2020). Constant stimulation from video games and digital media makes the brain increasingly dependent on dopamine-driven pleasurable experiences (Guan & Chen, 2023). Frequent gaming can develop into habitual behaviors that may lead to addiction (van Elzelingen et al., 2022). Cyberculture, the spectacle society, and the ludification of culture immerse individuals in a digital environment, accessible anytime (Debord, 2021; Lévy, 2001; Raessens, 2006). This overstimulation, especially in youth, desensitizes the brain's reward system, leading to a preference for immediate rewards and weakening attentional capacities (Verma et al., 2024). The relentless pursuit of fleeting happiness fosters dissatisfaction (Lipovetsky, 2009; Lipovetsky et al., 2002). Boredom plays a crucial role in human functioning by reducing attention to tasks, increasing arousal, and motivating a desire for change, which leads to the pursuit of alternative goals and new opportunities for stimulation (Bench & Lench, 2013). It signals dissatisfaction and prompts the need for escape or change (Elpidorou, 2023). As society becomes more reliant on highly stimulating digital media, the cycle of seeking more stimulation intensifies, reinforcing the brain's dependence on immediate rewards and leaving little room for boredom.

Playing Brains and Resting Bodies

Play activities are essential for developing physical, social, communicative, and personal potential during socialization, especially in childhood (Serykh et al., 2021). Unlike traditional play, which involves physical presence and movement (Børve & Børve, 2017), video games are structured with set rules (Adams, 2014; Esposito, 2005). Non-active video games, more common than active ones that demand physical activity, are linked to increased sedentary time (Simons et al., 2015), reduced physical activity (Haug et al., 2022), and increased body mass, though the effect is small (Marker et al., 2022). The brain minimizes effort by avoiding tasks with higher demands (Patzelt et al., 2019) and evaluating costs and benefits through regions like the ventral striatum, anterior insula, and prefrontal cortex (Sescousse et al., 2013; Westbrook et al., 2019). Physical effort reduces an action's value (Kurniawan et al., 2010), making video games appealing due to their low physical demands and high rewards from dopamine release (Benady-Chorney et al., 2020). Interactions in virtual environments involve unique forms of embodiment and presence, where avatars enable interaction independent of the physical world, with social engagement being a key factor in creating presence (S. Evans, 2012). Video game avatars serve as tools for players, acting in virtual worlds as disembodied minds (Black, 2017), while modern relationships increasingly rely on screen-mediated interactions (Lemma, 2015). As video games advance, posthuman empathy examines the relationship between avatars and players, and machines and humans, focusing on aligning subjective and embodied experiences (Wilde & Evans, 2019). Digital experiences are becoming physically effortless, with humanized digital bodies, leading society toward interactions where the brain is active, but the body remains still.

Fun as Relief in a Stressful Society

As human civilization evolved from hunter-gatherer groups to modern societies, stress shifted from physical threats to self-inflicted psychosocial pressures due to societal expectations and productivity demands, leading to self-stress (Orquiza, 2024). Modern society grapples with wicked problems like climate change, global poverty, and systemic racism, which resist solutions and challenge policymakers, researchers, and citizens (Hipólito & Khanduja, 2024). These factors, along with social media and distressing news, have fueled anxiety and depression among youth (Brunette et al., 2023). Relieving stress is neurologically crucial to preventing chronic activation of the hypothalamic-pituitary-adrenal (HPA) axis, which otherwise leads to increased glucocorticoid levels, depression, cardiovascular issues, and cognitive decline (Ulrich-Lai et al., 2016). Preventing depression and anxiety is essential for brain health, as these conditions can impair the prefrontal cortex, which is responsible for emotional regulation and cognitive control (Zheng et al., 2024). Screens, including video games, are linked to mental health problems like stress and anxiety (Santos et al., 2024), though they also offer coping as a distraction and relaxation (Khalili-Mahani et al., 2019). Video games, while providing relief from daily stress and restoring mental well-being (Iacovides & Mekler, 2019; Stenseng et al., 2012), can harm mental health when used for self-suppression or addiction (Kim et al., 2022; Stenseng et al., 2021), blurring the line between healthy escapism and disconnection from reality as individuals may seek refuge from the complexities of society. Figure 5 summarizes this section.

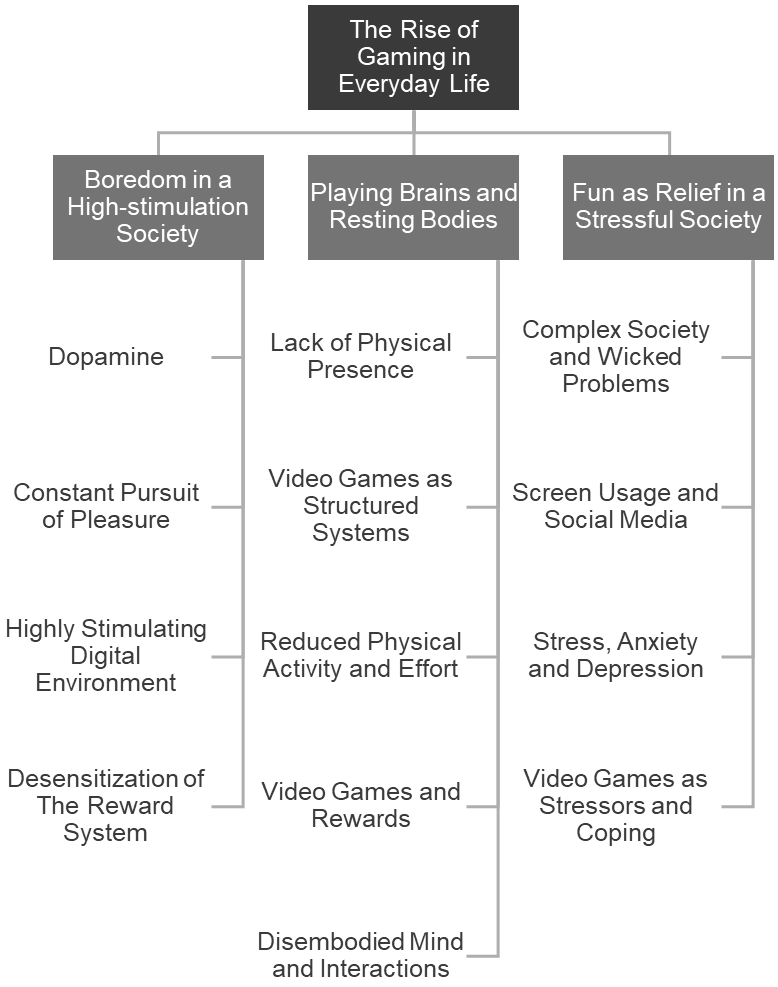

Figure 5: The Rise of Gaming in Everyday Life

DISCUSSION AND CRITICAL EVALUATION

The appeal of screens in youth presents societal risks, requiring attention from families, schools, governments, and companies. Balancing digital and physical play, while recognizing both the risks and benefits of video games, is crucial.

The Allure of Screen Flow on Youth

Given the critical neurodevelopmental stages of children and adolescents (Marzola et al., 2023) and the risk of addiction from excessive gaming (A. Weinstein & Lejoyeux, 2015; Wise & Jordan, 2021), monitoring gaming behavior and implementing protective measures is essential. Digital literacy is crucial for understanding technology's mental health impact (Lazonder et al., 2020). Open discussions among families, schools, governments, and companies are needed to foster healthy tech habits (Coelho & Abreu, 2025).

Parents shape child development (Terras & Ramsay, 2016), so setting recreational screen time limits according to guidelines (no screen time until 2 years, 1 hour for ages 2-5, and 2 hours for 5-17 years) is key (Joshi & Hinkley, 2021; McArthur et al., 2022). As digital tools integrate into education (Otterborn et al., 2019; Secretaria-Geral da Presidência et al., 2023), it is also necessary to consider this school screen time. It is crucial to mitigate the development of addictive behaviors, which often stem from habitual actions (van Elzelingen et al., 2022), avoiding repeating the same behavior in recurring contexts (Wood & Rünger, 2016) and limiting constant stimulation to prevent dopamine dependence (Guan & Chen, 2023). We recommend taking breaks during gameplay and avoiding making it a fixed habit by varying intervals and times. Since violent content can influence pathological behavior (Greitemeyer & Mügge, 2014), supervision through age ratings like the Entertainment Software Rating Board (ESRB) is crucial to prevent problematic content consumption (Duffy & Derevensky, 2022). Also, healthy behaviors should be adopted by parents and educators, not just children, as screens are often used for stress relief in front of children (McDaniel & Radesky, 2018; Whitbourne et al., 2013), reinforcing unhealthy behaviors (G. W. Evans et al., 2018).

Monetization in video games is evolving rapidly, raising concerns about digital consumption and mental health, especially regarding gambling-like elements (Denoo et al., 2024). Therefore, governments must regulate video games, which pose addiction risks, by enforcing transparency, setting age restrictions, regulating in-game money transactions, and controlling gambling elements, especially for minors (Lischer et al., 2022). Regarding companies, while making games less addictive could be a positive social contribution, this might reduce their appeal, enjoyment, and profitability (Király et al., 2018), making it an unrealistic option. However, video game companies can tackle these issues by promoting healthier gaming habits, such as rewarding breaks instead of extended gameplay, fostering collaborative digital environments, penalizing toxic behavior, enhancing parental controls and age restrictions, and encouraging real-world interactions, such as movement detection and GPS use. Figure 6 links the topics discussed previously.

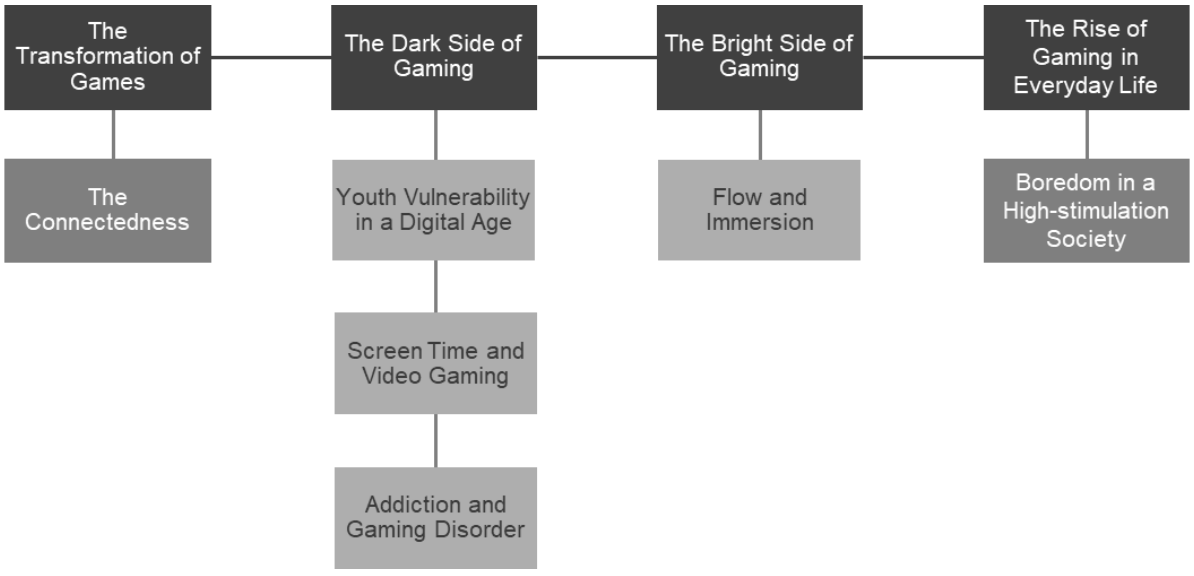

Figure 6: The Allure of Screen Flow on Youth

Balancing Digital and Physical Play

The decline in physical play is concerning, as free play is crucial for socio-emotional and cognitive development (Yogman et al., 2018). To balance this, physical activity and real-world interactions are crucial for mental health, helping offset the effects of digital culture (Abreu, 2022) and reducing anxiety (Weng & Chiang, 2014). Ensuring that gaming does not overshadow in-person activities is crucial, balancing technology use with real-life experiences. Physical presence and human interaction help reduce stress by boosting oxytocin and lowering cortisol (Estapé, 2021; Heinrichs et al., 2003). While gaming behavior appeals due to its low physical effort and high dopamine rewards (Benady-Chorney et al., 2020; Kurniawan et al., 2010), it is important not to let gaming encourage idleness and social isolation, prioritizing in-person interactions and free play whenever feasible. When that is not feasible, selecting active video games that involve physical movement (Simons et al., 2015) or those that promote positive social connections, such as "Couch co-op" games (Consalvo, 2017), can serve as suitable alternatives. Balancing digital and physical play fosters a healthier relationship with the world. Figure 7 links the topics discussed previously.

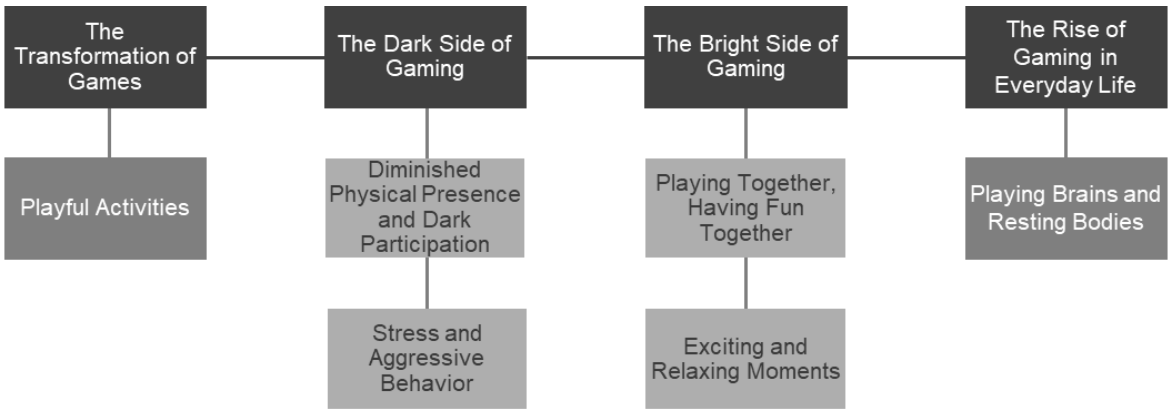

Figure 7: Balancing Digital and Physical Play

Navigating the Video Gaming World

In a stressful society facing social, economic, and health challenges (Orquiza, 2024), video games offer moments of relief and enjoyment (Iacovides & Mekler, 2019; Stenseng et al., 2012). Video games can enhance cognitive functions (Buelow et al., 2015; Momi et al., 2018), reduce stress (Beitle, 2021), offer therapeutic benefits for anxiety and depression (Ohannessian, 2018; Zayeni et al., 2020), cognitive rehabilitation for the elderly (Abd-alrazaq et al., 2022), and neurodiverse individuals (Damaševičius et al., 2023). However, video games can easily shift from beneficial to addiction (A. Weinstein & Lejoyeux, 2015), being associated with sedentarism (Simons et al., 2015), poor sleep (Handayani et al., 2021), compulsive eating (Caner & Evgin, 2021), self-suppression (Stenseng et al., 2021), and loneliness (J.-L. Wang et al., 2019). To prevent these negative effects, it is crucial to balance gaming with physical activities, avoid late-night sleeping, excessive screen time, and habit-forming gaming, while maintaining healthy eating, prioritizing social interactions, and responsibilities. Gaming

without these harmful behaviors can be seen as a healthy form of fun that promotes several cognitive benefits. However, since video games can be associated with such issues, it is essential to recognize problematic behaviors early on and address them before they escalate into pathological behaviors. Figure 8 links the topics discussed previously.

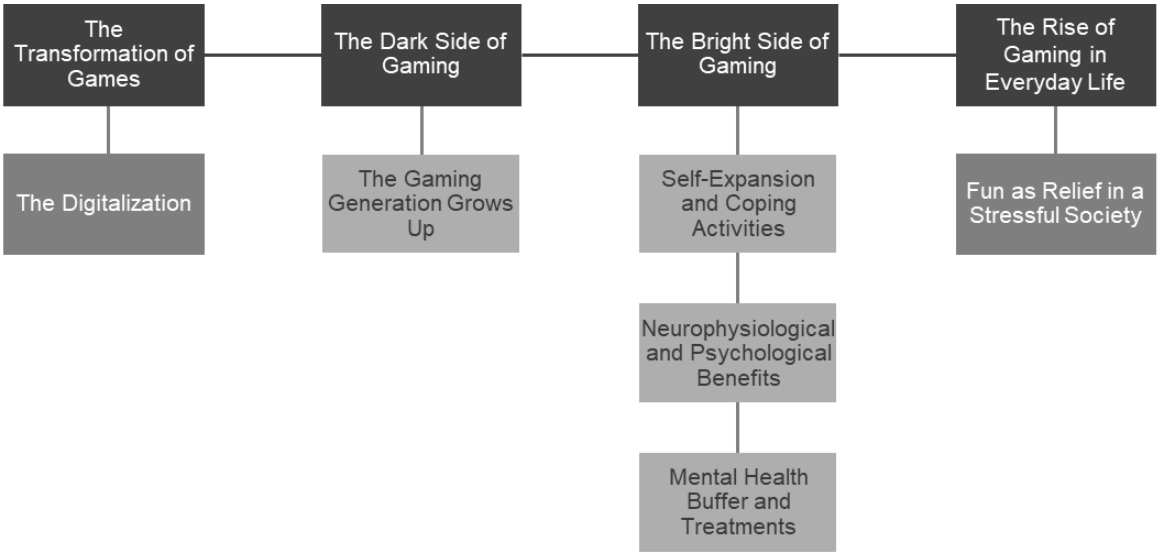

Figure 8: Navigating the Video Gaming World

CONCLUSION

This research examines the evolution of video games and their impact on the brain and society from a neurosociological perspective. We interconnected several themes in three key areas: first, the appeal of video games among youth raises concerns about addiction, especially during neurodevelopment. Second, we stressed the importance of balancing digital and physical play, as video games should not replace essential human interaction. Third, we advocate for a cautious yet open integration of video games into society, recognizing both the problematic behaviors and the cognitive and social benefits they offer. In each area, heightened awareness is essential, leading to carefully considered recommendations that address the roles of families, schools, governments, companies, and the players themselves. This research underscores the crucial role of new digital media and technology in mediating human development (Kyshtymova & Skorova, 2024), emphasizing the importance of recognizing video games as both a significant cultural phenomenon and a cognitive influence in contemporary society.

LIMITATIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

Much of the existing research has been conducted in controlled settings, which may not fully translate to real-world scenarios. We recommend future research using randomized controlled trials and meta-analyses for a further rigorous evaluation of insights discussed in this paper, but we advocate for studies in more ecological environments, integrating neuroscience and social sciences to better understand video games' impact beyond the lab. The lack of

neurosociological research about video games using advanced tools like hyperscanning highlights the need for such methods to analyze such social contexts, benefiting both neuroscience and sociology. Finally, although we did not focus on extended realities (XR) and artificial intelligence (AI), these technologies are poised to transform gaming by offering more immersive experiences and AI-driven content (Demers et al., 2020; G. Edwards et al., 2021; Newzoo, 2023). As these technologies evolve, they present both opportunities and risks, including addiction and disorders, requiring urgent interdisciplinary research to consider benefits and harms and prescribe safe and healthy guidelines.

IMPLICATIONS FOR RESEARCH, APPLICATIONS, AND POLICY

From a research and theoretical perspective, this study advances neurosociology by exploring how video games shape human interactions, neural processes, and behavioral patterns. Viewing video games as both a cultural and cognitive force, particularly for youth, provides insight into habit formation, reward mechanisms, and the socio-emotional impact of digital play. In practice, fostering healthier gaming habits requires cooperation among families, educators, game developers, and policymakers. Implementing digital literacy education, setting balanced screen time guidelines and habits, and promoting active or cooperative gaming can reduce risks like addiction and social isolation while enhancing cognitive and emotional well-being. At the policy level, governments should regulate monetization strategies, ensure transparency in in-game transactions, and enforce age-appropriate content guidelines. Meanwhile, gaming companies can integrate responsible design choices that promote healthier gaming behaviors without diminishing engagement. A holistic approach integrating research, education, and regulation is necessary to harness the positive potential of gaming while preventing its adverse effects on youth and society.

ACKNOWLEDGEMENTS

We express our sincere gratitude to FCT (Fundação para a Ciência e a Tecnologia) for the financial support. This work is financially supported by National Funds through FCT, I.P., under the projects UID/04279 - Centro de investigação Interdisciplinar em Saúde (CIIS) (https://doi.org/10.54499/UID/04279/2025); and 2022.10688.BD - Franz Coelho (https://doi.org/10.54499/2022.10688.BD)

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Human Technology
ISSN 1795-6889
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