



A critical review on the moderating role of contextual factors in the associations between video gaming and well-being

Andree Hartanto^{a,*}, Verity Y.Q. Lua^a, Frosch Y.X. Quek^a, Jose C. Yong^b, Matthew H.S. Ng^a

^a Singapore Management University, Singapore

^b Nanyang Technological University, Singapore

ARTICLE INFO

Keywords:

Video games
Contextual factors
Well-being
Depression
Anxiety

ABSTRACT

The appeal of video gaming has undoubtedly withstood the test of time. In view of its increasing popularity, lay people and researchers alike have taken an interest in the psychological consequences of video gaming. However, there seems to be a paradox associated with the effect of video gaming on gamers' well-being—namely, while most video game players cite “fun” as their motivation to play video games, video games continue to hold a notorious reputation among some researchers for being detrimental to mental health and emotional well-being as measured by indicators such as happiness, perceived stress, anxiety, and depressive symptoms. We suggest that a significant contributor to the mixed literature is the oversight of contextual factors that may moderate this relationship. The current review highlights five important contextual factors that should be considered when studying the associations between the frequency of video gaming and well-being. Specifically, we suggest that unless the social context (who), type (what), motivation (why), time and day (when), and amount (how much) of video gaming activities are adequately considered, examinations of well-being outcomes in relation to video gaming will remain incomplete.

Video games have been around since the 1950s (American Physical Society, 2008), and the appeal of video gaming has withstood the test of time. Between 2015 and 2020, the number of active gamers worldwide has risen from 1.99 billion to 2.69 billion, and this figure is projected to continue increasing (Clement, 2021). The purpose of video games is also increasingly diversifying such that their use extends well beyond the traditional arena of play to include cognitive, educational, physical, and mental health aspects (e.g., Chan, Kow, & Cheng, 2017; Colder Carras et al., 2017; Ferguson & Colwell, 2017; Green & Bavelier, 2012; Green & Seitz, 2015; Molyneux, Vasudevan, & de Zúñiga, 2015). In view of its popularity, laypersons and researchers alike have taken an interest in the effects of video games (Barlett, Anderson, & Swing, 2009; Cade & Gates, 2017; Ferguson, 2013; Ferguson, Copenhaver, & Markey, 2020; Hartanto, Toh, & Yang, 2016; Markey & Ferguson, 2017; Shaw, 2010). In particular, there is growing interest in the effects of video games on well-being because of a seemingly paradoxical feature of video gaming—while most video game players cite “fun” as their motivation to play video games (Reid, 2012), video games continue to hold a notorious reputation among some researchers for being detrimental to mental health and emotional well-being as measured by indicators like happiness, perceived stress, anxiety, and depressive symptoms (e.g.,

Gentile, Bender, & Anderson, 2017; Rehbein, Kleimann, & Mössle, 2010; Tortolero et al., 2014). Alongside the centrality of emotional well-being to almost all aspects of life outcomes (Hernandez et al., 2018; Huppert, 2009; Prince et al., 2007) as well as the rise of mental health issues among adolescent and young adults (Hidaka, 2012; Parodi et al., 2021; Steffen, Thom, Jacobi, Holstiege, & Bätzing, 2020), a careful examination of the links between video gaming and emotional well-being is warranted.

Findings from decades of research on the relationship between video gaming frequency and emotional well-being have been inconsistent and even contradictory. While some studies have found a negative correlation between video gaming and emotional well-being (Liu et al., 2018; Lo, Wang, & Fang, 2005; Madrigal-Pana, Gómez-Figueroa, & Moncada-Jiménez, 2018; Maras et al., 2015; Mikuška & Vazsonyi, 2018; Rehbein et al., 2010; Tortolero et al., 2014; Twenge & Campbell, 2019), a growing body of research has shown that video gaming is associated with higher levels of emotional well-being (Johannes, Vuorre, & Przybylski, 2021; Jones, Scholes, Johnson, Katsikitis, & Carras, 2014; Kühn, Berna, Lüdtke, Gallinat, & Moritz, 2018; Orben & Przybylski, 2019; Viana et al., 2017). Although these mixed findings may be due, in part, to the vastly different or suboptimal methodologies used to examine this

* Corresponding author. Singapore Management University, School of Social Sciences, 90 Stamford Road, Level 4, 178903, Singapore.

E-mail address: andreeh@smu.edu.sg (A. Hartanto).

<https://doi.org/10.1016/j.chbr.2021.100135>

Received 15 May 2021; Received in revised form 19 July 2021; Accepted 17 August 2021

Available online 18 August 2021

2451-9588/© 2021 The Authors.

Published by Elsevier Ltd.

This is an open access article under the CC BY-NC-ND license

(<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

relationship (Johannes et al., 2021; Odgers & Jensen, 2020) or potential third variables in numerous studies (Ophir, Lipshits-Braziler, & Rosenberg, 2020; Pallavicini, Ferrari, & Mantovani, 2018), we suggest that another significant contributor to the mixed literature is the insufficient consideration of contextual factors that may affect this relationship.

Numerous theories have been developed to explain how video gaming may harm well-being. One of the more popular explanations, namely the displacement hypothesis, posits that video gaming displaces time for players to engage in healthy activities (e.g., socializing, exercise; Williams, Yee, & Caplan, 2008), thus impairing health and well-being among gamers. Others have argued that video gaming causes poorer sleep (Peracchia & Curcio, 2018), which has also been found to be associated with poorer well-being (Ness & Saksvik-Lehoullier, 2018). A third line of argument suggests that the violence depicted in video games acts as a mediator between video gaming and poorer well-being (Flannery, 2016; Tortolero et al., 2014). Lastly, some have argued that poor psychological and emotional outcomes are an antecedent rather than a consequence of video gaming (e.g., Blasi et al., 2019; Loton, Borkoles, Lubman, & Polman, 2016). According to this view, those attracted to video gaming may have poorer well-being to begin with and use video games as a way to cope with negative emotional experiences. Regardless of their conclusions, these various theories are built on specific assumptions about video games that hold to different extents across contexts. Therefore, it is important that contextual factors are carefully considered when examining the relationship between video gaming and well-being.

Critical reviews that account for some contextual factors of video gaming in recent years (e.g., Adachi & Willoughby, 2017; Halbrook, O'Donnell, & Msetfi, 2019; Wiederhold, 2021), while undeniably important, often concentrate on a limited number of contextual components but overlook others that are also worth noting. Moreover, many reviews have focused on the domain of cognitive functions and aggression (Bavelier & Green, 2019; Choi et al., 2020; Dale & Green, 2017; Ferguson, Bowman, & Kowert, 2017), which were argued to correlate with video games through different assumptions and theoretical mechanisms. Hence, to guide interested researchers toward a more comprehensive assessment of the video gaming landscape, the current article highlights five important contextual factors that should be considered when studying the associations between video gaming frequency and well-being. More specifically, given the increasing complexities of modern video gaming that underlie nuances in its psychological effects (Dale & Green, 2017; also see a recent finding by; Klecka, Johnston, Bowman, & Green, 2021), we suggest that unless the social context (who), type (what), motivation (why), time and day (when), and amount (how much) of video gaming activities are considered, examinations of well-being outcomes in relation to video gaming will remain incomplete. In closing, the current article will elaborate on the challenges of studying these contextual factors and propose concrete and practical recommendations that researchers may utilize to overcome these challenges.

Who: the social context of video gaming

A common theory as to why video games may have a negative impact on well-being alludes to how video gaming is detrimental to gamers' social lives. According to the displacement hypothesis (Twenge, 2019; Williams et al., 2008), video gaming takes time away from players that could otherwise be spent on meaningful social interactions, thus negatively affecting gamers' mental health and well-being. Numerous studies have found converging evidence of the positive effects of social interactions on a wide array of factors underlying people's well-being (e.g., Berry & Hansen, 1996; Sandstrom & Dunn, 2014; Sun, Harris, & Vazire, 2020). Yet, the fact that technological advancements have paved the way for interactive online video gaming and the growing prevalence of multiplayer games in recent decades (K. Jones, 2020) indicates that this theory may not always be true. Social gaming, put simply, refers to

games that are played with multiple individuals either cooperatively or competitively (Halbrook et al., 2019; Kowert, Domahidi, Festl, & Quandt, 2014). In contrast, non-social games like single-player video games lack human interaction elements that are present in social games. Indeed, modern video games have been shown to benefit social capital outcomes including establishing and maintaining social relationships with other players (Perry et al., 2018). Unsurprisingly, video games with social elements have been shown to have similar positive effects as those associated with social interaction on gamers' social well-being (Kaye, Kowert, & Quinn, 2017; Longman, O'Connor, & Obst, 2009; Mandryk, Frommel, Armstrong, & Johnson, 2020). Moreover, socially oriented video games have been found to be associated with less problematic gaming symptoms compared to games with fewer or no social components (ColderCarras et al., 2017).

Just as important is the target of the interaction during social video gaming, which can affect the depth and quality of social interactions (Dubois, Bonezzi, & De Angelis, 2016). According to a survey conducted by the Pew Research Center (2015), while 89% of gamers play video games with friends they know in person, many gamers (54%) also play with people they have only met online. A substantial number also play video games with their families (Eklund, 2015). These differences in social dynamics may play a part in influencing how social video games affect a player's well-being. For instance, a study that examined differences in gaming with family, friends, and strangers concluded that players' level of engagement in video games varies as a function of who they play with (Eklund, 2015). Another study revealed that distinct empathic responses and prosocial behaviors were elicited by different social gaming targets (Fraser et al., 2012). As the social context of video games can differentially impact players' well-being, researchers should pay close attention to the "who" when exploring the associations between video gaming and well-being.

Why: the motivation behind video gaming

A second contextual factor that researchers should consider when examining the relationship between video gaming and well-being is the motivation behind the desire to play video games. Video gaming motivation has been largely explored through the lens of self-determination theory, which proposes that the inclination to play video games stems from players' needs for autonomy, competence, and relatedness (Przybylski, Rigby, & Ryan, 2010). Self-determination theory further suggests that individuals would experience enhancements in psychological well-being should these needs be fulfilled. Consistent with the theory's predictions, research has shown that people's well-being increments after video gaming were directly associated with the satisfaction of autonomy, competence, and relatedness needs (Ryan, Rigby, & Przybylski, 2006). On the other hand, when those needs are not met—which tends to occur when the play is solely driven by extrinsic motivation and players feel pressured to play—video gaming becomes negatively associated with well-being (Przybylski, Weinstein, Murayama, Lynch, & Ryan, 2012; Przybylski & Weinstein, 2019; Tamborini, Bowman, Eden, Grizzard, & Organ, 2010). These findings highlight the distinct effects of video gaming on well-being in accordance with the fulfillment (or non-fulfillment) of psychological needs as postulated by self-determination theory.

Aside from the fulfillment of autonomy, competence, and relatedness needs, another prevalent motivation that mediates the link between video gaming and well-being is the use of video gaming as a form of emotional coping. For instance, a study of 165 Multiplayer Online Battle Arena (MOBA) players showed that escapist motivation mediated the negative correlation between frequency of video gaming and indicators of psychological well-being, such as anxiety, insomnia, and depression (Goh, Jones, & Copello, 2019). Another study similarly found that participants' motivation to play video games as a form of distraction or to regulate negative emotions was associated with lower levels of life satisfaction, self-esteem, and trait positive affect (von der Heiden et al.,

2019). Interestingly, the same participants reported higher state positive affect while playing games, suggesting that video gaming might be a promising emotion regulation activity. This finding is consistent with an experimental study demonstrating that clinically depressed patients who were assigned to play an action video game had lower maladaptive rumination than those who were assigned to the wait-list control group (Kühn et al., 2018). Taken together, these findings highlight the importance of accounting for the motivations behind video gaming, as poorer psychological well-being may be a cause rather than a consequence of video gaming for those who use video games as a coping mechanism (Chak & Leung, 2004; Hartanto, Quek, Tng, & Yong, 2021; Ko et al., 2005). In fact, video gaming appears to be a promising activity in helping people cope temporarily with psychological distress.

What: the genre of video games

Another important context that influences the link between video gaming and well-being is the genre of video games. From action games to role-playing games and even gambling games, a wide variety of video game genres exist today. Yet, video gaming studies have tended to refer to video games as a general category (e.g., Gentile et al., 2011; Maras et al., 2015; Mikuška & Vazsonyi, 2018), neglecting the possibility that different video game genres have specific features that impose highly unique effects on well-being.

One of the most promising video game genres that can improve physical and psychological health outcomes is exergames—a genre that requires players to move physically in order to progress through the game. Consoles like the Nintendo Wii and Microsoft Kinect allow users to engage in a variety of exergames that incorporate psychomotor challenges, such as aerobic exercise routines (Kimhy et al., 2015) and dancing according to visual and rhythmic cues (Eggenberger, Wolf, Schumann, & de Bruin, 2016). Unlike the typical sedentary video game, exergames resemble moderate-intensity physical exercise with increased energy expenditure, heart rate, and oxygen consumption during gameplay (Haddock, 2012; Wu, Wu, & Chu, 2015). Considering the well-established psychological benefits of physical exercise (Zhang & Chen, 2019), exergames may likewise be highly beneficial for psychological health. Indeed, research on exergames has consistently revealed associations between higher frequency of playing exergames and better emotional outcomes, such as fewer depressive symptoms, reduced anxiety, and greater positive affect across different age groups (Viana et al., 2017; Zheng, Li, Salmon, & Theng, 2020). Thus, instead of taking time away from players to engage in physical exercise, exergames can actually serve as a fun source of exercise and motivate people to keep physically fit.

At the other end of the spectrum, violent video games have often been implicated as a cause of reduced emotional well-being (Kim & Ahn, 2016; C. M.; Weaver, Borkowski, & Whitman, 2008). Proponents of this view (e.g., Flannery, 2016; Tortolero et al., 2014) have argued that the intense and aggressive content of such games may induce anxiety and depression, citing research that found indirect exposure to real-life violence (e.g., as a witness of violent crime) to be associated with negative affectivity and poorer mental health (Fowler, Tompsett, Braciszewski, Jacques-Tiura, & Baltes, 2009; Gollub, Green, Richardson, Kaplan, & Shervington, 2019; Shukla and Wiesner, 2015). While evidence for the link between violent video games and depression is limited and contentious (Ferguson & Wang, 2019; Tortolero et al., 2014; Valadez & Ferguson, 2012), there is some preliminary evidence that playing violent video games compared to non-violent video games can increase stress levels as measured by cardiovascular activity, such as increased blood pressure, heart rate variability (Porter & Goolkasian, 2019), and cardiac coherence (Hasan, Bègue, & Bushman, 2013). However, this effect could be sex specific. For example, a study indicated that violent video game exposure increased stress only for girls, which was mainly attributed to the lack of familiarity over (and thus, frustration toward) the game's mechanics (Ferguson et al., 2016). Another study showed

that video gaming was associated with lower anxiety symptomatology in boys but was positively associated with higher anxiety symptomatology in girls, which was also attributed to the lack of preference toward violent video games among female video game players (Ohannessian, 2009, 2018). These various lines of research highlight the need to consider the role of gameplay preferences and mechanics, as well as how they affect players' enjoyment of video gaming and satisfaction of psychological needs, when analyzing the impact of video games on emotional outcomes.

When: the time and day of video gaming

The “when” factor, regarding the time and day of gaming, is another contextual aspect that may moderate the association between video gaming and well-being. Consider, for instance, the impact of video gaming at different times of the day on a key factor of health and well-being: sleep. Taking a zero-sum approach to time, the displacement hypothesis (Twenge, 2019; Williams et al., 2008) predicts that video gaming at night is more detrimental to well-being compared to daytime video gaming because of the loss of time that should be used for sleeping (King et al., 2013; Nie & Hillygus, 2002). Indeed, late-night video gamers reportedly feel that game time is “never enough” and are less capable of regulating themselves to get more sleep (King & Delfabbro, 2009). Unlike other well-being activities, such as social interaction or physical activities, the displacement of sleep cannot be mitigated by different types of gameplay, such as multiplayer, social, or exercise games. Thus, the displacement of sleep is unique compared to other types of displacement. Knowing that sleep deprivation can increase negative mood states like anxiety and depressive symptoms (Babson, Trainor, Feldner, & Blumenthal, 2010; Kahn-Greene, Killgore, Kamimori, Balkin, & Killgore, 2007), there is a need to consider the potential moderating effect of gaming time and pre-sleep gaming on the link between video gaming and well-being.

Some preliminary evidence exists on how the association between video gaming and well-being depends on day-versus night-time engagement. Video gaming has been shown to increase arousal and cognitive alertness, which suggests that late-night gaming may cause sleep disturbance (E. Weaver, Gradisar, Dohnt, Lovato, & Douglas, 2010). Additionally, sleep quality was found to mediate the positive correlation between night-time media usage before sleep and depressive symptoms (Adams & Kisler, 2013; Lemola, Perkinson-Gloor, Brand, Dewald-Kaufmann, & Grob, 2015). More importantly, a study of 646 adolescents and young adults showed that habitual computer gaming between 10pm and 6am was significantly associated with increased risk of depressive symptoms, and this effect was partly mediated by daytime sleepiness (Lemola et al., 2011). On the contrary, these associations were not found when gaming occurred at earlier timings.

Aside from the time of day, another temporal variable that may moderate the relationship between video gaming and well-being is whether video games are played on weekdays or weekends. Tracing back to the displacement hypothesis, weekday gaming usually forces the gamer to play later at night due to fixed day-time activities such as work or school, thereby decreasing the time available for sleep (Mahmassani, Chen, Huang, Williams, & Contractor, 2010). Meanwhile, playing on the weekends would less likely decrease gamers' overall sleep duration due to greater flexibility over their awake timings compared to playing on weekdays when awake periods are more rigid (Drummond & Sauer, 2019; Hartanto, Toh, & Yang, 2018; Roepke & Duffy, 2010). Supporting these predictions, a study found that sleep duration in children was more affected by gaming on weekdays than on weekends (Li et al., 2007). Similarly, a survey of 2546 secondary school students in Belgium demonstrated that frequent video gaming led to shorter sleep durations only on weekdays, whereas only the time of awakening was delayed while sleep duration was unperturbed on weekends (Van Den Bulck, 2004). Given that weekday gaming can result in inadequate sleep compared to weekend gaming and that a healthy circadian rhythm is

crucial for well-being (Lemola et al., 2011), weekday gaming is likely to be worse than weekend gaming for well-being. Indeed, a study on Swedish adolescents revealed that weekday gamers faced a higher probability of suffering from depressive, musculoskeletal, and psychosomatic symptoms than weekend gamers (Hellström, Nilsson, Leppert, & Åslund, 2015). Relatedly, studies on screen-time exposure and social media use, which have similar stimulating effects as video gaming on wakefulness and sleep (He et al., 2020; Levenson, Shensa, Sidani, Colclitz, & Primack, 2017; Munezawa et al., 2011), show that weekday consumption of media is more detrimental than weekend consumption (e.g., Garrett, Liu, & Young, 2018; Przybylski & Weinstein, 2017). Taken together, findings on the differential impact of the time and day of video gaming on well-being highlight the importance of taking temporal variables into account.

How much: excessive video gaming

Lastly, the excessiveness of video gaming is another important context that should be considered in studies of video gaming and well-being. From a displacement perspective, the negative effects of media use and video gaming in particular should be directly proportional to exposure or time spent on those activities. However, a growing number of studies have demonstrated a contrasting beneficial effect of moderate video gaming on emotional well-being and cognitive functioning, such as increased calmness, improved visuospatial processing, and better mood states (Durkin & Barber, 2002; Ferguson, 2007; C. M. Jones et al., 2014). To explain this phenomenon, researchers have proposed the digital Goldilocks hypothesis that media or technology use is not harmful at moderate levels and may even be advantageous, whereas excessive use can indeed displace time that would be better spent on well-being activities and thus jeopardize the user (Przybylski & Weinstein, 2017a). In other words, a moderate amount, rather than complete abstinence or excessive video gaming, would produce the most satisfactory outcomes for well-being. In support of the digital Goldilocks hypothesis, a large study of English adolescents revealed a concave downward quadratic relationship between screen time and mental well-being (Przybylski & Weinstein, 2017a). Similar studies on other electronic media activities have also demonstrated the same quadratic trend (e.g., Ferguson, 2017; Przybylski, Orben, & Weinstein, 2020; Przybylski & Weinstein, 2017b; Sanders, Parker, delPozo-Cruz, Noetel, & Lonsdale, 2019; Twenge & Campbell, 2018), although it is important to note that the effect sizes reported by these studies tend to be small.

While video game studies have largely and traditionally focused on the negative effects of gaming on well-being (Jones et al., 2014), related findings from the technology-use literature have cautioned against studies that only examine a linear relationship between video gaming and well-being. In fact, several studies have surfaced revealing that video gaming might, to some extent, be beneficial for well-being (Desai, Krishnan-Sarin, Cavallo, & Potenza, 2010; Durkin & Barber, 2002; Lemmens, Valkenburg, & Peter, 2011; Wang, Khoo, Liu, & Divakaran, 2008), thus highlighting the potential importance of viewing the amount of time spent on video gaming along a continuum and evaluating potential non-linear relations between video gaming and well-being.

Discussion and recommendations

The literature on video gaming and well-being is replete with mixed and inconclusive findings, and there is a widespread but problematic view of video games as a convenient culprit for poorer psychological outcomes. In light of these mixed and inconclusive findings, we emphasized the need to consider contextual factors (i.e., who, why, what, when, and how much) when performing research on the links between video gaming and well-being. As shown in our review of important contexts that moderate the psychological dynamics of video gaming, failure to account for contextual factors would render any

conclusions regarding the negative impact of video games on well-being premature. For instance, whether a video gamer is playing in isolation or engaging in social gaming with others (Kowert et al., 2014; Perry et al., 2018) or whether they were playing to fulfill their psychological needs or to cope with negative emotions (Ryan et al., 2006; Von Der Heiden et al., 2019) can lead to very different emotional well-being outcomes. Thus, we hope that the contexts specified in this paper will allow researchers to achieve greater nuance in their studies of video gaming effects.

While the various aforementioned contextual factors are individually important in their own way, there is also incremental value in examining the interactions between them as the effects of some contextual factors may be strengthened or diminished by others. For example, studies examining the benefits of social video gaming (who) revealed that improvements in psychological outcomes were greater among players who played moderately (how much) and for social purposes (why) compared to players who played excessively (Longman et al., 2009) with an achievement-oriented purpose (ColderCarras et al., 2017) or for escapism (Hagström & Kaldo, 2014). Similarly, a study indicated that the amount of time spent on video games (how much) and the day of video gaming (when) interactively influenced well-being such that video gaming in small amounts was related to improved psychological well-being during the weekends (a quadratic relationship), whereas video gaming of any duration was linearly associated with poorer psychological well-being during weekdays (Sanders et al., 2019). Hence, the knowledge gained from studying the interactions between multiple contextual factors is likely to be substantial.

Moving forward

While we stress the necessity of paying more attention to contextual factors in future investigations on video gaming and well-being, it is important to recognize that several factors, including the increasing complexity of video games, possible reverse causations, outdated measures of video game exposure, inaccuracy of self-reported video-gaming behavior, and issues related to publication bias and small effect sizes, can impose substantial difficulties on this endeavor. To provide interested scholars with clearer guidelines on how contextual video gaming effects can be examined, we discuss these challenges and propose several practical and concrete steps for future research to achieve a more holistic understanding of the relationship between video gaming and well-being.

One difficulty in capturing the contextual factors of video gaming is the ever-increasing complexity of video games. With the rise of online games and “hybrid genres” (Clement, 2021; Dale & Green, 2017), tracking differences in video gaming using categories such as genres may be increasingly unviable. Today, many popular games incorporate multiple game modes that allow players to choose whether they would like to play independently or with others. For example, popular games like World of Warcraft and Final Fantasy XIV allow players to not only pursue independent quests but also interact with and play alongside other players in the same online virtual world. Many games also incorporate and blend elements from multiple genres to appeal to a wider range of audiences. For instance, action-adventure video games (e.g., Star Wars Jedi: Fallen Order (2019), Marvel’s Spider-Man (2018)) engage players’ reflexes (like an action game) while also offering a storyline (like an adventure game). As such, focusing on traditional categories like genres to understand the effects of video gaming on well-being may no longer be ideal; instead, researchers should focus on how the mechanisms of video games affect well-being (see Dale & Green, 2017 for a comprehensive review). For example, rather than classifying games as “multiplayer” versus “single-player” games, researchers should consider asking participants to report *who* they interacted with while playing video games and the nature of those interactions to gain a richer understanding. Researchers can also ask players to describe the specific characteristics of the games they played,

such as whether they were exposed to violent or gory stimuli. By capturing the precise features of video games instead of relying on traditional classifications, researchers can examine with greater rigor the specific explanatory mechanisms (e.g., the displacement hypothesis, digital Goldilocks hypothesis, psychological benefits of physical exercise) that underlie the well-being effects of video gaming and elucidate the nuances of video gaming amidst an increasingly sophisticated video game market.

Additionally, the overwhelming use of cross-sectional designs in the current literature to uncover the psychological correlates of video gaming gives rise to a serious limitation: the inability to determine the causal nature of observed relationships. As mentioned earlier, some research has suggested that poorer well-being may be an antecedent to rather than a consequence of video gaming for individuals with certain motivations (Chak & Leung, 2004; Hartanto et al., 2021; Ko et al., 2005). Yet, cross-sectional studies do little to untangle the directionality of this relationship. We suggest the use of longitudinal daily diary designs with random intercept cross-lagged panel analysis or dynamic structural equation modelling to examine bidirectionality and the possibility of reverse-causation in future studies of video gaming and well-being (Asparouhov, Hamaker, & Muthén, 2018; Hamaker, Kuiper, & Grasman, 2015; Leszczensky & Wolbring, 2019). Researchers can, for example, measure gaming intentions as well as fluctuations in gaming behaviors and emotional well-being over time, which will allow for a comprehensive examination of how the motivation to play may moderate the longitudinal association between video gaming and well-being in an ecological and temporal context.

Apart from study design, there is a need to move from self-report assessments of time spent on video games to objective data-logged measurements of actual video gaming activity to allow for more precise observations of video-gaming habits, which speak particularly to the “when” and “how much” factors. Recent studies have shown that subjective evaluations of screen time are often inaccurate, biased, and vulnerable to memory distortion (Hodes & Thomas, 2021; Parry et al., 2021; Shaw et al., 2020). This is especially true for video gaming—because of the habitual and engaging nature of video gaming, video gamers may lose track of time and underestimate how long they spend on games, resulting in inaccurate reports of actual video gaming (Bisson & Grondin, 2013). Objective data-logged measures can facilitate the collection of highly accurate and precise data on the time and day of video gaming, and numerous widely used gaming platforms (e.g., Steam), consoles (e.g., Nintendo Switch, PS4), and games (e.g., FIFA 21, Uncharted 4) already have in-built time trackers detailing how much time one spends on a game (Singh, 2020; Stanton, 2019, 2020). Even for mobile games, the in-built iOS and Android Screen Time functions have been shown to be reliable in assessing screen time (Ohme et al., 2020). Future research should tap on these available features to improve data quality, through which a better understanding of how time spent and time and day of video gaming might differentially affect well-being can be attained.

Next, the examination of excessive video gaming (the “how much” context) based on the digital Goldilocks hypothesis should not rely solely on the quadratic trend of time spent on video games. As mentioned earlier, evidence of the quadratic effect of screen time on emotional well-being is somewhat tenuous with inconsistent results and small effect sizes, which may have occurred because time spent on video gaming does not account for differences between positive and negative video gaming experiences as well as between problematic and normative video gaming engagements (Charlton, 2002). We suggest the use of longitudinal methods to track how video gaming interferes with important life needs and responsibilities and how this interference may predict emotional well-being (Ferguson, Coulson, & Barnett, 2011). This operationalization of excessive video gaming will allow researchers to rigorously assess whether excessive video gaming is problematic or simply the symptoms of underlying mental health problems.

Lastly, other than accounting for the proposed contextual factors, it

is also crucial that researchers embrace transparent scientific practices when investigating the links between video gaming and emotional well-being, such as pre-registration of studies and the utilization of the open science framework. Despite the benefits of pre-registration in reducing false positives and confirmation bias (Simmons, Nelson, & Simonsohn, 2020), only a few studies of video gaming and well-being were pre-registered (Ferguson & Wang, 2021; Orben & Przybylski, 2019). As publication bias and undisclosed flexibility in data analysis have been observed in the video gaming literature (e.g., Ferguson & Wang, 2021; Hilgard, Engelhardt, & Rouder, 2017; Przybylski & Weinstein, 2019), the utilization of open science practices can enhance the quality of research on how video gaming and emotional well-being are connected. Furthermore, closer scrutiny of the literature on video gaming and well-being has revealed that many of the effect sizes reported in previous studies were small despite the significant *p* values found (e.g., Lobel, Engels, Stone, Burk, & Granic, 2017; Maras et al., 2015; Przybylski & Weinstein, 2017a; Tortolero et al., 2014). Thus, it is of paramount importance that future studies use consistent effect size reporting, perform replications with larger sample sizes, and pay more attention to the interpretation of effect size estimates and the crud factor (Orben & Lakens, 2020; for a guide on effect size, see; Ferguson, 2009).

Conclusion

In sum, many theories and studies that attempt to explain the links between video gaming and well-being in the current literature are based on a limited understanding of the contextual factors associated with video gaming. Drawing on research that has demonstrated important variations in the relationships between video gaming and well-being as a function of context, we stress that a careful consideration of contextual factors can help researchers reconcile conflicting observations in the current literature and execute more robust investigations of these relationships. While the factors we highlighted may not be exhaustive, we hope that the current paper serves as an important step toward uncovering the rich complexities that underlie video gaming and well-being.

Declaration of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

This research was supported by a grant awarded to Andree Hartanto by Singapore Management University through research grants from the Ministry of Education Academy Research Fund Tier 1 (20-C242-SMU-001) and Lee Kong Chian Fund for Research Excellence. We thank Nadya Majeed for her comments on the earlier version of the manuscript.

References

- Adachi, P. J. C., & Willoughby, T. (2017). The link between playing video games and positive youth outcomes. *Child Development Perspectives*, 11(3), 202–206. <https://doi.org/10.1111/cdep.12232>.
- Adams, S. K., & Kislir, T. S. (2013). Sleep quality as a mediator between technology-related sleep quality, depression, and anxiety. *Cyberpsychology, Behavior, and Social Networking*, 16(1), 25–30. <https://doi.org/10.1089/cyber.2012.0157>.
- American Physical Society. (2008). This month in physics history. *APS News*, 17(9), 2. <http://www.aps.org/publications/apsnews/200810/physicshistory.cfm>.
- Asparouhov, T., Hamaker, E. L., & Muthén, B. (2018). Dynamic structural equation models. *Structural Equation Modeling: A Multidisciplinary Journal*, 25(3), 359–388. <https://doi.org/10.1080/10705511.2017.1406803>.
- Babson, K. A., Trainor, C. D., Feldner, M. T., & Blumenthal, H. (2010). A test of the effects of acute sleep deprivation on general and specific self-reported anxiety and depressive symptoms: An experimental extension. *Journal of Behavior Therapy and Experimental Psychiatry*, 41(3), 297–303. <https://doi.org/10.1016/j.jbtep.2010.02.008>.

- Barlett, C. P., Anderson, C. A., & Swing, E. L. (2009). Video game effects—confirmed, suspected, and speculative: A review of the evidence. *Simulation & Gaming*, 40(3), 377–403. <https://doi.org/10.1177/1046878108327539>.
- Bavelier, D., & Green, C. S. (2019). Enhancing attentional control: Lessons from action video games. *Neuron*, 104(1), 147–163. <https://doi.org/10.1016/j.neuron.2019.09.031>.
- Berry, D. S., & Hansen, J. S. (1996). Positive affect, negative affect, and social interaction. *Journal of Personality and Social Psychology*, 71(4), 796–809. <https://doi.org/10.1037/0022-3514.71.4.796>.
- Bisson, N., & Grondin, S. (2013). Time estimates of internet surfing and video gaming. *Timing & Time Perception*, 1(1), 39–64. <https://doi.org/10.1163/22134468-00002002>.
- Blasi, M. D. I., Giardina, A., Giordano, C., Coco, G. L. O., Tosto, C., Billieux, J., et al. (2019). Problematic video game use as an emotional coping strategy: Evidence from a sample of MMORPG gamers. *Journal of Behavioral Addictions*, 8(1), 25–34. <https://doi.org/10.1556/2006.8.2019.02>.
- Cade, R., & Gates, J. (2017). Gamers and video game culture: An introduction for counselors. *The Family Journal*, 25(1), 70–75. <https://doi.org/10.1177/1066480716679809>.
- Chak, K., & Leung, L. (2004). Shyness and locus of control as predictors of internet addiction and internet use. *CyberPsychology and Behavior*, 7(5), 559–570. <https://doi.org/10.1089/cpb.2004.7.559>.
- Chan, A., Kow, R., & Cheng, J. K. (2017). Adolescents' perceptions on smartphone applications (apps) for health management. *Journal of Mobile Technology in Medicine*, 6(2), 47–55. <https://doi.org/10.7309/jmtm.6.2.6>.
- Charlton, J. P. (2002). A factor-analytic investigation of computer 'addiction' and engagement. *British Journal of Psychology*, 93(3), 329–344. <https://doi.org/10.1348/000712602760146242>.
- Choi, E., Shin, S.-H., Ryu, J.-K., Jung, K.-I., Kim, S.-Y., & Park, M.-H. (2020). Commercial video games and cognitive functions: Video game genres and modulating factors of cognitive enhancement. *Behavioral and Brain Functions*, 16(1), 1–14. <https://doi.org/10.1186/s12993-020-0165-z>.
- Clement, J. (2021, May 26). *Online PC gaming market value worldwide 2011-2025*. Statista. <https://www.statista.com/statistics/292516/pc-online-game-market-value-worldwide/>.
- Colder Carras, M., Van Rooij, A. J., Van de Mheen, D., Musci, R., Xue, Q. L., & Mendelson, T. (2017). Video gaming in a hyperconnected world: A cross-sectional study of heavy gaming, problematic gaming symptoms, and online socializing in adolescents. *Computers in Human Behavior*, 68, 472–479. <https://doi.org/10.1016/j.chb.2016.11.060>.
- Dale, G., & Green, S. C. (2017). The changing face of video games and video gamers: Future directions in the scientific study of video game play and cognitive performance. *Journal of Cognitive Enhancement*, 1(3), 280–294. <https://doi.org/10.1007/s41465-017-0015-6>.
- Desai, R. A., Krishnan-Sarin, S., Cavallo, D., & Potenza, M. N. (2010). Video-gaming among high school students: Health correlates, gender differences, and problematic gaming. *Pediatrics*, 126(6), 1414–1424. <https://doi.org/10.1542/peds.2009-2706>.
- Drummond, A., & Sauer, J. (2019). Timesplitters: Playing video games before (but not after) school on weekdays is associated with poorer adolescent academic performance. A test of competing theoretical accounts. *Computers & Education*, 144, Article 103704. <https://doi.org/10.1016/j.compedu.2019.103704>.
- Dubois, D., Bonezzi, A., & De Angelis, M. (2016). Sharing with friends versus strangers: How interpersonal closeness influences Word-of-Mouth Valence. *Journal of Marketing Research*, 53(5), 712–727. <https://doi.org/10.1509/jmr.13.0312>.
- Durkin, K., & Barber, B. (2002). Not so doomed: Computer game play and positive adolescent development. *Journal of Applied Developmental Psychology*, 23(4), 373–392. [https://doi.org/10.1016/S0193-3973\(02\)00124-7](https://doi.org/10.1016/S0193-3973(02)00124-7).
- Eggenberger, P., Wolf, M., Schumann, M., & de Bruin, E. D. (2016). Exergame and balance training modulate prefrontal brain activity during walking and enhance executive function in older adults. *Frontiers in Aging Neuroscience*, 8(APR), 66. <https://doi.org/10.3389/fnagi.2016.00066>.
- Eklund, L. (2015). Playing video games together with others: Differences in gaming with family, friends and strangers. *Journal of Gaming & Virtual Worlds*, 7(3), 259–277. <https://doi.org/10.1386/jgvw.7.3.259.1>.
- Ferguson, C. J. (2007). The good, the bad and the ugly: A meta-analytic review of positive and negative effects of violent video games. *The Psychiatric Quarterly*, 78(4), 309–316. <https://doi.org/10.1007/s11126-007-9056-9>.
- Ferguson, C. J. (2009). An effect size primer: A guide for clinicians and researchers. *Professional Psychology: Research and Practice*, 40(5), 532–538. <https://doi.org/10.1037/a0015808>.
- Ferguson, C. J. (2013). Violent video games and the supreme court: Lessons for the scientific community in the wake of Brown v. Entertainment Merchants Association. *American Psychologist*, 68(2), 57–74. <https://doi.org/10.1037/a0030597>.
- Ferguson, C. J. (2017). Everything in moderation: Moderate use of screens unassociated with child behavior problems. *Psychiatric Quarterly*, 88(4), 797–805. <https://doi.org/10.1007/s11126-016-9486-3>.
- Ferguson, C. J., Bowman, N. D., & Kowert, R. (2017). Is the link between games and aggression more about the player, less about the game? In P. Sturmeijer (Ed.), *The Wiley handbook of violence and aggression*. John Wiley & Sons Ltd. <https://doi.org/10.1002/9781119057574.whbva036>.
- Ferguson, C. J., & Colwell, J. (2017). Understanding why scholars hold different views on the influences of video games on public health. *Journal of Communication*, 67(3), 305–327. <https://doi.org/10.1111/jcom.12293>.
- Ferguson, C. J., Copenhaver, A., & Markey, P. (2020). Reexamining the findings of the American psychological association's 2015 task force on violent media: A meta-analysis. *Perspectives on Psychological Science*, 15(6), 1423–1443. <https://doi.org/10.1177/1745691620927666>.
- Ferguson, C. J., Coulson, M., & Barnett, J. (2011). A meta-analysis of pathological gaming prevalence and comorbidity with mental health, academic and social problems. *Journal of Psychiatric Research*, 45(12), 1573–1578. <https://doi.org/10.1016/j.jpsychires.2011.09.005>.
- Ferguson, C. J., Trigani, B., Pilato, S., Miller, S., Foley, K., & Barr, H. (2016). Violent video games don't increase hostility in teens, but they do stress girls out. *Psychiatric Quarterly*, 87(1), 49–56. <https://doi.org/10.1007/s11126-015-9361-7>.
- Ferguson, C. J., & Wang, J. C. K. (2019). Aggressive video games are not a risk factor for mental health problems in youth: A longitudinal study. *Cyberpsychology, Behavior, and Social Networking*, 24(1), 70–73. <https://doi.org/10.1089/cyber.2020.0027>.
- Ferguson, C. J., & Wang, C. K. J. (2021). Aggressive video games are not a risk factor for mental health problems in youth: A longitudinal study. *Cyberpsychology, Behavior, and Social Networking*, 24(1), 70–73. <https://doi.org/10.1089/cyber.2020.0027>.
- Flannery, D. J. (2016). *Here's how witnessing violence harms children's mental health*. The Conversation. <https://theconversation.com/heres-how-witnessing-violence-harms-childrens-mental-health-91971>.
- Fowler, P. J., Tompsett, C. J., Braciszewski, J. M., Jacques-Tiura, A. J., & Baltes, B. B. (2009). Community violence: A meta-analysis on the effect of exposure and mental health outcomes of children and adolescents. *Development and Psychopathology*, 21(1), 227–259. <https://doi.org/10.1017/S0954579409000145>.
- Fraser, A. M., Padilla-Walker, L. M., Coyne, S. M., Nelson, L. J., & Stockdale, L. A. (2012). Associations between violent video gaming, empathic concern, and prosocial behavior toward strangers, friends, and family members. *Journal of Youth and Adolescence*, 41(5), 636–649. <https://doi.org/10.1007/s10964-012-9742-2>.
- Garett, R., Liu, S., & Young, S. D. (2018). The relationship between social media use and sleep quality among undergraduate students. *Information, Communication & Society*, 21(2), 163–173. <https://doi.org/10.1080/1369118X.2016.1266374>.
- Gentile, D. A., Bender, P. K., & Anderson, C. A. (2017). Violent video game effects on salivary cortisol, arousal, and aggressive thoughts in children. *Computers in Human Behavior*, 70, 39–43. <https://doi.org/10.1016/j.chb.2016.12.045>.
- Gentile, D. A., Choo, H., Liau, A., Sim, T., Li, D., Fung, D., et al. (2011). Pathological video game use among youths: A two-year longitudinal study. *Pediatrics*, 127(2), 319–329. <https://doi.org/10.1542/peds.2010-1353>.
- Goh, C., Jones, C., & Copello, A. (2019). A further test of the impact of online gaming on psychological wellbeing and the role of play motivations and problematic use. *Psychiatric Quarterly*, 90(4), 747–760. <https://doi.org/10.1007/s11126-019-09656-x>.
- Gollub, E. L., Green, J., Richardson, L., Kaplan, I., & Shervington, D. (2019). Indirect violence exposure and mental health symptoms among an urban public-school population: Prevalence and correlates. *PLoS One*, 14(11), Article e0224499. <https://doi.org/10.1371/journal.pone.0224499>.
- Green, C. S., & Bavelier, D. (2012). Learning, attentional control and action video games. *Current Biology*, 22(6), R197–R206. <https://doi.org/10.1016/j.cub.2012.02.012>.
- Green, C. S., & Seitz, A. R. (2015). The impacts of video games on cognition (and how the government can guide the industry). *Policy Insights from the Behavioral and Brain Sciences*, 2(1), 101–110. <https://doi.org/10.1177/2372732215601121>.
- Haddock, B. (2012). Measurement of energy expenditure while playing exergames at a self-selected intensity. *The Open Sports Sciences Journal*, 5, 1–6. <https://doi.org/10.2174/1875399X01205010001>.
- Hagström, D., & Kaldo, V. (2014). Escapism among players of MMORPGs—conceptual clarification, its relation to mental health factors, and development of a new measure. *Cyberpsychology, Behavior, and Social Networking*, 17(1), 19–25. <https://doi.org/10.1089/cyber.2012.0222>.
- Halbrook, Y. J., O'Donnell, A. T., & Msetfi, R. M. (2019). When and how video games can be good: A review of the positive effects of video games on well-being. *Perspectives on Psychological Science*, 14(6), 1096–1104. <https://doi.org/10.1177/1745691619863807>.
- Hamaker, E. L., Kuiper, R. M., & Grasman, R. P. P. (2015). A critique of the cross-lagged panel model. *Psychological Methods*, 20(1), 102–116. <https://doi.org/10.1037/a0038889>.
- Hartanto, A., Quek, F. Y. X., Tng, G. Y. Q., & Yong, J. C. (2021). Does social media use increase depressive symptoms? A reverse causation perspective. *Frontiers in Psychiatry*, 12, 641934. <https://doi.org/10.3389/fpsy.2021.641934>.
- Hartanto, A., Toh, W. X., & Yang, H. (2016). Age matters: The effect of onset age of video game play on task-switching abilities. *Attention, Perception, & Psychophysics*, 78, 1125–1136. <https://doi.org/10.3758/s13414-016-1068-9>.
- Hartanto, A., Toh, W. X., & Yang, H. (2018). Context counts: The different implications of weekday and weekend video gaming for academic performance in mathematics, reading, and science. *Computers and Education*, 120, 51–63. <https://doi.org/10.1016/j.compedu.2017.12.007>.
- Hasan, Y., Bègue, L., & Bushman, B. J. (2013). Violent video games stress people out and make them more aggressive. *Aggressive Behavior*, 39(1), 64–70. <https://doi.org/10.1002/ab.21454>.
- von der Heiden, J. M., Braun, B., Müller, K. W., & Egloff, B. (2019). The association between video gaming and psychological functioning. *Frontiers in Psychology*, 10 (JULY), 1731. <https://doi.org/10.3389/fpsyg.2019.01731>.
- Hellström, C., Nilsson, K. W., Leppert, J., & Åslund, C. (2015). Effects of adolescent online gaming time and motives on depressive, musculoskeletal, and psychosomatic symptoms. *Upsala Journal of Medical Sciences*, 120(4), 263–275. <https://doi.org/10.3109/03009734.2015.1049724>.
- Hernandez, R., Cheung, E., Liao, M., Boughton, S. W., Tito, L. G., & Sarkisian, C. (2018). The association between depressive symptoms and cognitive functioning in older hispanic/latino adults enrolled in an exercise intervention: Results from the

- “¡Caminemos!” study. *Journal of Aging and Health*, 30(6), 843–862. <https://doi.org/10.1177/0898264317696776>.
- He, J., Tu, Z., Xiao, L., Su, T., & Tang, Y. (2020). Effect of restricting bedtime mobile phone use on sleep, arousal, mood, and working memory: A randomized pilot trial. *PLoS One*, 15(2), Article e0228756. <https://doi.org/10.1371/journal.pone.0228756>.
- Hidaka, B. H. (2012). Depression as a disease of modernity: Explanations for increasing prevalence. *Journal of Affective Disorders*, 140(3), 205–214. <https://doi.org/10.1016/j.jad.2011.12.036>.
- Hilgard, J., Engelhardt, C. R., & Roudier, J. N. (2017). Overstated evidence for short-term effects of violent games on affect and behavior: A reanalysis of Anderson et al. *Psychological Bulletin*, 143(7), 757–774. <https://doi.org/10.1037/bul0000074>, 2010.
- Hodes, L. N., & Thomas, K. G. F. (2021). Smartphone screen time: Inaccuracy of self-reports and influence of psychological and contextual factors. *Computers in Human Behavior*, 115, Article 106616. <https://doi.org/10.1016/j.chb.2020.106616>.
- Huppert, F. A. (2009). Psychological well-being: Evidence regarding its causes and consequences. *Applied Psychology: Health and Well-Being*, 1(2), 137–164. <https://doi.org/10.1111/j.1758-0854.2009.01008.x>.
- Johannes, N., Vuorre, M., & Przybylski, A. K. (2021). Video game play is positively correlated with well-being. *Royal Society Open Science*, 8(202049), Article 202049. <https://doi.org/10.1098/rsos.202049>.
- Jones, K. (2020). Online gaming: The rise of a multi-billion dollar industry. In *Visual capitalist*. <https://www.visualcapitalist.com/online-gaming-the-rise-of-a-multi-billion-dollar-industry/>.
- Jones, C. M., Scholes, L., Johnson, D., Katsikitis, M., & Carras, M. C. (2014). Gaming well: Links between videogames and flourishing mental health. *Frontiers in Psychology*, 5 (MAR), 260. <https://doi.org/10.3389/fpsyg.2014.00260>.
- Kahn-Greene, E. T., Killgore, D. B., Kamimori, G. H., Balkin, T. J., & Killgore, W. D. S. (2007). The effects of sleep deprivation on symptoms of psychopathology in healthy adults. *Sleep Medicine*, 8(3), 215–221. <https://doi.org/10.1016/j.sleep.2006.08.007>.
- Kaye, L. K., Kowert, R., & Quinn, S. (2017). The role of social identity and online social capital on psychosocial outcomes in MMO players. *Computers in Human Behavior*, 74, 215–223. <https://doi.org/10.1016/j.chb.2017.04.030>.
- Kim, H. H. S., & Ahn, S. J. G. (2016). How does neighborhood quality moderate the association between online video game play and depression? A population-level analysis of Korean students. *Cyberpsychology, Behavior, and Social Networking*, 19 (10), 628–634. <https://doi.org/10.1089/cyber.2016.0155>.
- Kimhy, D., Vakhushcheva, J., Bartels, M. N., Armstrong, H. F., Ballon, J. S., Khan, S., et al. (2015). The impact of aerobic exercise on brain-derived neurotrophic factor and neurocognition in individuals with schizophrenia: A single-blind, randomized clinical trial. *Schizophrenia Bulletin*, 41(4), 859–868. <https://doi.org/10.1093/schbul/sbv022>.
- King, D. L., & Delfabbro, P. (2009). Motivational differences in problem video game play. *Journal of Cyber Therapy and Rehabilitation*, 2(2), 139–149.
- King, D. L., Gradisar, M., Drummond, A., Lovato, N., Wessel, J., Micic, G., et al. (2013). The impact of prolonged violent video-gaming on adolescent sleep: An experimental study. *Journal of Sleep Research*, 22(2), 137–143. <https://doi.org/10.1111/j.1365-2869.2012.01060.x>.
- Klecka, H., Johnston, I., Bowman, N. D., & Green, C. S. (2021). Researchers' commercial video game knowledge associated with differences in beliefs about the impact of gaming on human behavior. *Entertainment Computing*, 38, Article 100406. <https://doi.org/10.1016/j.entcom.2021.100406>.
- Kowert, R., Domahidi, E., Festl, R., & Quandt, T. (2014). Social gaming, lonely life? The impact of digital game play on adolescents' social circles. *Computers in Human Behavior*, 36, 385–390. <https://doi.org/10.1016/j.chb.2014.04.003>.
- Ko, C.-H., Yen, C.-F., Yen, C.-N., Yen, J.-Y., Chen, C.-C., & Chen, S.-H. (2005). Screening for internet addiction: An empirical study on cut-off points for the Chen internet addiction scale. *The Kaohsiung Journal of Medical Sciences*, 21(12), 545–551. [https://doi.org/10.1016/S1607-551X\(09\)70206-2](https://doi.org/10.1016/S1607-551X(09)70206-2).
- Kühn, S., Berna, F., Lüdtke, T., Gallinat, J., & Moritz, S. (2018). Fighting depression: Action video game play may reduce rumination and increase subjective and objective cognition in depressed patients. *Frontiers in Psychology*, 9(FEB), 129. <https://doi.org/10.3389/fpsyg.2018.00129>.
- Lemmens, J. S., Valkenburg, P. M., & Peter, J. (2011). Psychosocial causes and consequences of pathological gaming. *Computers in Human Behavior*, 27(1), 144–152. <https://doi.org/10.1016/j.chb.2010.07.015>.
- Lemola, S., Brand, S., Vogler, N., Perkinson-Gloor, N., Allemand, M., & Grob, A. (2011). Habitual computer game playing at night is related to depressive symptoms. *Personality and Individual Differences*, 51(2), 117–122. <https://doi.org/10.1016/j.paid.2011.03.024>.
- Lemola, S., Perkinson-Gloor, N., Brand, S., Dewald-Kaufmann, J. F., & Grob, A. (2015). Adolescents' electronic media use at night, sleep disturbance, and depressive symptoms in the smartphone age. *Journal of Youth and Adolescence*, 44(2), 405–418. <https://doi.org/10.1007/s10964-014-0176-x>.
- Lenhart, A., Smith, A., Anderson, M., Duggan, M., & Perrin, A. (2015). *Video games, teen boys and building social skills and friendships*. Pew Research Center. <https://www.pewresearch.org/internet/2015/08/06/chapter-3-video-games-are-key-elements-in-friendships-for-many-boys/>.
- Leszczynski, L., & Wolbring, T. (2019). How to deal with reverse causality using panel data? Recommendations for researchers based on a simulation study. *Sociological Methods & Research*, Article 0049124119882473. <https://doi.org/10.1177/0049124119882473>.
- Levenson, J. C., Shensa, A., Sidani, J. E., Colditz, J. B., & Primack, B. A. (2017). Social media use before bed and sleep disturbance among young adults in the United States: A nationally representative study. *Sleep*, 40(9), zsx113. <https://doi.org/10.1093/sleep/zsx113>.
- Li, S., Jin, X., Wu, S., Jiang, F., Yan, C., & Shen, X. (2007). The impact of media use on sleep patterns and sleep disorders among school-aged children in China. *Sleep*, 30(3), 361–367. <https://doi.org/10.1093/sleep/30.3.361>.
- Liu, L., Yao, Y.-W., Li, C. R., Zhang, J.-T., Xia, C.-C., Lan, J., et al. (2018). The comorbidity between internet gaming disorder and depression: Interrelationship and neural mechanisms. *Frontiers in Psychiatry*, 9, 154. <https://doi.org/10.3389/fpsyg.2018.00154>.
- Lobel, A., Engels, R. C. M. E., Stone, L. L., Burk, W. J., & Granic, I. (2017). Video gaming and children's psychosocial wellbeing: A longitudinal study. *Journal of Youth and Adolescence*, 46(4), 884–897. <https://doi.org/10.1007/s10964-017-0646-z>.
- Longman, H., O'Connor, E., & Obst, P. (2009). The effect of social support derived from world of warcraft on negative psychological symptoms. *CyberPsychology and Behavior*, 12(5), 563–566. <https://doi.org/10.1089/cpb.2009.0001>.
- Loton, D., Borkoles, E., Lubman, D., & Polman, R. (2016). Video game addiction, engagement and symptoms of stress, depression and anxiety: The mediating role of coping. *International Journal of Mental Health and Addiction*, 14(4), 565–578. <https://doi.org/10.1007/s11469-015-9578-6>.
- Lo, S.-K., Wang, C.-C., & Fang, W. (2005). Physical interpersonal relationships and social anxiety among online game players. *CyberPsychology and Behavior: The Impact of the Internet, Multimedia and Virtual Reality on Behavior and Society*, 8(1), 15–20. <https://doi.org/10.1089/cpb.2005.8.15>.
- Madrigal-Pana, J., Gómez-Figueroa, J., & Moncada-Jiménez, J. (2018). Adult perception toward videogames and physical activity using Pokémon Go. *Games for Health Journal*, 8(3), 227–235. <https://doi.org/10.1089/g4h.2018.0100>.
- Mahmassani, H. S., Chen, R. B., Huang, Y., Williams, D., & Contractor, N. (2010). Time to play? Activity engagement in multiplayer online role-playing games. *Transportation Research Record*, 2157, 129–137. <https://doi.org/10.3141/2157-16>.
- Mandryk, R. L., Frommel, J., Armstrong, A., & Johnson, D. (2020). How passion for playing World of Warcraft predicts in-game social capital, loneliness, and wellbeing. *Frontiers in Psychology*, 11, 2165. <https://doi.org/10.3389/fpsyg.2020.02165>.
- Maras, D., Flament, M. F., Murray, M., Buchholz, A., Henderson, K. A., Obeid, N., et al. (2015). Screen time is associated with depression and anxiety in Canadian youth. *Preventive Medicine*, 73, 133–138. <https://doi.org/10.1016/j.ypmed.2015.01.029>.
- Markey, P. M., & Ferguson, C. J. (2017). Moral combat: Why the war on violent video games is wrong. In *Moral combat: Why the war on violent video games is wrong*. BenBella Books.
- Mikuška, J., & Vazsonyi, A. T. (2018). Developmental links between gaming and depressive symptoms. *Journal of Research on Adolescence*, 28(3), 680–697. <https://doi.org/10.1111/jora.12359>.
- Molyneux, L., Vasudevan, K., & de Zúñiga, H. G. (2015). Gaming social capital: Exploring civic value in multiplayer video games. *Journal of Computer-Mediated Communication*, 20(4), 381–399. <https://doi.org/10.1111/jcc4.12123>.
- Munezawa, T., Kaneita, Y., Osaki, Y., Kanda, H., Minowa, M., Suzuki, K., et al. (2011). The association between use of mobile phones after lights out and sleep disturbances among Japanese adolescents: A nationwide cross-sectional survey. *Sleep*, 34, 1013–1020. <https://doi.org/10.5665/SLEEP.1152>.
- Ness, T. E. B., & Saksvik-Lehouillier, I. (2018). The relationships between life satisfaction and sleep quality, sleep duration and variability of sleep in university students. *Journal of European Psychology Students*, 9(1), 28–39. <https://doi.org/10.5334/jeps.434>.
- Nie, N. H., & Hillygus, D. S. (2002). The impact of internet use on sociability: Time-diary findings. *IT & Society*, 1(1), 1–20.
- Odgers, C. L., & Jensen, M. R. (2020). Annual research review: Adolescent mental health in the digital age: Facts, fears, and future directions. *Journal of Child Psychology and Psychiatry*, 61(3), 336–348. <https://doi.org/10.1111/jcpp.13190>.
- Ohanessian, C. M. C. (2009). Media use and adolescent psychological adjustment: An examination of gender differences. *Journal of Child and Family Studies*, 18(5), 582–593. <https://doi.org/10.1007/s10826-009-9261-2>.
- Ohanessian, C. M. C. (2018). Video game play and anxiety during late adolescence: The moderating effects of gender and social context. *Journal of Affective Disorders*, 226, 216–219. <https://doi.org/10.1016/j.jad.2017.10.009>.
- Ohme, J., Araujo, T., de Vreese, C. H., & Piotrowski, J. T. (2020). Mobile data donations: Assessing self-report accuracy and sample biases with the iOS Screen Time function. *Mobile Media & Communication*, 9(2), 293–313. <https://doi.org/10.1177/2050157920959106>.
- Ophir, Y., Lipschits-Braziler, Y., & Rosenberg, H. (2020). New-media screen time is not (necessarily) linked to depression: Comments on Twenge, Joiner, Rogers, and Martin (2018). *Clinical Psychological Science*, 8(2), 374–378. <https://doi.org/10.1177/2167702619849412>.
- Orben, A., & Lakens, D. (2020). Crud (Re)defined. *Advances in Methods and Practices in Psychological Science*, 3(2), 238–247. <https://doi.org/10.1177/2515245920917961>.
- Orben, A., & Przybylski, A. K. (2019). Screens, teens, and psychological well-being: Evidence from three time-use-diary studies. *Psychological Science*, 30(5), 682–696. <https://doi.org/10.1177/0956797619830329>.
- Pallavicini, F., Ferrari, A., & Mantovani, F. (2018). Video games for well-being: A systematic review on the application of computer games for cognitive and emotional training in the adult population. *Frontiers in Psychology*, 9, 2127. <https://doi.org/10.3389/fpsyg.2018.02127>.
- Parodi, K. B., Holt, M. K., Green, J. G., Porche, M. V., Koenig, B., & Xuan, Z. (2021). Time trends and disparities in anxiety among adolescents, 2012–2018. *Social Psychiatry and Psychiatric Epidemiology*. <https://doi.org/10.1007/s00127-021-02122-9>.
- Parry, D. A., Davidson, B. I., Sewall, C. J. R., Fisher, J. T., Mieczkowski, H., & Quintana, D. S. (2021). A systematic review and meta-analysis of discrepancies between logged and self-reported digital media use. *Nature Human Behaviour*, 1–13. <https://doi.org/10.1038/s41562-021-01117-5>.

- Peracchia, S., & Curcio, G. (2018). Exposure to video games: Effects on sleep and on post-sleep cognitive abilities. A systematic review of experimental evidences. *Sleep Science (Sao Paulo, Brazil)*, 11(4), 302–314. <https://doi.org/10.5935/1984-0063.20180046>.
- Perry, R., Drachen, A., Kearney, A., Kriglstein, S., Nacke, L. E., Sifa, R., et al. (2018). Online-only friends, real-life friends or strangers? Differential associations with passion and social capital in video game play. *Computers in Human Behavior*, 79, 202–210. <https://doi.org/10.1016/j.chb.2017.10.032>.
- Porter, A. M., & Goolkasian, P. (2019). Video games and stress: How stress appraisals and game content affect cardiovascular and emotion outcomes. *Frontiers in Psychology*, 10 (APR), 967. <https://doi.org/10.3389/fpsyg.2019.00967>.
- Prince, M., Patel, V., Saxena, S., Maj, M., Maselko, J., Phillips, M. R., et al. (2007). No health without mental health. *The Lancet*, 370(9590), 859–877. [https://doi.org/10.1016/S0140-6736\(07\)61238-0](https://doi.org/10.1016/S0140-6736(07)61238-0).
- Przybylski, A. K., Orben, A., & Weinstein, N. (2020). How much is too much? Examining the relationship between digital screen engagement and psychosocial functioning in a confirmatory cohort study. *Journal of the American Academy of Child & Adolescent Psychiatry*, 59(9), 1080–1088. <https://doi.org/10.1016/j.jaac.2019.06.017>.
- Przybylski, A. K., Rigby, C. S., & Ryan, R. M. (2010). A motivational model of video game engagement motivation and video games. *Review of General Psychology*, 14(2), 154–166. <https://doi.org/10.1037/a0019440>.
- Przybylski, A. K., & Weinstein, N. (2017a). A large-scale test of the goldilocks hypothesis: Quantifying the relations between digital-screen use and the mental well-being of adolescents. *Psychological Science*, 28(2), 204–215. <https://doi.org/10.1177/0956797616678438>.
- Przybylski, A. K., & Weinstein, N. (2017b). Digital screen time limits and young children's psychological well-being: Evidence from a population-based study. *Child Development*, 90(1), e56–e65. <https://doi.org/10.1111/cdev.13007>.
- Przybylski, A. K., & Weinstein, N. (2019). Violent video game engagement is not associated with adolescents' aggressive behaviour: Evidence from a registered report. *Royal Society Open Science*, 6(2), Article 171474. <https://doi.org/10.1098/rsos.171474>.
- Przybylski, A. K., Weinstein, N., Murayama, K., Lynch, M. F., & Ryan, R. M. (2012). The ideal self at play: The appeal of video games that let you be all you can be. *Psychological Science*, 23(1), 69–76. <https://doi.org/10.1177/0956797611418676>.
- Rehbein, F., Kleimann, M., & Mössle, T. (2010). Prevalence and risk factors of video game dependency in adolescence: Results of a German nationwide survey. *Cyberpsychology, Behavior, and Social Networking*, 13(3), 269–277. <https://doi.org/10.1089/cyber.2009.0227>.
- Reid, G. (2012). Motivation in video games: A literature review. *The Computer Games Journal*, 1(2), 70–81. <https://doi.org/10.1007/BF03395967>.
- Roepke, S. E., & Duffy, J. F. (2010). Differential impact of chronotype on weekday and weekend sleep timing and duration. *Nature and Science of Sleep*, 2, 213–220. <https://doi.org/10.2147/NSS.S12572>.
- Ryan, R. M., Rigby, C. S., & Przybylski, A. (2006). The motivational pull of video games: A self-determination theory approach. *Motivation and Emotion*, 30(4), 344–360. <https://doi.org/10.1007/s11031-006-9051-8>.
- Sanders, T., Parker, P. D., del Pozo-Cruz, B., Noetel, M., & Lonsdale, C. (2019). Type of screen time moderates effects on outcomes in 4013 children: Evidence from the Longitudinal Study of Australian Children. *International Journal of Behavioral Nutrition and Physical Activity*, 16(1), 117. <https://doi.org/10.1186/s12966-019-0881-7>.
- Sandstrom, G. M., & Dunn, E. W. (2014). Social interactions and well-being: The surprising power of weak ties. *Personality and Social Psychology Bulletin*, 40(7), 910–922. <https://doi.org/10.1177/0146167214529799>.
- Shaw, A. (2010). What is video game culture? Cultural studies and game studies. *Games and Culture*, 5(4), 403–424. <https://doi.org/10.1177/1555412009360414>.
- Shaw, H., Ellis, D. A., Geyer, K., Davidson, B. I., Ziegler, F. V., & Smith, A. (2020). Quantifying smartphone “use”: Choice of measurement impacts relationships between “usage” and health. *Technology, Mind, and Behavior*, 1(2). <https://doi.org/10.1037/ymb0000022>.
- Shukla, K. D., & Wiesner, M. (2015). Direct and indirect violence exposure: Relations to depression for economically disadvantaged ethnic minority mid-adolescents. *Violence & Victims*, 30(1), 120–135. <https://doi.org/10.1891/0886-6708.vv-d-12-00042>.
- Simmons, J., Nelson, L., & Simonsohn, U. (2020). Pre-registration: Why and how. *Journal of Consumer Psychology*, 31(1), 151–162. <https://doi.org/10.1002/jcpy.1208>.
- Singh, S. (2020, November 13). Here's how to track how much time you've spent playing 'FIFA 21'. NME. https://www.nme.com/en_asia/news/gaming-news/track-how-much-time-youve-spent-playing-fifa-21-2816232.
- Stanton, W. (2019, December 10). How to view hours played on the nintendo switch. Alphr. <https://www.alphr.com/view-hours-played-nintendo-switch/>.
- Stanton, W. (2020, October 7). How to view how many hours you've played on steam. Alphr. <https://www.alphr.com/view-hours-played-steam/>.
- Steffen, A., Thom, J., Jacobi, F., Holstiege, J., & Bätzing, J. (2020). Trends in prevalence of depression in Germany between 2009 and 2017 based on nationwide ambulatory claims data. *Journal of Affective Disorders*, 271, 239–247. <https://doi.org/10.1016/j.jad.2020.03.082>.
- Sun, J., Harris, K., & Vazire, S. (2020). Is well-being associated with the quantity and quality of social interactions? *Journal of Personality and Social Psychology*, 119(6), 1478–1496. <https://doi.org/10.1037/pspp0000272>.
- Tamborini, R., Bowman, N. D., Eden, A., Grizzard, M., & Organ, A. (2010). Defining media enjoyment as the satisfaction of intrinsic needs. *Journal of Communication*, 60(4), 758–777. <https://doi.org/10.1111/j.1460-2466.2010.01513.x>.
- Tortolero, S. R., Peskin, M. F., Baumler, E. R., Cuccaro, P. M., Elliott, M. N., Davies, S. L., et al. (2014). Daily violent video game playing and depression in preadolescent youth. *Cyberpsychology, Behavior, and Social Networking*, 17(9), 609–615. <https://doi.org/10.1089/cyber.2014.0091>.
- Twenge, J. M. (2019). More time on technology, less happiness? Associations between digital-media use and psychological well-being. *Current Directions in Psychological Science*, 28(4), 372–379. <https://doi.org/10.1177/0963721419838244>.
- Twenge, J. M., & Campbell, W. K. (2018). Associations between screen time and lower psychological well-being among children and adolescents: Evidence from a population-based study. *Preventive Medicine Reports*, 12, 271–283. <https://doi.org/10.1016/j.pmedr.2018.10.003>.
- Twenge, J. M., & Campbell, W. K. (2019). Media use is linked to lower psychological well-being: Evidence from three datasets. *Psychiatric Quarterly*, 90(2), 311–331. <https://doi.org/10.1007/s11126-019-09630-7>.
- Valadez, J. J., & Ferguson, C. J. (2012). Just a game after all: Violent video game exposure and time spent playing effects on hostile feelings, depression, and visuospatial cognition. *Computers in Human Behavior*, 28(2), 608–616. <https://doi.org/10.1016/j.chb.2011.11.006>.
- Van Den Bulck, J. (2004). Television viewing, computer game playing, and internet use and self-reported time to bed and time out of bed in secondary-school children. *Sleep*, 27(1), 101–104. <https://doi.org/10.1093/sleep/27.1.101>.
- Viana, R. B., Alves, C. L., Vieira, C. A., Vancini, R. L., Campos, M. H., Gentil, P., et al. (2017). Anxiolytic effects of a single session of the exergame Zumba® fitness on healthy young women. *Games for Health Journal*, 6(6), 365–370. <https://doi.org/10.1089/g4h.2017.0085>.
- Wang, C. K. J., Khoo, A., Liu, W. C., & Divaharan, S. (2008). Passion and intrinsic motivation in digital gaming. *CyberPsychology and Behavior*, 11(1), 39–45. <https://doi.org/10.1089/cpb.2007.0004>.
- Weaver, C. M., Borkowski, J. G., & Whitman, T. L. (2008). Violence breeds violence: Childhood exposure and adolescent conduct problems. *Journal of Community Psychology*, 36(1), 96–112. <https://doi.org/10.1002/jcop.20219>.
- Weaver, E., Gradsar, M., Dohnt, H., Lovato, N., & Douglas, P. (2010). The effect of presleep video-game playing on adolescent sleep. *Journal of Clinical Sleep Medicine: JCSM: Official Publication of the American Academy of Sleep Medicine*, 6(2), 184–189.
- Wiederhold, B. K. (2021). Kids will find a way: The benefits of social video games. *Cyberpsychology, Behavior, and Social Networking*, 24(4), 213–214. <https://doi.org/10.1089/cyber.2021.29211.editorial>.
- Williams, D., Yee, N., & Caplan, S. E. (2008). Who plays, how much, and why? Debunking the stereotypical gamer profile. *Journal of Computer-Mediated Communication*, 13(4), 993–1018. <https://doi.org/10.1111/j.1083-6101.2008.00428.x>.
- Wu, P. T., Wu, W. L., & Chu, I. H. (2015). Energy expenditure and intensity in healthy young adults during exergaming. *American Journal of Health Behavior*, 39(4), 557–561. <https://doi.org/10.5993/AJHB.39.4.12>.
- Zhang, Z., & Chen, W. (2019). A systematic review of the relationship between physical activity and happiness. *Journal of Happiness Studies*, 20, 1305–1322. <https://doi.org/10.1007/s10902-018-9976-0>.
- Zheng, H., Li, J., Salmon, C. T., & Theng, Y. L. (2020). The effects of exergames on emotional well-being of older adults. *Computers in Human Behavior*, 110, Article 106383. <https://doi.org/10.1016/j.chb.2020.106383>.