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To my wife, Diana, and son, Roman, who have, together, always been my foundation. And to my dad, Stuart, may he rest in peace.

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About the Editor

Christopher J. Ferguson, PhD is a professor of psychology at Stetson University in DeLand, FL. He has published dozens of articles related to video game influences on behaviors, including video game violence, addiction issues, and representation of female characters in games. He is a fellow of the American Psychological Association and received an Early Career Scientist Award from the Media Psychology and Technology Division of the APA. He also publishes fiction, including a novel, *Suicide Kings*, and short stories that are available at his website ChristopherJFerguson.com.

Introduction

Christopher J. Ferguson

In February 2018, a 19-year-old man entered Marjory Stoneman Douglas High School in Parkland, FL, with an AR-15 rifle and killed 17 students and staff and wounded many others. This tragic crime restarted familiar debates about the impact of mental health, police procedures, and gun control on gun violence in the United States. As the nation began a fevered discussion of gun control in particular, the National Rifle Association (NRA) and its political supporters including President Trump attempted to shift the conversation onto violence in video games. Despite that it was unknown at the time whether the shooter had actually played violent video games (although being a 19-year-old male, odds were that he had as most young males play violent video games), the President called for a meeting on the impact of games to which no scholars were invited. The reaction from the popular press (e.g., Crecente, 2018; Salam & Stack, 2018; Zendle, 2018) was largely negative, and it seemed unlikely any actual policy would result from this meeting, other than to shift the conversation away from gun control debates.

Debates over the impact of violence in video games tend to emerge after mass shootings, particularly when perpetrated by young males (whereas shootings by older males or, more rarely, women such as the young woman who opened fire on offices if YouTube soon after the Parkland shooting do not raise questions of video games). That some young males, such as the shooters in the Virginia Tech (Virginia Tech Review Panel, 2007) and Sandy Hook (State's Attorney for the Judicial District of Danbury, 2013) shootings, ultimately proved not to be avid violent video game players have done little to squelch these debates. Debates regarding the effects of video games among the general public have often raged with great intensity.

Although the issue of video games impacting violent behavior is one of the most high-profile debates waging over video games, it is far from the only one. Other important opposing views are exchanged regarding whether video games detract

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from (or enhance) educational achievement, may or may not be addictive, can prevent dementia in older adults, or if they boost certain types of cognitive abilities.

One of the principles of this book is that debate is good! Arguably, one of the problems in our field of video game studies has come when one group of scholars or another on some side of a debate has attempted to claim consensus and shut down debate. We know that the history of science is littered with scientific consensus views that have proved incorrect. Attempts to stifle academic debates are inherently anti-science. True, some individuals may find themselves uncomfortable with the sometimes endless impasses that seem to come with many of the disputes related to media effects. However, from such discomfort can also come new insight, an awareness that the status quo is not sufficient, and new theory.

The old adage goes "Debates in academia are so vicious because the stakes are so small." Presumably, this half-joke is meant to poke fun at the insularity of so many academic deliberations that may focus on minor points of pedagogy about which most regular people do not care. However, as we saw from the renewed debates on violence following the Parkland shooting, this is not always true for debates focused on video games. People outside of academia really do care one way or another about video games. Sure, video games are not akin to a cure for cancer, grinding world poverty, or looming threats of war or global warming. Nevertheless, technology clearly does fascinate people, sometimes frightening them, at other times offering the promise of something wondrous.

This popular interest in video games can, at times, make discussions of video game effects difficult. If we accept that video game influences are likely small, nuanced, and idiosyncratic, it may be difficult for researchers to communicate this to a public audience that wants *the answer* regarding whether games are addictive or may help prevent dementia. More than one official at a professional guild organization communicated to me personally how much pressure these organizations are under to provide clear answers to complex questions that will drive public policy.

With this in mind, it may not be surprising that it has often been difficult to discuss video game influences in a way that is strictly objective, collegial, and, indeed, fun. Debates about video games too easily are wound up in questions of morality, money, personal prestige, and politics. The politics of video games and the tenor of debates in the public sphere likely have had a negative influence on arguments among scholars. In effect, video game research has had too many brass rings to grasp for – everything from *saving the children* to grant funding, political and professional prestige, and newspaper headlines. The political narratives about video games can make intellectual conversations about them more difficult.

This political pressure has undoubtedly resulted in an over eagerness to make definitive conclusions and reach *consensus.* Several times in video game research, certain groups of scholars have declared a consensus regarding specific types of effects, only to see large groups of scholars challenge such views. As one such example, in 2014, a large group of scholars released a statement indicating that a consensus existed that brain games caused no appreciable cognitive benefit for players (Stanford Center on Longevity, 2014). Perhaps predictably, soon after, another larger group of scholars released their own statement, disagreeing with the first (Cognitive Training Data, 2014). Curiously, some scholars appear to have signed both forms. We have seen similar false claims of consensus in other areas of video game research such as violent games and aggression and addiction.

If consensus statements have taught us anything, it is that we should be suspicious of consensus statements. They do not appear to typically have been constructed with any clear effort to ascertain whether a consensus actually does exist. Rather, certain groups seem to develop them as a means to stake out the desirability of a particular moral or social position. Indeed, they function as a form of social pressure, encouraging conformity rather than proper scientific scrutiny. Even if a consensus were to exist (and they appear rarer than claimed), a consensus is not evidence. Argument to consensus is a logical fallacy, and we must remember that.

Thus, rigorous inquiry, open debate, and skeptical scrutiny are essential values of science. Particular in social and human realms, thinking in terms of *the answer* may be an inherently fraught process. Media effects are likely to be complex, subtle, and idiosyncratic. Although empirical data, particularly when obtained through preregistered, standardized, transparent, rigorous scientific procedures, can be valuable in directing us toward the truth, so too can rigorous and meaning intellectual dialogue.

To that end, this book functions as a platform for such dialogue. To such degree that dialogue occurs within video game studies, it is often of the argumentative acrimonious variety. Although heated debate can indeed have its purpose particularly when some actors act in questionable faith (I am not of the opinion that all dissent must be cordial, and enforced collegiality can, at times, chill rigorous skepticism), one hopes that dialogue between good-faith opponents with differing views can be conducted in an atmosphere of mutual respect.

I observe that there are few areas of video game studies upon which all or even a majority of scholars agree other than simply that video games exist. Therefore, I hope that this book will be an outlet for understanding where debates exist, how scholars have come to differing good-faith conclusions about controversial topics, and how we can discuss these issues in a mutually respectful environment. The intent is that, for different areas of controversy, scholars with opposing views would present their best case for their perspective but do so in a way that demonstrated respect for opposing views. As much as anything, we hope to demonstrate that debating on controversial topics can be fun, enlightening, and valuable even if, at the end of it all, we still do not agree.

In that sense, the aim of this book is not necessarily to convince the reader of any particular perspective regarding video games. I hope that the essays within will inform, but expect readers will still come away with multiple views of what games do or do not do. However, this book will be one small step in distancing game studies from the vitriol, politics, and conformity that have often limited scientific progress. And, more than anything, I hope it will be an interesting read!

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Violent Video Games *Do* Contribute to Aggression

Erica Scharrer, Gichuhi Kamau, Stephen Warren, and Congcong Zhang

Throughout history, concern about the effects of exposure to violence in the media has circulated with the introduction and widespread adoption of many forms of media technology, including film, television, and the Internet. When each of these media types has found its way to the daily lives of the public, their use has triggered expressions of concern about the violent images and actions found within their content. Video games seem to have spurred particularly anxious commentary and critique, likely attributable in large part to their interactive nature, technology that immerses the player in the action, and the notoriety of some of their most popular titles. With games in the Call of Duty and Grand Theft Auto franchises capturing headlines for both popularity and record-breaking sales (Macy, 2017; Minoti, 2017) and for their inclusion of violent images and simulations (Olson, 2012; Saar, 2014), the potential for violence in video games to have an adverse influence has captured the popular imagination.

Scholars, too, have posed research questions and tested hypotheses pertaining to the potential influence of violence in video games on players young and old for quite some time. Using survey design, the social scientist is able to examine the long-term, cumulative ways in which time spent gaming with violent genres and titles might relate to one's level of aggression. Using experimental design, the short-term, immediate impact of gaming can be measured. Despite the use of these research tools in the research performed to date, this topic has generated a rather vehement debate within the scholarly community, with researchers battling it out in published commentaries and other forums on the merits of the studies and on the ways in which those studies have been framed, discussed, and represented. We will trace through some of the most pertinent points of departure among researchers that

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help fuel the debate surrounding the issue. We divide our discussion of the existing research by major method employed—experiments and surveys—to look for correspondence and divergence in approach and findings within similar types of studies.

The distinction between the term "aggression" and the term "violence" is an important starting place. Most social scientists conceive of aggression as the more general, umbrella term and violence as a narrower subset of actions underneath (Baron & Richardson, 1994). Psychologists and other social scientists generally use the term aggression to signify anything one human might do to intentionally inflict harm on another (Kirsh, 2012). Aggression can have physical (harming with the body or with weapons), verbal (harming with words), and even indirect (harming someone without them having to be present) components (Kirsh, 2012). When aggression takes a physical form, the act can range from causing decidedly illegal and decisively severe (like shooting, stabbing, or engaging in sexual violence) to relatively more minor harm (like children shoving each other on the playground or even acts against objects like slamming a door in anger). Violence is typically confined in its use by scholars to more severe acts of physical forms of aggression, acts at the overtly and seriously harmful end of the aggression continuum (Anderson, Berkowitz, Donnerstein, Huesmann, Johnson, Linz, et al., 2003). Using this logic, not all aggression is violent, but all violence is aggressive. This distinction will prove quite important in our review of the existing research and will factor heavily in the opposing interpretations of the meaningfulness of the existing research evidence.

The Evidence from Experiments

Lab experiments can illuminate the ways in which individuals respond to games of varying types. Yet, the experimenter has to contend with threats to validity in the conditions created by the experiment, including the ways in which aggression is measured. The researcher also has to make sure conditions are equivalent on as many factors as possible besides the amount of violence in the game. Ethical considerations are also exceptionally important. Fundamentally, the researcher would not want to trigger an expression of violence among research participants and therefore has to confine herself to outcome measures generally characterized as aggression rather than violence.

Measuring Aggression in the Lab

How to measure aggression ethically as well as validly and reliably is perhaps the most difficult challenge that social scientists studying video game violence effects face. Employing an indirect measure of aggression, for example, Giumetti and

Markey (2007) first measured dispositional anger (how much a person tends to feel anger and emotional arousal day to day) among 167 college student participants and then randomly assigned them to play violent games or non-violent games on the Xbox for 15 min. Participants were presented with three story stems, describing scenarios in which individuals found themselves in vexing situations. The researchers asked the participants to list 20 things that an individual in that situation might do, say, or feel and measured those responses for the presence of aggression. Those who had played the violent games wrote down significantly more aggressive thoughts, feelings, and actions for the character in the story stem compared to those who played the non-violent games.

In an additional example of an indirect measure, McGloin and colleagues (McGloin, Farrar, Krcmar, Park, & Fisklock, 2016) randomly assigned 488 participants (again, college students) to play the game Time Crisis 4 (a first person shooter) with a traditional button and joystick controller or with a gun controller for 10 min on the PlayStation 3. The measure of aggression was an adaptation of the Buss-Perry self-report questionnaire that was revised to measure participants' state aggression (their current levels, as expressed by intentions to use verbal or physical aggression) rather than their trait aggression (their general willingness to use aggression on a daily basis). In the results, the researchers found two paths to increased aggression. The effect of playing with a gun controller was associated with participants' perceptions of the naturalness of the controller, which, in turn, predicted realism; which, again in turn, predicted enjoyment; and which, finally, predicted increased reports of state aggression. The effect of playing with a gun controller again predicted perceptions of naturalness in the second path, but then in-game failure (number of times the player was killed and had to press continue) predicted frustration which led to higher reports of state aggression, as well. More and less skilled players, therefore, had different paths to state aggression, yet in each the naturalness of the controller (using a gun to simulate the first person shooting) seemed to make a difference.

When researchers employ direct, physical expressions of aggression in a laboratory setting, they must do so in a manner that does not cause serious harm to research participants. Examples of such measures used in studies of the effects of video games include administering unpleasant tastes or sounds to individuals. A recent study conducted by Arriaga and colleagues (Arriaga, Adrião, Madeira, Cavaleiro, Maia e Silva, et al., 2015) provides a good example and a complex research design. In their study, participants played either Time Crisis 4 or Need for Speed (two games rated similarly by participants for enjoyment, difficulty, and frustration but rated quite differently for violence) and then were shown pictures of victims of violence, during which eye tracking technology measured their pupil dilation. Next, participants participated in a competitive reaction time test in which they and a competitive partner were each trying to achieve the fastest reaction time. The competitive partner was actually a programmed computer, but the participants believed they were issuing unpleasant and loud blasts of noise to a person against whom they were competing. Those who played the violent game had lower pupillary dilation responses to victims shown in distress or injury (an indication of desensitization) compared to those who played the non-violent game. Those low pupil dilation responses, in turn, predicted increased use of the noise blasts, the behavioral aggression measure used in the study.

Zumbach, Seitz, and Bluemke (2015) employed a unique design using an implicit association task to measure the association between the self and aggressive words before compared to after playing a violent game, thereby avoiding the limits of self-report. The researchers found a closer association between the self and aggressive words after playing a violent game (Call of Duty: Modern Warfare 2) compared to before playing (whereas a more explicit measure of aggression did not differ from pre- to post-playing). Playing the game in 3D mode with shutter goggles rather than in 2D mode on the PC did not matter for this outcome.

Choosing Stimulus Materials

Another key challenge in experimental studies is how to select video games for treatment group and control group members to play that are equivalent in as many factors as possible except for the presence of or different types of violence in the game (Adachi & Willoughby, 2011). Anderson and Carnagey (2009) attempted to address the issue of whether competitiveness or violence is the key driving force in links between video game exposure and aggression. They had undergraduate student research participants play either a sports game that contained the typical amount of aggression that one would find in the sport (Madden Football, MVP Baseball 2004) or a version of those same sports games in which aggressive behaviors are exaggerated within the playing options of the game. In MLB Slugfest, players can punch other players, and in NFL Blitz Football, the hits are particularly intense. Those who played the games with the gratuitous violence scored higher on one of four state hostility measures (a measure showing an aggravated state) and on a noise blast competitive reaction test. As we have seen, other approaches used to isolate the impact of violence include measuring whether games played across conditions were equivalent in enjoyment, difficulty, or other characteristics (as Arriaga et al., 2015 had done) or having a number of violent and non-violent options (as Giumetti and Markey, 2007 had done).

Game content and mode of play are additional factors that the careful researcher must also consider. There is indication in the research that being rewarded by accruing points or gaining access to new tools, levels, or worlds for aggressive play can stimulate more aggressive thoughts (as measured by a word completion task; completing the beginning of ki__ as kill, for instance) and actions (again, using the competitive reaction time test) compared to being punished for the same acts by losing points (Carnagey & Anderson, 2005). Realism of the game's content may play a role, as well. Barlett and Rodeheffer (2009) found that those who played a game based on a plausible and even historical premise (Conflict Desert Storm) experienced more aggressive feelings (as measured by the self-report state hostility scale) than those who played a violent game with a fantasy theme (Star Wars Battlefront 2). For aggressive cognitions (the word completion task), playing either of the games with violence led to higher scores compared to the control group. Recent research also suggests that playing a violent game competitively rather than cooperatively with others helps determine aggressive response (Velez, Greitemeyer, Whitaker, Ewoldsen, & Bushman, 2016).

Age is an important factor to consider, as well, when choosing games to use as experimental stimulus materials and when deciding how to measure aggression. Saleem, Anderson, and Gentile (2012) assigned young people aged 9 to 14 to play E-rated games with and without violence and assessed outcomes by asking participants to assign puzzles for an ostensible competitive game partner to solve. They found that playing the more violent games led to more hindering behavior (i.e., assigning the opponent more difficult puzzles), whereas playing the prosocial games led to more helping behavior (i.e., assigning easier puzzles). Konijn, Bijvank, and Bushman (2007) found that among adolescent boys, wishful identification with the game character (an expressed desire to be like the character) interacted with playing a violent game to predict aggression as measured by the competitive reaction time test and corresponding noise blasts.

Of course, this is just a selection of experimental studies conducted on the topic of video game violence and its potential influence on aggression. There are certainly studies in the literature that find such effects are either stronger or contingent on such factors as identifying with the main character (Lin, 2013), having a dispositional tendency toward anger (Engelhardt, Bartholow, & Saults, 2011), or other factors. There are even some studies that do not show an immediate effect of violent video game playing on aggression at all (e.g., McCarthy, Coley, Wagner, Zengel, & Basham, 2016). Furthermore, experiments, in particular, have been shown to be susceptible to publication bias, meaning that studies that do, indeed, find the effects they are looking for are often more likely to be accepted for publication compared to those that do no find an effect. Relying on the published literature, therefore, runs the risk of overestimating effects. Recently, in fact, researchers have found that the results of experimental studies exploring the effects of video game violence on aggression array in such a way as to indicate the likelihood of such a publication bias (Hilgard, Engelhardt, & Rouder, 2017). It is possible, then, that there are studies that remain unpublished that fail to show a link between video game violence and aggression. Yet, we base our conclusion on what *is* published, since those studies are available for our analysis and interpretation and have undergone rigorous peer review.

The Evidence from Surveys

Surveys Conducted at a Single Point in Time

Cross-sectional studies conducted in the United States have gathered data from undergraduate students and adults outside the university setting. In Fox and Potocki (2015), for instance, respondents estimated frequency of exposure to violent video games during childhood, adolescence, and adulthood. That measure was found to predict more favorable attitudes toward interpersonal aggression, which, in turn, predicted both hostile sexism and rape myth acceptance. Tang and Fox (2016) determined that number of hours of online game play, game involvement, and hostile sexism each predicted male players' use of generalized or sexualized harassment of other players during online game play. Ivory, Ivory, and Lanier (2017) surveyed 533 college students from across the United States. Most central to our topic, they found amount of weekly video gaming predicted participants' reports of the number of times they had carried a weapon in the past year, the number of times they had gotten into a physical fight, and the number of times those fights required someone seeking medical attention. Amount of time spent with action games, in particular, a genre in which violence is typically quite central, also predicted carrying a weapon and getting into fights requiring medical attention.

Cross-sectional surveys have gathered data from children and/or adolescents from various locations around the globe (e.g., Brändle, Cardaba, & Rivera, 2015; Breuer, Festl, & Quandt, 2014; Dittrick et al., 2013; Gentile, Lynch, Linder, & Walsh, 2004; Lam, Cheng, & Liu, 2013; Möller & Krahé, 2009; Rudaksikira, Muula, & Siziya, 2008; You, Kim, & No, 2015). Lam et al. (2013), for instance, found that among adolescents from two cities in Northeast China, moderate to high levels of violent video game exposure predicted reporting being a perpetrator as well as being concurrently a perpetrator and a victim of cyberbullying. Similarly, in Canada, Dittrick et al. (2013) found those 10- to 17-year-olds whose three favorite games contained violence were more likely to report bullying peers both on- and offline. In the United States, Rudatsikira, Muula, and Siziya (2008) found, in a large national sample of youth, that playing video games for 3 h or more daily was one of several significant predictors of reporting having engaged in a physical fight on school property in the 12 months prior to the survey. In Germany, Festl, Scharkow, and Quandt (2013) found that although most respondents scored quite low, higher scores on the Game Addiction Scale were associated with self-reports of physical aggression and anger among a large sample of respondents aged 14 and older. Prior research had shown that meeting the criteria for game addiction was strongly associated with time spent with games (Lemmens, Valkenburg, & Peter, 2011).

Surveys Conducted over Multiple Points in Time

Of course, correlation is not causation, even with a number of control variables included in data analysis. The prime concern with the cross-sectional approach is that researchers cannot rule out the reverse explanation and that observed links between aggression and violent gaming are explained by those high in aggressiveness seeking out violent games rather than the game causing their aggression. Longitudinal studies measure respondents over multiple points in time, and are therefore able to establish the sequence necessary for a causal interpretation, with violent gaming preceding and predicting aggression rather than (or perhaps in addition to) aggression preceding and predicting violent gaming. Möller and Krahé (2009) used cross-lagged path analysis and found a significant relationship between violent video game use at time 1 and physical aggression at time 2. Slater et al. (2003) studied data from over 2500 children in grades 6 and 7 for 2 years. Results pointed to a "downward spiral" of mutually reinforcing associations between violent media use (which included Internet, TV, and video and computer games) and aggressive thoughts, values, and behavior. Aggression of the young person predicted the selection of violent media consistently throughout the periods of data collection, whereas violent media use predicted the youth's aggression increasingly over time. Research by Fikkers, Piotrowski, Weeda, Vassen, and Valkenburg (2013) using longitudinal data from 499 10- to 14-year-olds in the Netherlands showed that exposure to television and video game violence was not a significant predictor of changes in aggression over time on its own. However, the media violence measure interacted with exposure to conflict within the family to modestly but significantly predict increases in aggression. The aggression measure used in the study included name calling, pushing, hitting or kicking, purposely tripping, threatening to beat up, or fighting. Finally, Willoughby, Adachi, and Good (2012) surveyed 1492 adolescents over the course of 9th through 12th grade. The dependent variable they used was self-reports of both typical aggressive behavioral patterns and specific aggressive behaviors enacted over the past year. More violent video game play predicted higher scores on these measures, even after controlling for prior levels of aggression. Non-violent video game use did not predict change in aggression, and prior aggression generally did not predict greater violent video game use.

Measuring Serious Levels of Harm

In surveys investigating a form of aggression likely to qualify as violence due to the severity of harm measured, the evidence for a meaningful connection between violent gaming and these behaviors is less consistent. In a large longitudinal sample of school-going youth, Ybarra, Huesmann, Korchmaros, and Reisner (2014) determined that violent video gaming was associated concurrently with carrying a weapon to school. Exelmans, Custers, and Van den Bulck (2015) found that among over 3000 Flemish 12- to 18-year-olds, violent video game exposure predicted reports of delinquent behaviors (an index in which the most common behavior was attacking someone with the intent of hurting them), even when accounting for a number of additional risk factors. Yet, other studies have found reduced or even unsupported associations between video game use and serious violence (Savage, 2004). Using the same data set from over 6000 eighth graders in Delaware, for example, both Gunter and Daly (2012) and DeCamp (2015) demonstrated that when young people who played video games were matched with young people who did not on a long list of factors, the differences between the groups on serious aggressive outcomes were small or nonsignificant. In the DeCamp study, for girls only, gaming contributed a small but significant amount of variance to hitting someone with the intention to hurt them and carrying a gun to school, but the size of the association was much smaller than the risk factors of witnessing violence at home and having high levels of sensation seeking. Ferguson, San Miguel, Garza, and Jerabeck (2012) found no connection between violent video game use and scores on a scale that measured youth and parent reports of serious aggression or dating violence in a longitudinal study of 165 mostly Latino youth.

On the whole, the evidence from survey research often finds statistical links between amount of time spent playing violent video games and aggression, and those links vary in size and strength based on factors that include individual differences and type of aggression under consideration. The existing body of evidence that use this form of research methodology were *not* found to array in such a manner as to indicate publication bias in the Hilgard et al. (2017) analysis, and therefore there is less of a need to speculate about what is not present in the published research literature. We believe the available evidence points toward a small but meaningful connection between our major variables of interest, and we point out that that connection has been established among multiple samples of research participants.

Sources of Debate

In assessing the divide between those that contend violent video games contribute meaningfully and importantly to aggression and those that dispute this claim, two overarching themes are evident, those pertaining to methodological approaches and those having to do with interpretation. In the former category, Elson and Ferguson (2014) argue that laboratory experiments tend to utilize trivial measures that lack reliability and external validity. As one of the most frequently employed outcome measures, the competitive reaction time task has been criticized for lacking validation and standardization (Ferguson, Smith, Miller-Stratton, Fritz, & Heinrich, 2008; Savage, 2004). The "hot sauce measure" has been similarly criticized (Elson & Ferguson, 2014; Ferguson & Rueda, 2009). Researchers that use the CRTT state that while multiple measures may be reported in different studies they yield similar results (Bushman, Rothstein, & Anderson, 2010), although one analysis of the CRTT in published studies shows considerable variability (Elson, Mohseni, Breuer, Scharkow, & Quandt, 2014). Further, evidence of high external validity is reported, as variables known to influence real-world aggression and violence have been shown to have the same effects on laboratory measures of aggression (Anderson & Bushman, 1997).

Regarding survey research, Elson and Ferguson (2014) suggest that correlational studies have failed in finding significant and conclusive results linking video game violence to aggression and that they are not effective in controlling for outside risk factors. On the opposing end, others make the point that correlational studies attempt to rule out alternative explanations through use of statistical controls (Anderson, 2003). They state that unlike experimental methods, correlational research ethically allows for the study of more serious and severe acts of aggression. Further, these researchers have argued that the average effect sizes for experimental studies and correlational studies are comparable (Anderson & Bushman, 2001).

The role that meta-analyses play has continually been put to task by some while adamantly defended by others. Some researchers argue that mean effect sizes estimated across multiple studies are potentially inflated to cover for weak methodology and unstandardized measures, as well as publication bias (Ferguson & Kilburn, 2010). In contrast, Bushman and Huesmann (2014) argue that effect sizes may be underestimates, since in research one is unable to expose participants to age-inappropriate video games, which does occur in the real world. Also, during experiments participants are exposed to violent video games for a significantly shorter (typically 15 to 30 minutes) period of time than is routinely reported in real-world play.

A fundamental area of disagreement among researchers focuses on the models and theories used to assess aggression. The General Aggression Model (GAM) is based on social cognitive theories and puts forth that repeated use of violent media results in increased aggression over time (Anderson & Bushman, 2002). Opponents argue that the GAM relies heavily on social learning and assumes a passiveness on the part of video game users while disregarding the role of biological factors (Ferguson & Dyck, 2012). In contrast to the GAM, the Catalyst Model as proposed by Ferguson, Rueda, et al. (2008) focuses primarily on how genetic factors and societal attributes, such as physical environment and family and peer interaction, influence aggression. Another argument suggests effects of violent gaming are confined to those with a predisposition to aggression (Ferguson, Ivory, & Beaver, 2013), whereas critics of this position state that research has not consistently substantiated the claim that certain populations are more susceptible (Bushman & Huesmann, 2014).

Opponents of the aggression claim have stated that in published studies the reported effect sizes are trivially small and inconclusive. Further, they posit that if there is a significant relationship, the increase in popularity of these games should result in an increase in violent crime rates in the United States while the inverse is the case (Ferguson, 2010; Markey, Markey, & French, 2015). Those in support have argued that, in fact, studies have linked high levels of violent video game exposure to delinquency, bullying, hitting, and other acts of aggressive behavior (Anderson, 2003). In critique of the logic that an increase in violent crime rates should be observed, proponents have been careful to note that other contributing factors to societal violence may have greater influence, arguing that while violent video games may not be the primary factor, they cannot be ignored entirely (Anderson & Bushman, 2002). As demonstrated by the research on other health risks, in certain cases small effect sizes can be cause for concern when occurring over time or when a large population is exposed (Bushman & Huesmann, 2014).

In relation to how findings are reported and presented, Ferguson (2015a) argues that researchers that support the claim of a link between violent video games and aggression often ignore research that differs from their stance on the issue. Further, the claim for publication bias in psychological science is made with the argument that positive results get published in professional journals, while negative findings often go unpublished. Yet, Anderson (2003) suggests researchers often cite studies more closely related to their own work especially given page limits in journals. Therefore, when reporting significance and formulating a discussion around positive results, similar literature is likely to be discussed. Lishner, Groves, and Chrobak (2015) state that a review of the research demonstrates that publication bias is not a valid concern as reported effect sizes are similar and health and behavioral science peer-reviewed journals have published work on both sides of the argument. On the other hand, Hilgard, Engelhardt, and Rouder (2017) analyzed data from the Anderson and colleagues' (2010) meta-analysis and found a tendency toward favoring studies with positive results (those finding a link between violent video game use and aggression) among the experimental studies but not the survey studies included in that meta-analysis.

Assembling the Evidence to Form Conclusions and Moving Forward

In this chapter, we have presented a select number of studies (limited by the pages permitted in the book) that exemplify some of the ways that social scientists have attempted to answer the important question of whether violent video games contribute meaningfully to aggression. We have seen that studies are complex and often show effects that are not universal but often are contingent upon features of the game or the gaming experience or factors pertaining to the individual players themselves. Nonetheless, they do, indeed, demonstrate effects.

Of course, every one of the studies that we have reviewed—and, indeed, every conceivable study—has limitations. Surveys are more natural and can produce valid self-reports under conditions of anonymity, but even under multiple controls, they fall short of unequivocally establishing a causal relationship. Experiments can measure short-term and delayed posttest causal effects, but they are inherently artificial, and they require the researcher to use oblique measures of aggression that may or may not map on to real-world actions. So, how can we then take the position that violent video games do contribute meaningfully to aggression?

We do so by looking across the individual studies to the research literature as a whole. In doing so, we find that most data that are available on the topic do point to a connection between playing violent games and some form of aggression. Together, the body of evidence, we argue, is sufficiently convincing to warrant the position we are taking in this chapter. We believe the limitations of each major method or single study when weighed against the strengths of the other method and the body of knowledge as a whole in the published research thus far allow for this conclusion. We are not alone in this interpretation. The American Psychological Association recently assigned a task force of scholars to do an independent assessment of the state of the knowledge in this field. The taskforce determined, "use of violent video games results in increases in overall aggression as well as increases in the individual variables of aggressive behaviors, aggressive cognitions, aggressive affect, desensitization, physiological arousal, and decreases in empathy" (Calvert, Appelbaum, Dodge, Graham, Nagayama Hall et al., 2017, p. 142). Similar to the distinction we have made, the members of the task force concluded that there were not "…sufficient studies to evaluate whether there is a link between violent video game use and criminal behavior" (Calvert et al., 2017, p. 142). Nonetheless, the task force report has not necessarily settled the matter for all. The approach taken by the task force and the conclusions it reached have met with criticism and controversy (Ferguson & Beresin, 2017).

To make our claim about the state of the research as a whole, we rely, as well, on meta-analyses. Meta-analyses amass as many existing studies as the researcher can find on a shared topic and determine statistically what the collected studies find. The most recent meta-analyses on video game violence and aggression (Anderson et al., 2010; Ferguson & Kilburn, 2010; Greitemeyer & Mügge, 2014) encompass 27–381 individual tests of the relationship between violent video game use and aggression, covering 12,000 to 130,000 participants. The effect sizes they estimate between violent gaming and aggressive behavior are quite similar: 0.14 for the Ferguson and Kilburn (2010) meta-analysis and 0.19 for the other two. The Anderson and colleagues' (2010) and the Greitemeyer and Mügge (2014) meta-analyses also estimate effect sizes of about the same magnitude or larger for the outcomes of aggressive thoughts and feelings. Confining the meta-analytic approach to both studies conducted with youth and those specifically measuring aggressive behavior, Ferguson (2015b) finds a similar effect size in the bivariate connection between violent video game use and aggression across 48 such studies ($r = 0.17$), yet a significantly reduced effect size of 0.06 among the 55 studies when using additional variables as statistical controls. Even the smaller effect size of 0.06, however, was statistically significant. Some scholars have called into question the decision to use the adjusted, partial correlation effect sizes in the Ferguson (2015b) meta-analysis (Boxer, Groves, & Docherty, 2015; Rothstein & Bushman, 2015; Valkenburg, 2015), whereas others have supported the decision and replicated the result in a reanalysis of the data used in the meta-analysis (Furuya-Kanamori & Doi, 2016).

Although the effect sizes are not large, we interpret them as establishing a small but significant (both statistically and colloquially) contribution of use of violent video games to aggression. Yet, others look at the same effect sizes and interpret them as inconsequential (Ferguson & Kilburn, 2010). As the debate currently stands, a consensus among researchers on questions concerning the link between violent video games and aggression appears somewhat distant. Perhaps one potential way to bring the two sides a bit closer together is to distinguish between acts of aggression at the more compared to the less severe end of the spectrum. Our own reading of the existing research is that the more severe end of the spectrum is the primary area in which research findings diverge and/or when effect sizes are diminished. We would argue that this makes intuitive sense, in that acting violently in a manner that goes entirely against societal norms, legal codes, and moral considerations is a rare and complex phenomenon likely driven by serious real-world experiences. A survey found that just 35% of scholars believe media violence can be linked to severe acts of real-world violence, yet a considerably larger 57% believe there is sufficient evidence to support the argument that violent media may lead to less extreme acts of aggression (Bushman, Gollwitzer, & Cruz, 2015).

Of course, even if all those involved in the scholarly debate agree that the size of the contribution of violent video gaming is larger for less compared to more severe forms of aggression, they are likely to still disagree about whether the impact of violent games on less severe forms is cause for concern. We would argue that it is, indeed, the case. The less severe forms of aggression identified in the studies we have reviewed and others would still represent harsh and quite unpleasant experiences for the parties involved. If we could make those experiences less likely, we would reduce important stressful conditions and conflicts among individuals. And unlike more intractable causes of aggression including poverty, systemic inequalities, and other cultural conditions, limiting or speaking up about violence in video gaming is a preventative approach relatively easy to achieve.

Another "best practice" that perhaps all scholars could observe in moving forward is using more precise language about the outcome measures used to study aggression. In this chapter, we have tried to be quite careful in including detail about how aggressive thoughts, feelings, and behaviors are measured and have attempted to model the use of descriptions of the actual measures themselves in interpreting outcomes in place of broader claims. We also believe additional studies are needed to sufficiently address whether and how age, gender, and other demographic and individual differences matter in the ways that individuals respond to violent video games. Overall, we hope researchers remain open and transparent in their studies on this topic, not over- or understating their results and interpretations, as the overall goal remains to advance knowledge and inform society using scientifically supported findings.

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The Infamous Relationship Between Violent Video Game Use and Aggression: Uncharted Moderators and Small Effects Make It a Far Cry from Certain

Aaron Drummond, James D. Sauer, and Shaun S. Garea

In 1978, Judas Priest released the album *Stained Class*. The album contained a version of the song *Better by You, Better Than Me* (originally released by the band Spooky Tooth in 1969). In 1985, after listening to Judas Priest's version of the song, James Vance and Raymond Belknap entered into a pact to end their lives with a shotgun. In 1990, Vance and Belknap's parents engaged a legal team to sue Judas Priest, claiming that subliminal messages in the song had prompted the suicide attempt. This is not the only time that rock 'n' roll has been a target for those seeking to identify a cause for society's ills. For example, Led Zeppelin's *Stairway to Heaven* has been suggested to include back-masked lyrics to convey subliminal, Satanic or drug-related messages (see Vokey & Read, 1985, for a consideration of subliminal message effects in music) and, when seeking an explanation for the 1999 Columbine Shooting, some suggested Marilyn Manson (among others musicians) was to blame (e.g. France, 2009). Moreover, rock 'n' roll is not the only scapegoat: violent films (e.g. Oliver Stone's *Natural Born Killers*), "gangsta rap" (e.g. NWA's *Straight Outta Compton*) and, more recently, violent video games (VVGs) have all at various points in time been targeted as catalysts for the (perceived[1]) downfall of, and increasing levels of violence and aggression within, society. Essentially, when groups of people perceive a societal problem, they look for a cause. Often, it seems, they settle on some form of media.

[1] We return to this perceived increase in societal violence later in the chapter.

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Concern about the potentially negative consequences of interacting with media, especially recent or evolving media, is not a new phenomenon. From Socrates' warning that writing could reach those with "understanding no less than those who have no business with it" (Plato, cited in Cooper & Hutchinson, 1997 p. 551) to historical accounts of concerns of potential reading addiction or mania (Furedi, 2016), the advent of new media invariably brings with it anxiety about potential adverse consequences. Clearly, it is right that it should do so. The potential harms of any new technology or media should be carefully weighed against the potential benefits in order to properly inform users of risks and, if necessary, to craft appropriate public policy responses.

One contemporary area of concern is whether playing VVGs might increase players' aggression or violence *outside the gaming environment*. Before considering the theoretical and empirical bases for such a claim, it is important to distinguish between two key outcomes: aggression and violence. The terms aggression and violence are often (and, we argue, incorrectly) used synonymously in the literature reporting adverse effects of violent gameplay. This can create confusion relating to the effects of VVG use on postgame behaviours (Anderson & Bushman, 2002; Ferguson & Kilburn, 2010). Aggression describes a wide variety of hostile behaviours (Allen & Anderson, 2017; Anderson & Bushman, 2002). Typically, aggression is motivated by fear or frustration, a desire to produce fear or frustration, or a tendency to place one's interest over others' (Allen & Anderson, 2017; Ramirez & Andreu, 2006). Aggression may be physical but can also be verbal or relational (i.e. attempting to hurt another by adversely affecting their relationships with other people). Violence is often discussed as a subtype of aggression, typically involving greater intensity and destruction than other forms of aggression and generally manifesting in an attempt to cause physical harm (Anderson & Bushman, 2001; Reiss & Roth, 1993). Thus, violence can be aggressive, but in many instances, aggression is not violent (Anderson & Bushman, 2002).

The relationship between VVG use and aggression is contentious. Proponents of the link between video game violence and aggression are adamant that even small effects are important (Anderson et al., 2010; Anderson & Bushman, 2001; Bushman & Anderson, 2002; Huesmann, 2010) and often evoke emotive imagery to drive their points home. For example, it is common practice to frame discussions of this issue with reference to the Sandy Hook and Columbine Shootings[2] (Markey, Markey, & French, 2015). Such case studies are relatively weak forms of evidence and cannot support causal links between VVGs and aggression. While citing such exemplars does not invalidate the work of proponents of the aggression-violent game link, those sceptical of the VVG-aggression link also argue that the size of the observed effects is negligible or non-existent (Ferguson, 2015; Ferguson & Kilburn, 2010; Hilgard, Engelhardt, & Rouder, 2017; Markey et al., 2015). While there are

[2] In fact, while writing this chapter, the Parkland School Shooting claimed the lives of 17 people in Florida. Lawmakers again sought to blame the shooting upon violent video games (e.g. https://www.usatoday.com/story/news/2018/02/20/after-parkland-video-games-back-critics-cross-hairs/356654002/). We return to this issue later in the societal section of this chapter.

plausible (and intuitively appealing) theoretical reasons to expect that playing VVGs may increase aggression, there are also a number of reasons to believe that the relationship is likely to be a complex one. For instance, Bandura (2001) suggests that behavioural modelling following observational learning processes is not synonymous with mimicry and includes the learning of rules about the appropriateness of particular behaviours for particular circumstances. Additionally, to the extent that VVGs are used to induce relaxation or for mood management, there is a potential for this relationship to be a negative one, with some evidence suggesting that VVG play can be associated with decreased hostility and increased positive mood (Ferguson & Olson, 2013; Ferguson & Rueda, 2010; Rieger, Frischlich, Wulf, Bente, & Kneer, 2015).

In this chapter, we argue, based on the strengths and weaknesses of the available empirical data, two key points about the effects of VVGs on aggression. First, while some evidence suggests there may be a relationship between VVGs and aggression under at least some circumstances, such effects are quite small and unlikely to be a primary cause of real-world aggression. Second, and somewhat more importantly, relatively little is known about the boundary conditions, mediators, and moderators of the relationship between VVGs and aggression. With such a limited understanding, it is difficult to properly characterise the relationship between violent game use and aggression, particularly regarding factors that might suppress or exacerbate the relationship. Demonstrating that a relationship can be observed under some conditions is much less informative than knowing the conditions under which a relationship is more or less likely to emerge or even whether certain conditions can produce the opposite relationship. For example, when being used for mood management, VVGs may result in reduced hostility (Ferguson & Rueda, 2010; Olson, 2010). Complex systems of variables in the real world interact in ways we do not yet understand, making it difficult to generalise many of the obtained findings to real-world applications.

Experimental Studies

Experimental studies investigating the effects of VVGs on aggression are essential for understanding whether there is a causal link between gameplay and aggression. The typical experimental study in the field of VVGs follows some general patterns. Participants are randomly assigned to play either a violent or non-violent game for some (usually short) period of time and are then administered some measure of aggressive cognition, affect, or behaviour. When measuring cognition, participants are often asked to complete a series of word stems which can be completed with either an aggressive or neutral word (e.g.Anderson & Carnagey, 2004; Carnagey & Anderson, 2005). If participants who played the violent (cf. non-violent) game complete a higher proportion of the ambiguous word stems with an aggressive word, this is interpreted as an effect of violent gameplay on increased ease of access of aggressive cognitions. It is worth noting that there is some debate about whether an increase in aggressive cognition is a meaningful finding in the absence of changes in either aggressive intent or behaviour (Ferguson & Dyck, 2012). Researchers have failed to demonstrate that increases in aggressive cognitions lead to real-world aggression (Freedman, 2002; Gauntlett, 2005; Savage, 2004), contributing to the US Supreme court's decision to strike down a ban on the sale of VVGs in the Brown vs EMA case.

When measuring aggressive behaviour – a far more important dependent measure when trying to generalise to real-world aggression – participants are often asked to administer some aversive stimuli an ostensibly real participant (usually either non-existent or a confederate). Common examples of the aversive stimuli include loud noise blasts (e.g.Anderson & Dill, 2000; Bushman, 1995; Elson, Mohseni, Breuer, Scharkow, & Quandt, 2014; Ferguson, Smith, Miller-Stratton, Fritz, & Heinrich, 2008), chilli jam or wasabi (e.g.Fischer, Kastenmüller, & Greitemeyer, 2010; Sauer, Drummond, & Nova, 2015), or pain in the form of exposure to very cold water (a cold pressor task; e.g. Ferguson et al., 2015). Here, higher administration of the aversive stimuli (i.e. in terms of quantity or duration) is interpreted as an increase in behavioural aggression.

The results of such experimental studies vary somewhat. Meta-analyses tend to yield one of two distinct results. Either the results imply that participants tend to show increased aggression following violent compared to non-violent gameplay (e.g.Anderson et al., 2010; Anderson & Bushman, 2001) or that there is little or no consistent relationship between violent gameplay and aggression (e.g. Ferguson, 2015; Furuya-Kanamori & Doi, 2016; Hilgard et al., 2017). In particular, there are important and stark disagreements about the size of any effect of VVG on aggression, the meaningfulness of this effect, and why effects occur.

In 2010, Anderson et al.'s extensive meta-analysis on the topic showed that, for experimental studies, the average effect of VVG exposure on aggression was about $r = 0.245$ (Anderson et al., 2010). Even if we accept this estimate as accurate (and as discussed below, there are good reasons to believe it represents an overestimate as discussed below; Ferguson & Kilburn, 2010; Hilgard et al., 2017), this implies a change of approximately 6% in non-pathological (i.e. persistent, maladaptive, trait) aggression between the participants who played a violent (cf. non-violent) game. Thus, under near-perfect laboratory conditions, the effects of VVGs on aggression are small at best (Cohen, 1992).

One of the biggest concerns with the validity of Anderson et al.'s (2010) estimate of the size of the effect of VVGs on aggression is publication bias. Studies reporting statistically significant results are more likely to be published than those reporting statistically non-significant differences (Ferguson, 2007a; Ferguson & Heene, 2012; Rosenthal, 1979). Unsurprisingly, this appears to be true in the field of video game research. In 2017, a reanalysis of the Anderson et al. (2010) meta-analysis correcting for publication bias yielded a substantially lower effect size estimate of $r = 0.13$ (Hilgard et al., 2017). Contrary to the earlier estimate by Anderson et al. (2010), such a figure suggests playing a violent (cf. non-violent) video game only accounts for approximately 2% (cf. 6%) of the between-group difference in non-pathological aggression scores. Moreover, Hilgard et al. (2017) present a range of estimates obtained with different bias-correction methods which further call into question the size of the effect, with *rs* ranging from as low as 0.02–0.15. Typically, *r* scores below 0.1 are considered negligible. Indeed, Hilgard's lowest estimate places the explanatory power of VVGs on aggressive behaviour as low as 0.04%, while the largest suggests a mere 2.25% of variance in aggression scores are attributable to exposure to violent (cf. non-violent) games under near-perfect laboratory conditions. Such estimates are similar to an earlier meta-analysis which also corrected for publication bias (Ferguson, 2007b).

For now, given the evidence available, the most prudent conclusion seems to be that, in general, the effects of VVGs on aggression in laboratory studies appear to be negligible to small among the general population (Hilgard et al., 2017).

Applied Studies

Applied studies of the VVG-aggression relationship have also yielded mixed results. Generally, such studies fall into two categories, employing either cross-sectional or longitudinal designs. Cross-sectional studies typically ask about the amount people play violent games and then gain a measure of aggression, be it self-reported incidents of behaviour or a measure of aggressive cognition such as the aforementioned word-stem completion task (e.g.Anderson & Dill, 2000; Ferguson, Garza, Jerabeck, Ramos, & Galindo, 2013). Longitudinal studies follow a specific group of people over time, looking at changes in both the prevalence of VVG use and aggression as measured by the lab-based tasks described earlier or through self-report measures of the frequency of aggressive behaviours (e.g.Anderson et al., 2008; Ferguson, San Miguel, Garza, & Jerabeck, 2012; Gentile, Lynch, Linder, & Walsh, 2004; Willoughby, Adachi, & Good, 2012).

On average, the VVG-aggression relationship observed in longitudinal studies tends to be smaller than in experimental studies. A meta-analysis estimate – which was not corrected for publication bias – yielded an approximate effect size of $r = 0.115$, suggesting that at most a mere 1.32% of variance in non-pathological aggression could be explained by VVG use (Anderson et al., 2010). This estimate also declined further when other factors such as culture, sex, and age were statistically controlled, yielding partial estimates of around $r = 0.059$ (or a meagre 0.34% of variance explained). As mentioned earlier in the chapter, however, this estimate is also considered by some to be inflated by publication bias (Ferguson et al., 2010). Even if taken as the true effect, there are several important caveats to place on any conclusion about the importance of this effect size. First, compared to other public health issues, the effect appears to be quite small (Ferguson et al., 2010). For example, the effect constitutes less than a fifth of the variance in violent crime explained by gun ownership (Ferguson, et al., 2010). Moreover, when the outcome of studies is limited to serious violent behaviour (e.g. criminal assault), the effect declines further to a mere $r = 0.04$, an effect so small; most statisticians would consider it negligible (Cohen, 1992; Ferguson & Kilburn, 2010). Thus, even if the reported effect size is valid, longitudinal studies suggest the predictive power of violent gameplay in explaining real-world aggression is low.

In cross-sectional studies, the relationship between VVGs and aggression appears to be stronger. Hilgard et al.'s (2017) reanalysis of Anderson et al.'s (2010) meta-analysis puts the effect size of this relationship at $r = 0.29–0.30$ (~9% of variance explained), or a moderate effect. However, it is worth noting that these correlations represent raw correlations and do not control for other factors that may influence aggression such as sex, age, culture, and trait aggression. Moreover, given the difficulties in establishing causation associated with cross-sectional data, these designs offer only a relatively weak form of evidence. For example, people with a predisposition towards aggression and violence are more interested in playing VVGs (Przybylski, Ryan, & Rigby, 2009; von Salisch, Vogelgesang, Kristen, & Oppl, 2011), and this is particularly problematic for cross-sectional designs because it is unclear whether it is the violent game use causing the aggression or the aggression causing the interest in VVGs. As discussed in the theoretical considerations section of the present chapter, people with high levels of aggression or psychoticism might be particularly affected by the violent content of games, further exaggerating the relationship compared to samples more representative of the general population.

Taken together, the experimental and real-world studies suggest that there is, at best, a small effect of playing VVGs on aggression. Indeed, some suggest that the effect is so small that it may be negligible. However, as we discuss later, results also hint that relationships may be stronger in some specialised populations (e.g.Engelhardt, Bartholow, & Saults, 2011; Giumetti & Markey, 2007) though, again, evidence is mixed (Engelhardt, Mazurek, Hilgard, Rouder, & Bartholow, 2015; Ferguson & Olson, 2014). Numerous moderators (some known, many likely unknown) might influence the presence or absence of the effect, and one must be careful not to confuse the effects of VVGs on vulnerable populations with the effects of the media in the general population, which, based on the empirical evidence, appears to be relatively small at best.

Theoretical Considerations

Of course, empirical data demonstrating the presence of a relationship is of limited utility in the absence of appropriate psychological theory to explain it. Those who claim that VVGs are associated with increased aggression typically draw upon the General Aggression Model (GAM; Anderson & Bushman, 2002; DeWall, Anderson, & Bushman, 2011) to explain the relationship. In this model, person and situation factors are viewed to contribute to or alter internal cognitive, affective, and arousal states. For VVGs, a particular focus is the cognitive changes brought about by video games. Here, violent actions in video games are considered to prime aggressive knowledge structures (e.g. schemata), increasing the likelihood that aggressive responses will be activated by stimuli outside the gaming environment. Moreover, proponents of the GAM propose that violent acts in games act as a kind of rehearsal mechanism for violent behaviour, strengthening and reinforcing underlying aggressive knowledge structures and increasing the likelihood of violent behaviours (Bushman & Anderson, 2002). Although the GAM was originally intended to explain short-term effects of exposure to violent media, there has been speculation that over time, and through repeated activation, these short-term effects may translate into long-term effects (e.g. Barlett, Anderson, & Swing, 2009). This focus on the short- and long-term cognitive changes brought about by VVG use is summarised best by Anderson and Dill (2000, p. 788): "Thus, the danger in exposure to VVGs seems to be in the ideas they teach, and not primarily in the emotions they incite…".

While the GAM is the predominant theory used to explain a potential relationship between VVG and increased aggression, some have criticised the theory. Although much of the criticism is outside of the scope of the present chapter, several points are worth mentioning here. First, the GAM is an incredibly broad theory which tends to have nebulous criteria upon which the theory could be disproven or falsified (Ferguson & Dyck, 2012). A theory which predicts the interaction of any situation with any person variable to produce cognitive changes is virtually impossible to falsify (though as we describe later, some researchers have reported evidence which offers serious challenges to the GAM). As falsification criteria are a key component of good scientific practice, the lack of criteria for observations which would disprove the GAM is concerning.

A second concerning criticism of the GAM in our view is the notion that the human brain does not distinguish fiction from reality and specifically that witnessing or enacting fictionalised violence, for example, by playing VVGs, is analogous to witnessing or enacting real-world aggression. This idea does not seem to be supported by work undertaken by developmental psychologists who show that humans learn to distinguish reality from fiction quite early in life (i.e. from 3 to 5 years old; Corriveau, Kim, Schwalen, & Harris, 2009; Woolley & Van Reet, 2006; for a discussion, see Ferguson & Dyck, 2012) and that observational learning involves developing an appreciation of the importance of context when determining the appropriateness of a behaviour (Bandura, 2001). Further, this idea also exposes a problematic logical contradiction within the GAM. Proponents of the GAM simultaneously view situational factors relating to aggression in media as strong enough to influence internal states yet situational factors relating to the fictional elements of media as too weak to moderate the impact of this media upon internal states. For a review of concerns about the assumptions and limitations of the GAM, see Ferguson and Dyck (2012).

Assuming that the effects of VVGs are large enough to consider an important predictor of aggression (i.e. the lowest estimates by Hilgard et al., 2017, are incorrect, and the true effect exceeds $r = 0.1$), it remains somewhat unclear why these effects occur. Understanding why effects occur is essential to understanding the generalisability of lab effects to applied situations and, where necessary, developing strategies to attenuate them. Although the GAM posits that the violent content of games is responsible for increased aggression, others have suggested that competitiveness plays a significant role (Adachi & Willoughby, 2011a, 2011b). Adachi and

Willoughby (2011a) equated the competitiveness of a violent and non-violent game and found no differences between them in postgame aggression. Moreover, more (cf. less) competitive games increased aggression irrespective of the amount of violence depicted within them (Adachi & Willoughby, 2011b). Recent evidence further suggests that losing a competitive game can lead to increased aggression among players *due to* a general increase in frustration and negative affect (Breuer, Scharkow, & Quandt, 2015). Such effects are difficult for the GAM to explain, since differing levels of in-game violence produced comparable degrees of postgame aggression. However, others have found divergent effects, with equally competitive games yielding different levels of aggression concordant with the violence depicted within them (Anderson & Carnagey, 2009). It is worth noting that the games differed on a number of other characteristics (e.g. difficulty) that may have confounded the results (Carnagey, 2006). Thus, it is difficult to know whether competitiveness and aggression are confounded, contribute to aggression independently, or interact in ways we are yet to understand.

Self-determination theory argues that aggression is caused by the thwarting of one or more of three basic human needs: the need for competence (feeling accomplishment through one's actions), the need for autonomy (personal independence and freedom of choice), and the need for relatedness (a sense of belonging to a community and validation from others; Deci & Ryan, 2000; Ryan & Deci, 2000). When these needs are impeded, it can result in lowered enjoyment and well-being, as well as poorer mood (Ryan, Rigby, & Przybylski, 2006). Initial investigations have shown, for instance, that playing games with less intuitive/more difficult controls (i.e. thwarting the need for competence) results in poorer mood than playing games with more intuitive controls (Ryan et al., 2006). Moreover, games that challenged players' sense of competence increased aggressive thoughts, feelings, and behaviours while showing no differences in aggression based on variations in violent content (Przybylski, Deci, Rigby, & Ryan, 2014). Thus, it is possible that at least some of the observed changes in aggression typically attributed to VVG play may in fact be driven by players finding (a) the game difficult to play after typically short familiarisation sessions or (b) that the narrow confines of a laboratory study frustrate their need for autonomy and control.

Emerging evidence from laboratory studies demonstrates that the effects of VVGs on aggression are moderated by a range of factors, some of which are not well accounted for by the GAM. For example, people who play games in which their character (avatar) is customised to look like the player tend to aggress more than those who play as avatars that do not look like them, supposedly due to a tendency for players to identify more with – and therefore be more likely to emulate – the actions of the in-game character (Fischer et al., 2010). Similarly, people who play easily identifiable villains aggress more following VVG play than those playing easily identifiable heroes, perhaps due to the perceived difference in the social acceptability of their in-game actions (Happ, Melzer, & Steffgen, 2013). These contextual effects are, at present, not well understood or accounted for by the GAM. Another recent study showed that players who read a short story implying their character's motivations are heroic aggress less than those read an antiheroic backstory for their character (Sauer et al., 2015). This presents a particularly difficult finding for the GAM to account for. Specifically, although this change in narrative influenced participants' exhibition of aggression after the game, it did not alter the amount of aggression a player exhibited during the game. Thus, although in-game aggression was consistent across players, the narrative structure only influenced the amount of aggression participants exhibited when they finished playing – a direct contradiction to the GAM's assertion that increased aggression exposure in game should be required for increased postgame aggression to occur. Conversely, in this study, reward structures were able to specifically increase in-game aggression without affecting postgame aggression, again challenging the GAM by showing that increased in-game aggression is not always associated with effects on postgame aggression (Sauer et al., 2015).

Individual differences – players' pre-existing characteristics that might predispose some "at-risk" populations to be particularly susceptible to the psychological effects of violent media – may also be an important moderator of the relationship between VVGs and aggression, though the evidence base for the moderating effects of these characteristics is young and the evidence is mixed. Specifically, some studies have shown that participants with high levels of pre-existing aggressiveness are likely to display greater aggression after playing a VVG than a non-VVG, an effect that does not occur for participants with low pre-existing aggressiveness (Engelhardt et al., 2011; Giumetti & Markey, 2007). However, several studies have failed to replicate the effect, finding little relationship between exposure to media violence and aggression to among high-aggression individuals (Ferguson, Ivory & Beaver, 2013) or even a negative relationship between video game violence and aggression for high trait aggression individuals (Ferguson & Olson, 2014). Other studies investigating potential vulnerable populations also yield mixed results, with one study finding that participants high in psychoticism aggressed more following violent gameplay than non-violent gameplay, a finding not replicated in participants low in psychoticism (Markey & Scherer, 2009). Conversely, autistic individuals do not show increased aggression following exposure to violent video games as some members of the public had previously suggested (Engelhardt et al., 2015). Overall, the limited evidence on individual differences and vulnerable populations is inconclusive. More work is required to establish whether there are specific populations that might be particularly vulnerable to the effects of VVGs, although we urge caution to ensure that any such investigations proceed with adequate moderation to ensure the rights and well-being of such populations are protected.

These studies suggest that there are hidden moderators to the VVG-aggression relationship that are, at present, poorly understood. This indicates a particularly important field of study. Understanding factors that can increase or inhibit the relationship will better allow us to understand if there are specific situations, populations, or game characteristics that are more likely to result in aggressive outcomes and to better specify a theoretical model which accounts for the effects of media on human psychology, as well as the boundary conditions under which these effects may occur.

One other important area where our understanding is lacking is whether the small increases in aggression typically observed in lab data are reflected in societal trends in a more important indicator: violence. That is, even if exposure to VVGs increases aggression in the lab, does this translate to effects on real-world violence?

Societal Trends in Violence

If, as the GAM suggests, exposure to violent media increases aggressive cognitions and behaviours – and, consequently, VVGs contribute meaningfully to interpersonal violence – then one might expect to see a positive relationship between the consumption of VVGs and trends in societal violence (e.g. violent crime rates). This assumption is expressed in nearly 30% of papers on the topic of violent video games, where authors augment theoretical rationales with reference to serious violent incidents such as the Columbine or Sandy Hook school shootings (Markey et al., 2015). It may be intuitively appealing to believe that social issues such as violence may be, at least in in part, caused by VVGs (in part because this would imply clear policy responses to such tragedies). However, it is worth noting that the evidence linking VVG use and school shootings is anecdotal (Markey et al., 2015). It should be noted that while VVG play has been identified as being used by some violent offenders, many violent offenders have had no exposure to VVGs, and, more importantly, many VVG players are not violent offenders. Indeed, it is important not to neglect the base rates of VVG exposure when discussing such exemplars. Given the fact that an estimated 88% of adolescents play video games at least occasionally (Gentile, 2009), it is somewhat trivial that many offenders have had some exposure to VVG.

As discussed earlier, Anderson et al.'s (2010) meta-analysis estimates the correlation between VVG exposure and aggression to be small (r ~ 0.15). One problem with extrapolating these findings relating to aggression in the lab to real-world violence is that violence represents a relatively small subset of aggressive behaviours. Thus, one would expect the relationship between VVG use and violence to be smaller than the already small relationship between VVG use and aggression.

Researchers have adopted an epidemiological approach to investigate the relationship between crime rates and video game sales, to investigate a potential link between VVGs and societal violence. In general, the results do not support the hypothesis that VVGs are linked to societal violence. Cunningham, Engelstatter, and Ward (2016) found no positive correlations and, in fact, showed a negative relationship between VVG sales and violence rate. Similarly, Markey, Markey, and French (2015) showed small but significant decreases in crime rates with increasing game sales. Further, Ferguson (2015) reported a strong negative relationship between youth violence rates and video game sales between 1996 and 2011. Thus, the available data clearly suggest that increased VVG sales (and exposure to VVG) are not associated with increased societal violence.

In Australia the Guidelines for the Classification of Computer Games (2012) went into effect on January 1, 2013. This was a new rating system for video games which restricted access to certain games based on age by considering violence, sexual themes, drug use, and language, looking at overall impact. This included the R18+ label for items not deemed fit for minors or adolescents and only accessible to those over the age of 18 years. The new system was ostensibly introduced in order to better protect youth and the public (Guidelines for the Classification of Computer Games, 2012). However, one argument against the introduction of an R18+ category was that it would allow for users to be exposed to more severe video game violence which may provoke violent responses from some individuals making society less safe (for an overview of the debate, see King & Delfabbro, 2010). The introduction of such a system on Jan 1, 2013, creates an unusually neat natural experiment which we can use to observe what difference in societal violence occurred year to year following the introduction of the R18+ classification. As can be seen from Fig. 1, there appears to be no appreciable changes in crime data. Burglaries continued their downward trend, homicides remained stable, and while sexual assault trended slightly upward, this was generally concordant with its historical upward trend.

In the 4 years since the introduction of an R18+ video game (which allowed for the release of both new and previously unclassified games which were not previously

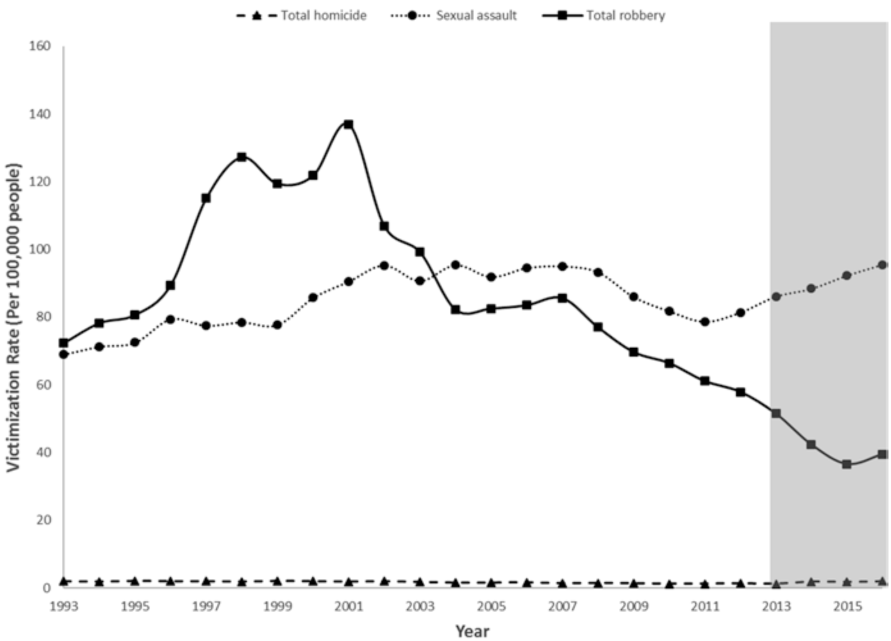

Fig. 1 Victimisation rate of violent crimes in Australia from 1993 to 2016. (Data taken from the Australian Institute of Criminology (AIC, 2017) and the Australian Bureau of Statistics (ABS, 2017))

able to be legally sold in Australia) classification on Jan 1, 2013 (the shaded region), the rate of robbery has continued to substantially decline, while the homicide and related offences rate has remained steady. The only violent offences rate to increase since 2013 is sexual assault, which can clearly be seen to be increasing prior to 2013, and in 2016 is equivalent to historical highs. Bayesian analyses (which should be interpreted cautiously due to the low number of post-2013 observations) suggest since 2013, it is approximately 7.3 times more likely that robberies were higher before Jan 1, 2013, than after, approximately 2.2 times as likely that homicides were higher before 2013 than after, and only 1.4 times more likely that sexual assaults are higher after 2013 than prior to it. Note that typically, anything less than 3 times as likely is considered anecdotal evidence at best (Wetzels et al., 2011).

Other Considerations

As a final note, when consulting the literature on the VVG-aggression relationship, we must consider the relevant research in the wider context of the current zeitgeist of psychological research. Presently, a large number of “established” psychological effects are being found to be unreliable (Schooler, 2014). There are a variety of reasons for this, but unidentified researcher degrees of freedom and falsification of data have received particular attention (Simmons, Nelson, & Simonsohn, 2011). Unidentified researcher degrees of freedom occur when researchers exclude some cases without fully disclosing the decision rules ahead of time, only report specific analyses that yield significant results, collect additional data after seeing if their initial results are significant, or fail to report analyses, dependent measures, or manipulations (Simmons et al., 2011). Such practices allow researchers substantial opportunity to present nearly any comparison as significant (Simmons et al., 2011). Research estimates that these practices are common, potentially as high as 78% for some practices such as failing to report all dependent measures (John, Loewenstein, & Prelec, 2012). The outright falsification of data is less common but is still estimated to occur at rates of around 9% (John et al., 2012).

Are these practices present in the field of violent video game research? With regard to unidentified researcher degrees of freedom, the measures used in many VVG studies are concerning. For instance, the Competitive Reaction Time Task (CRTT) is an often-used measure of aggression. The CRTT operationalises aggression as severity and/or duration of noise blasts administered by a participant against an ostensibly real opponent. The CRTT is a methodologically supple measure which can be quantified into a dependent measure in numerous ways, for example, by including the duration of noise blasts in the outcome measure or considering only severity, using only the first trial or an average of 25 trials, or by log transforming the data (Elson, 2016; Elson et al., 2014). Thus, the CRTT has been used inconsistently both across and within publications (Elson, 2016; Elson et al., 2014). Elson (2016) has identified 156 different strategies for quantifying CRTT data across 130 different publications. This inconsistency in the standardisation of the measure allows for significant researcher degrees of freedom in how they approach the analysis of CRTT data: for example, by allowing researchers to choose to incorporate duration or not depending on which analysis yields more favourable results. Similarly, a recent reanalysis of a study investigating the effect of sexist video games on empathy towards women (Gabbiadini, Riva, Andrighetto, Volpato, & Bushman, 2016) showed that only one very specific kind of analysis yielded the effects reported in the paper, and reanalysis with simpler but no less appropriate models yielded no such difference (Ferguson & Donnellan, 2017). This issue is, admittedly, only tangentially related to the effects of violent games on aggression per se. However, it further illuminates the potential for effects of undisclosed researcher degrees of freedom in video game research and the need to exercise judicious caution when considering reported effects based on the CRTT measure.

The video game research literature has also seen papers retracted for irregularities in reported data. In 2017, a paper suggesting that playing VVGs with a gun-shaped controller made people better marksmen in real life was retracted due to irregularities in the data files and missing raw data (Whitaker & Bushman, 2014). Similarly, another paper suggesting a link between cartoon violence and reduced verbal performance was retracted due to irregularities in the data (Çetin, Wai, Altay, & Bushman, 2016). Although we certainly do not claim that these, or any other researchers in the field, have done anything untoward, the potential for a combination of undisclosed researcher degrees of freedom and retractions due to data irregularities further adds to the difficulties associated with ascertaining whether exposure to VVGs is a causal influence in aggression and violence.

Conclusion

What does all this mean? Are VVGs good or bad for youth or society? Like proponents of the link between VVGs and aggression, we concur that these questions are far too simplistic (Anderson et al., 2017). There are certainly theoretically plausible mechanisms through which exposure to violent media might contribute to increased cognitive and behavioural aggression (e.g. via social learning mechanisms). However, we have reviewed evidence suggesting that, under many circumstances, the effects of VVG play on postgame aggression are small or even negligible. Yet, research also suggests that hidden moderators can influence the presence or absence (and strength) of these effects. For instance, participants who find their competence challenged by poor game controls may be more vulnerable to enact postgame aggression (Przybylski et al., 2014), and the context presented for in-game violence seems to influence the presence (or absence) of postgame aggression (e.g. Sauer et al., 2015). In sum, if a relationship is present, it is unlikely to be a simple one. Given the difficulties in (a) measuring aggression and (b) accounting for potentially important individual differences in the laboratory, a useful understanding of the relationship is likely to require rigorous lab research combined with real-world data and interpreted within a suitable theoretical framework. At present, we feel the most responsible conclusion is that the observed effects of violent gameplay on aggression are small in the lab and negligible when considered in terms of societal violence. However, we do not discount that exposure to violent video games may have negative consequences for some consumers. We also acknowledge the potential for VVGs to have positive benefits under some circumstance – for example, reducing hostility when used by consumers to manage mood or for relaxation (Ferguson & Rueda, 2010; Olson, 2010). As a field of scientific enquiry, we will be better served by asking not "do VVGs cause aggression?" but "under what circumstances might VVGs lead to an increase or decrease in aggression?". Focussing on this latter question will better equip media psychologists to debate what content is and is not appropriate for specific audiences.

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Making the Case for Video Game Addiction: Does It Exist or Not?

Halley M. Pontes

Introduction

There has been a steady rise in the popularity of video games as a pastime and leisure activity over the last few years as this phenomenon has become an integral part of many people's lives. Video games, particularly online gaming activities, play a major role in the leisure and social pursuits of children, adolescents, and adults. According to a nationwide study conducted in the United States of America (USA), about 65% of all households in the USA are home to someone who plays video games on a regular basis, with 67% of all American households owning a device used to play video games (Entertainment Software Association, 2017). Regarding the key demographics of gamers, the average gamer is 35 years old, and about 41% of all gamers in the USA are women (Entertainment Software Association, 2017). Interestingly, the female age group that plays the most is aged 50 years or more (13%), in comparison to under 18 years (11%), 18–35 years (10%), and 36–49 years (8%) gamers. This data partly supports the notion of "soccer mom" that refers to a usually white, suburban middle-classed mother that plays video games. In males, gaming is mostly prevalent among under 18 years (18%) in comparison to gamers with ages between 18–35 years (17%), 36–49 years (11%), and older than 50 years (13%). These figures clearly debunk old stereotypes that the average gamer is a lonely teenager as this data illustrate that video games are widespread across society and played by both genders relatively equally at all age groups even though male and females play different types of video games.

Although the present chapter will focus exclusively on video game addiction as a particularly controversial effect emerging from video games, it is important to note that researchers have been investigating a wide range of effects associated to

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video game play for many decades. Those effects are usually related to how playing video games may elicit aggression, addiction, and other controversial psychiatric disorders (e.g., depression, anxiety, obsessive-compulsive disorder, etc.). Despite the potential and controversial adverse effects, video games can result in a wide range of psychological, social, and cognitive advantages and benefits (see Granic, Lobel, & Engels, 2013; Martončik & Lokša, 2016; Roy & Ferguson, 2016; Toril, Reales, & Ballesteros, 2014; Yeh, 2015; Zhang & Kaufman, 2017). Early research demonstrated that, at the cognitive level, playing video games can result in significantly better hand-eye motor coordination on a rotary pursuit task (Griffith, Voloschin, Gibb, & Bailey, 1983), while additional recent research found that video game players exhibit better performance in perceptual and attentional tasks than non-gamers (Howard, Wilding, & Guest, 2016). Additionally, video games may also help diminish cognitive decline in older adults as older adults playing strategy games were shown to have obtained significant improvements in their working memory, abstract reasoning, distractor inhibition, and mental rotation and a significant reduction in task-switching costs after training compared with those receiving no intervention (Basak, Boot, Voss, & Kramer, 2008). Although a large body of evidence provides support for the positive effects and benefits of playing video games, a recent study conducted by Unsworth et al. (2015) found mixed results regarding to the relationship between video games and enhanced cognitive abilities.

In terms of the potential addictive nature of video games, this effect may result from excessive and dysregulated engagement with video games. Research on video game addiction has focused on many aspects of video game play, such as the structural characteristics of video games (e.g., King, Delfabbro, & Griffiths, 2010; Laffan, Greaney, Barton, & Kaye, 2016; Westwood & Griffiths, 2010) in order to understand the addictive properties of video games and their accompanying detrimental and health-related negative outcomes. The first reports on video game addiction date back to the early 1980s (see Klein, 1984; Nilles, 1982; Ross, Finestone, & Lavin, 1982; Soper & Miller, 1983). More recently, researchers and the public have been increasingly interested in the potential addictive nature of video games due to the extensive ongoing debates on whether video game addiction should be categorized as mental disorder (e.g., Billieux, Schimmenti, Khazaal, Maurage, & Heeren, 2015; Griffiths et al., 2016; Maraz, Király, & Demetrovics, 2015). Although the field of video game addiction has had substantial controversies, these debates have further intensified due to the inclusion of "Internet gaming disorder" in Section III of the *Diagnostic and Statistical Manual of Mental Disorders*, fifth edition (DSM-5; American Psychiatric Association, 2013), as a condition warranting further study.

The American Psychiatric Association defines Internet gaming disorder as a behavior reflecting persistent and recurrent engagement with video games, often with other players, leading to clinically significant impairments or distress as indicated by five (or more) of the following nine core criteria over a 12-month period: (1) preoccupation with video games; (2) withdrawal symptoms when gaming is taken away; (3) tolerance, resulting in the need to spend increasing amounts of time engaged in video games; (4) unsuccessful attempts to control participation in video games; (5) loss of interest in previous hobbies and entertainment as a result of, and with the exception of, video games; (6) continued excessive use of video games despite knowledge of psychosocial problems; (7) deceiving family members, therapists, or others regarding the amount of gaming; (8) use of video games to escape or relieve negative moods; and (9) jeopardizing or losing a significant relationship, job, or education or career opportunity because of participation in video games.

Despite the controversial status of video game addiction as a mental health disorder and a bona fide addiction, the present chapter aims at summarizing some of the evidence supporting video game addiction as a potential psychiatric disorder affecting a minority of gamers. In order to achieve this aim, this chapter will analyze evidence on video game addiction from different research areas and perspectives, namely, (i) theoretical evidence, (ii) empirical evidence, and (iii) clinical evidence.

Video Game Addiction: Theoretical Evidence

For many people, the concept of video game addiction seems rather elusive and/or far-fetched, particularly if their definition of addiction is restricted to the taking of substances. Despite the predominance of drug-based definitions of addiction, there is now a growing movement that views a number of behaviors as potentially addictive (e.g., computer game playing and gambling) (Griffiths & Davies, 2005). This approach has led to a new framework that generated modern definitions of addiction without overemphasizing the intake of substances. For example, the American Society of Addiction Medicine [ASAM] (2017) suggests that addiction is “reflected in an individual pathologically pursuing reward and/or relief by substance use *and other behaviors*, and is characterized by inability to consistently abstain, impairment in behavioral control, craving, diminished recognition of significant problems with one’s behaviors and interpersonal relationships, and a dysfunctional emotional response” (ASAM, 2017). Following this shift in the paradigm of addiction, the DSM-5 (American Psychiatric Association, 2013) reclassified “gambling disorder” as an addiction disorder rather than a disorder of impulse control as it was in previous editions of the DSM. The implications of this reclassification are potentially far-reaching for the definition of addiction. Consequently, if an activity that does not involve the ingestion of intoxicants (such as gambling) can be recognized as a genuine addiction that is accepted by official medical bodies, there are no theoretical reasons as to why other problematic and excessive behaviors (e.g., gaming) cannot be classed as a bona fide addiction (Griffiths & Pontes, 2014).

In addition to the recent changes in the way addiction is defined, researchers have systematically argued that all addictions share similar features and commonalities. In this context, it has been argued that addiction may occur regardless of the means (i.e., substance intake or excessive behavior) when an individual endorses the six core components of addiction (i.e., salience, tolerance, withdrawal symptoms, mood modification, conflict, and relapse) (Griffiths, 2005). Several empirical studies appear to support this notion as the core components of addictions have been empirically tested and shown to apply to a wide range of addictive behaviors, such as Internet gaming disorder (Pontes, Király, Demetrovics, & Griffiths, 2014), problematic Tinder use (Orosz, Tóth-Király, Bőthe, & Melher, 2016), exercise addiction (Terry, Szabo, & Griffiths, 2004), generalized Internet addiction (Kuss, Shorter, Van Rooij, Van de Mheen, & Griffiths, 2014), work addiction (Andreassen, Griffiths, Hetland, & Pallesen, 2012), shopping addiction (Andreassen et al., 2015), dance addiction (Maraz, Urbán, Griffiths, & Demetrovics, 2015), and even addiction to studying (i.e., a precursor to work addiction) (Atroszko, Andreassen, Griffiths, & Pallesen, 2015). Some of these specific forms of (behavioral) addictions have been termed as "technological addictions" (Griffiths, 1995) for over two decades ago. Technological addictions have been operationally defined as nonchemical behavioral addictions involving excessive human-machine interaction (Griffiths, 1995). Moreover, technological addictions can either be passive (e.g., watching television) or active (e.g., playing video games) and usually contain inducing and reinforcing features that can contribute to the promotion of addictive tendencies (Griffiths, 1995). Based on this, technological addictions can be viewed as a subset of behavioral addictions (Marks, 1990), featuring all six core components of addiction (i.e., salience, tolerance, withdrawal symptoms, mood modification, conflict, and relapse) first outlined by Brown (1993) and subsequently modified by Griffiths (1996, 2005). As a consequence of these theoretical developments and views regarding how addiction can be conceptualized, it results that any behavior (including video game playing) that fulfills the six core criteria of addiction can therefore be operationally defined as an addiction (Griffiths & Davies, 2005).

Video Game Addiction: Empirical Evidence

In addition to the outlined theoretical evidence, the existence of video game addiction can also be argued from an empirical perspective by considering the existing published empirical evidence from different sources. At the psychological level, research on video game addiction is primarily concerned with the development and refinement of its diagnostic criteria, establishing prevalence rates, cross-cultural factors, motivations, and predictors of video game addiction. Based on these goals, a substantial amount of research has been conducted on video game addiction using different types of research designs and methods, such as qualitative studies; quantitative studies using cross-sectional, experimental, longitudinal, and/or mixed methods design; and neurobiological studies.

After the release of the first commercial video games in the early 1970s, it took approximately a decade for the first reports about video game addiction to emerge in the psychological and psychiatric literature (see Klein, 1984; Nilles, 1982; Ross et al., 1982; Soper & Miller, 1983). In the early 1980s, Ross et al. (1982) reported three cases of video game obsession, while Nilles (1982) described a phenomenon related to excessive gaming by labeling it as "computer catatonia." Furthermore, Soper and Miller (1983) provided a comprehensive description of video game addic-

Table 1 Prevalence rates of video game addiction in epidemiological studies

Authors	Prevalence	Country	Sample Size	Sample Characteristics
Strittmatter et al. (2015)	3.11%	6 countries[a]	8.807	Adolescents
Baggio et al. (2015)	2.3%	Switzerland	5.663	Young adults
Brunborg et al. (2015)	0.7%	Norway	10.081	General population
Müller et al. (2015)	1.6%	7 countries[b]	12.938	Adolescents
Wittek et al. (2015)	1.4%	Norway	10.081	General population
Henchoz et al. (2016)	2.2%	Switzerland	5.990	Young adults
Lemmens and Hendriks (2016)	5.8%	Netherlands	2.442	General population
Pontes, Macur, and Griffiths (2016)	2.5%	Slovenia	1.071	Adolescents
Ustinavičienė et al. (2016)	9.3%	Lithuania	1.806	Young adolescents
Yu and Cho (2016)	5.9%	South Korea	2.024	Young adolescents
Carras et al. (2017)	1.3%	Netherlands	9.733	Adolescents
Park, Jeon, Son, Kim, and Hong (2017)	4.0%	South Korea	7.650	Adults
Rosenkranz, Müller, Dreier, Beutel, and Wölfling (2017)	3.6%	Germany	5.667	Adolescents
Wartberg, Kriston, and Thomasius (2017)	5.7%	Germany	1.531	Adolescents
Przybylski et al. (2017)	2.7%	United Kingdom	1899	Adults

Notes: [a]Estonia, Germany, Italy, Romania, Spain, and Sweden
[b]Germany, Greece, Iceland, Netherlands, Poland, Romania, and Spain

tion by positing it was akin to other behavioral addictions, consisting of compulsive behavioral involvement, a lack of interest in other activities, association and friendship circles essentially with other addicted gamers, and physical and mental symptoms when the players attempted to cease the behavior. Even though these initial research efforts were significantly limited in nature in terms of their methodological robustness and rigor, these studies have helped defining a research agenda on video game addiction. More recently, researchers have highlighted a wide range of issues supporting the notion of video game addiction, particularly by conducting epidemiological, correlational, and neurobiological studies on video game addiction.

The epidemiological research conducted on video game addiction has essentially attempted to estimate the prevalence and extension of video game addiction in different cultural contexts. Overall, these studies suggest that video game addiction only affects a small minority of gamers worldwide. In fact, prevalence rates reported by robust studies using large and representative samples have been found to range from 0.7% in Norway (Brunborg, Hanss, Mentzoni, & Pallesen, 2015) to 9.3% in Lithuania (Ustinavičienė et al., 2016) (see Table 1).

The results obtained by epidemiological research on video game addiction present with several limitations as prevalence rates tend to vary significantly from one study to another according to the geographical area they are conducted as higher rates are traditionally reported in Asian countries. In general terms, there are several potential reasons accounting for these discrepancies. For example, prevalence rates may differ according to study designs, type of assessment utilized, and population assessed. The majority of epidemiological studies on video game addiction are cross-sectional and use adolescent school-based samples with self-report questionnaires. It is also common practice for researchers to recruit participants from gaming venues or communities, even though recruiting participants from the general has been recommended to help reduce selection bias (Pontes & Griffiths, 2014).

In additional to epidemiological research, correlational research has demonstrated that video game addiction presents with specific psychiatric comorbidities. Recent research from Wang, Cho, and Kim (2018) found that the prevalence of comorbid depression in video game addiction was 2.59 times as high as that of healthy individuals. Further research by Wang et al. (2018) reported that female gender, problematic alcohol use, anxiety symptoms, and history of previous psychiatric counseling or treatment for video game addiction were strong predictors of comorbid depression and video game addiction. Additional empirical research conducted recently demonstrated that, when compared to healthy controls, individuals addicted to video games showed significantly higher rates of comorbid major depressive disorder (59% against 27%), attention deficit/hyperactive disorder (91% against 67%), generalized anxiety disorder (47% against 17%), and obsessive-compulsive disorder (47% against 18%) (Pearcy, McEvoy, & Roberts, 2017). Finally, this type of research has also demonstrated that impulsivity and hostility are key factors involved in comorbid attention deficit/hyperactive disorder and video game addiction (Yen et al., 2017).

The concept of video game addiction may also be partly supported by findings from correlational research showing that video game addiction may affect psychological, social, and biological health. Indeed, numerous studies have systematically reported different types of harmful effects video games can have on human health because of their potentially addictive properties (e.g., Eichenbaum, Kattner, Bradford, Gentile, & Green, 2015; Lehenbauer-Baum et al., 2015; Pontes, 2017; Schmitt & Livingston, 2015; Van Rooij et al., 2014). Furthermore, empirical research has also demonstrated a wide range of detrimental effects emerging from video game addiction both from a psychosocial and neurobiological standpoint (Brunborg, Mentzoni, & Frøyland, 2014; Fauth-Bühler & Mann, 2017; Pontes, Kuss, & Griffiths, 2017).

From a psychosocial perspective, harmful effects related to video game addiction can include greater incidence of psychiatric symptoms (Vukosavljevic-Gvozden, Filipovic, & Opacic, 2015); lower levels of sociability, self-efficacy, and satisfaction with life (Festl, Scharkow, & Quandt, 2013); decreased academic performance (Brunborg et al., 2014) and lower expected college engagement and grades in adolescent students (Schmitt & Livingston, 2015); increased levels of stress (Snodgrass et al., 2014); decreased levels of exercise and sports (Henchoz et al., 2016);

decreased emotional and behavioral functioning (Baer, Saran, & Green, 2012); and overall poorer psychosomatic health (Wittek et al., 2015). From a neurobiological standpoint, recent review studies of the neuroimaging evidence on video game addiction (e.g., Palaus, Marrón, Viejo-Sobera, & Redolar-Ripoll, 2017; Pontes et al., 2017; Weinstein, 2017; Weinstein, Livny, & Weizman, 2017) found that video game addiction is associated to changes on the behavioral, molecular, and neural circuitry levels, providing further evidence of the biological commonalities between video game addiction and substance use disorders. Neurobiological research (e.g., Dong, DeVito, Du, & Cui, 2012; Dong & Potenza, 2014; Liu et al., 2016) found that video game addiction is often associated with abnormal activations in frontal, insular, temporal, and parietal cortices when affected individuals perform tasks related to impulse control. Moreover, studies have found that video game addiction was associated with structural abnormalities in gray matter, such as decreased lower gray matter density in the bilateral inferior frontal gyrus, left cingulate gyrus, insula, right precuneus, and right hippocampus (Lin, Dong, Wang, & Du, 2015; Lin, Jia, Zang, & Dong, 2015). Video game addiction has also been found to be associated with lower white matter density in the inferior frontal gyrus, insula, amygdala, and anterior cingulate, brain regions that are involved in decision-making, behavioral inhibition, and emotional regulation (Lin, Dong, et al., 2015; Lin, Jia, et al., 2015).

Video Game Addiction: Clinical Evidence

The scientific feasibility of video game addiction may also be argued using the existing clinical evidence that appears to provide preliminary support for the concept of video game addiction. Studies focusing on the clinical aspect of video game addiction are mostly related to specific clinical case studies and research investigating different approaches that can be adopted to treat video game addiction (e.g., Griffiths, Kuss, & Pontes, 2016; Han, Hwang, & Renshaw, 2010; Li et al., 2017; Vasilu & Vasile, 2017).

Previous research has provided useful insights and potential evidence supporting the notion of video game addiction and its associated negative outcomes. In the mid-to-late 1980s, the first clinical reports (Keepers, 1990; Klein, 1984; Kuczmierczyk, Walley, & Calhoun, 1987) suggested that many of the children they counseled were apparently addicted to video games, as several had skipped classes and spent their lunch money or, alternatively, stole or begged money to get their "video game fix" (Klein, 1984, p. 396). More recently, several video game addiction case studies have been published in the literature (e.g., Eickhoff et al., 2015; Griffiths, 2010; Voss et al., 2015; Wood, 2008). In 2004, the term "eThrombosis" emerged in the medical lexicon when Lee (2004) reported a case of a 24-year-old South Korean gamer who died due to a fatal pulmonary thromboembolism after playing computer games for about 80 h continuously. The man was unemployed and visited a computer game room and played a game called "myu" from 9:21 p.m. on October 4 to 10:40 a.m. on October 8, 2002, with poor sleep and feeding himself with healthy instant noodles. After playing for about 80 h, the man collapsed abruptly and then recovered consciousness for a short moment and called for help. However, the man was found dead in the toilet an hour later.

More recently, Eickhoff et al. (2015) presented three cases of video game addiction and demonstrated how it negatively impacted in their daily lives. The authors noted all three patients were voluntarily referred to mental health after presenting symptoms of blunted affect, poor concentration, inability to focus, irritability, and insomnia. Additionally, the three patients endorsed several video game addiction symptoms based on DSM-5 criteria for Internet gaming disorder, such as withdrawal symptoms, continued excessive use despite knowledge of psychological problems, use of video games to escape or relieve negative mood, work performance jeopardized by video gaming, and unsuccessful attempts to cut back on video gaming. Furthermore, Eickhoff et al. (2015) reported that the patients shared sleep deprivation associated with excessive amounts of video game play (i.e., 30–60 h per week) and that sleep deprivation resulting from excessive video gaming is associated with daytime drowsiness, fatigue, poor concentration, irritability, poor work performance, expressed anger, and blunted affect.

With regard to the treatment of video game addiction, a number of studies focusing in this particular area were published recently. Winkler, Dörsing, Rief, Shen, and Glombiewski (2013) evaluated the short-term and long-term efficacy of both pharmacological and psychological treatments for Internet use disorders (including online gaming addiction) by reviewing 16 studies that included 670 patients. The authors found that both types of treatment were effective in treating and reducing symptoms of different types of Internet use disorders (including video game addiction), time spent online, anxiety, and depression. According to Winkler et al. (2013), the short-term efficacy of psychological treatments was found to be large and robust and maintained over a follow-up period. As to the psychological treatments for video game addiction, cognitive behavioral therapy appears to be the most widely used treatment method, and a number of studies have showed that this type of treatment can be successfully employed to treat video game addiction (King, Delfabbro, Griffiths, & Gradisar, 2011; Vasilu & Vasile, 2017; Winkler et al., 2013). Finally, with regard to pharmacotherapy in the treatment of video game addiction, Przepiorka, Blachnio, Miziak, and Czuczwar (2014) reported that antidepressants, antipsychotics, opioid receptor antagonists, glutamate receptor antagonists, and psychostimulants may be recommended for the treatment of video game addiction. Moreover, effective treatment may require a combination of psychological and pharmacological treatments. In summary, research focusing on the pharmacological treatment of video game addiction has demonstrated that medical treatment utilized for treating substance use disorder may also work effectively in the treatment of video game addiction (e.g., Han et al., 2010; Song et al., 2016), further supporting the notion that video game addiction and addictive behaviors in general are relatively similar to substance-based addictions.

Conclusions and Implications

The aim of this chapter was to contribute to the discussion as to whether or not video game addiction should be conceptualized and framed as a mental disorder capable of affecting a minority of gamers. In order to achieve this, this chapter has examined different studies and strands of research that may be useful in generating a critical discussion about the phenomenon and providing preliminary support for the argument that video game addiction may exist as a clinical disorder. Overall, the three broad types of evidence analyzed were (i) theoretical evidence, (ii) empirical evidence, and (iii) clinical evidence.

In terms of the theoretical evidence, it is clear that official medical bodies such as the American Psychiatric Association or ASAM have contributed toward broadening the concept of addiction to include behaviors and remove the exclusive emphasis on substance intake. In principle, if one behavior is formally recognized as an addiction (e.g., gambling disorder), then it is almost theoretically impossible to exclude other behaviors such as video game addiction from gaining a similar medicalized status. However, although there is plasticity in the way addiction is defined (West, 2001), the information discussed in this chapter regarding the potential theoretical evidence supporting video game addiction is not entirely consensual. Starcevic and Aboujaoude (2017) contended that video game addiction is more characterized by impulsivity than compulsivity, and if the hallmark of behavioral addictions is the initial impulsivity followed by compulsivity, then video game addiction may be more akin to an impulse-control disorder than a behavioral addiction.

Regarding the empirical evidence supporting video game addiction as a disorder, it was found that video game addiction only affects a minority of gamers and is not as widespread as sometimes portrayed by the media and that, besides negative effects, video games can also result in a number of benefits and advantages. Despite the obvious and well-known positive outcomes of healthy gaming, video game addiction has been systematically associated to a wide range of dysfunctional and abnormal behaviors that hinder an individual's life and well-being. However, caution is advised when interpreting the results of these studies as a number of conceptual and methodological issues regarding video game addiction still exist. At the conceptual level, some of the key issues surrounding these controversies relate to (i) whether the definition and criteria proposed in the DSM-5 are appropriate, (ii) what should the term of the disorder be, (iii) whether addiction is the best theoretical framework for this problematic behavior, and (iv) whether the acceptance of video game addiction as a formal disorder is timely or not (see Aarseth et al., 2016; Griffiths, Kuss, Lopez-Fernandez, & Pontes, 2017; Griffiths, Van Rooij, et al., 2016; Király & Demetrovics, 2017; Kuss, Griffiths, & Pontes, 2017; Petry et al., 2014; van den Brink, 2017). At the methodological level, a number of issues remain to be resolved as researchers investigating video game addiction do not agree on how to approach its assessment in a valid and reliable way that would allow findings across studies to be robustly compared (Griffiths, Király, Pontes, & Demetrovics, 2015; Pontes & Griffiths, 2014). This issue was described in a review of 63 empirical studies on video game addiction involving 58,415 participants and a set of 18 distinct psychometric assessment tools (King, Haagsma, Delfabbro, Gradisar, & Griffiths, 2013). In their study, King et al. (2013) identified a number of problems among the most commonly utilized instruments to assess video game addiction, such as (i) inconsistency of core addiction indicators between studies, (ii) lack of temporal dimension in the instruments, (iii) inconsistent cutoff scores to determine video game addiction, (iv) insufficient or lack of interrater reliability and predictive validity, and (v) inconsistent and/or untested factor structure. Additionally, limitations about the suitability of certain tools for specific settings also emerged as those used in clinical practice milieus may require a different emphasis than those utilized in epidemiological, experimental, or neurobiological research settings (Griffiths et al., 2015; King et al., 2013). Finally, the empirical evidence on video game addiction is essentially correlational, rendering causal relationships between video game addiction and negative outcomes impossible to be established.

The present chapter also analyzed clinical evidence surrounding video game addiction. In this context, the very few published case reports and treatment studies were examined. Although there is some preliminary evidence supporting the notion of video game addiction based on these studies, this type of evidence is still very scant, and more similar studies need to be published if video game addiction is to be fully recognized as a mental health disorder. Drawing from two cases, Griffiths (2010) argued that video game addiction should be characterized by the extent to which the activity impacts negatively on other areas of life rather than the amount of time spent engaged playing video games. Griffiths (2010) also concluded that video game addiction does not occur when the activity presents with a few or no negative consequences in the player's life even if the player spends a significant amount of time playing video games. Further similar studies have argued against the concept of video game addiction by suggesting that the most likely reasons that people play video games excessively are due to either ineffective time management skills, or as a symptomatic response to other underlying problems that they are escaping from, rather than any inherent addictive properties of the actual games (Wood, 2008).

Furthermore, treatment studies focused on employing and delivering psychological and pharmacological treatments to mitigate the symptoms and severity of video game addiction. From these studies, it is clear that video game addiction shares similar underlying mechanisms with more established addictions (e.g., substance-based addictions). However, it is unclear whether these similarities exist due to the way in which video game addiction is defined similarly to substance-based addictions or due to the fact that such similarities indeed exist at the neurobiological level. Irrespective of this, although different types of psychological treatments have been utilized to treat video game addiction, there are a number of issues emerging from these studies and treatment protocols. King et al. (2017) conducted a recent review of treatment studies of video game addiction and assessed their quality. In this review, a total of 30 treatment studies conducted from 2007 to 2016 were reviewed, and some of the key shortcomings about these studies included (a) inconsistencies in the definition, diagnosis, and measurement of disordered use; (b) lack of randomization and blinding; (c) lack of controls; and (d) insufficient information on recruitment dates, sample characteristics, and effect sizes. It was also found that the quality in the design of video game addiction studies did not improve over the last decade, indicating a need for greater consistency and standardization in this area (King et al., 2017). These findings were also supported by similar review study that was published recently (Zajac, Ginley, Chang, & Petry, 2017).

It is envisaged that this chapter will contribute to a critical and evidence-based discussion on the feasibility of the concept of video game addiction as a mental health disorder and bona fide addiction, which is timely given that the World Health Organization (2018) has decided to include "gaming disorder" as a formal disorder in the next revision of the 11th revision of the International Classification of Diseases (ICD-11). Based on the set of evidence presented and potential limitations considered, and after having operationally defined addiction and video game addiction under a robust conceptual framework, it is this author's view that video game addiction does exist but that it affects only a small minority of gamers.

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Helping Parents Make Sense of Video Game Addiction

Rune K. L. Nielsen and Daniel Kardefelt-Winther

Introduction

In 2005, the number of Internet users in the world was estimated at 1 billion or just below 16% of the world population. Today, 13 years later, that number has increased to over 3 billion, or around 43% of the world population, marking an exponential increase in the number of Internet users worldwide (ITU, 2017). According to recent global estimates, approximately one in three Internet users is a child, and child Internet users now outnumber adult users in many parts of the world (Livingstone, Carr, & Byrne, 2016). It is clear at this point that access to and use of digital technology have a transformative potential for children. As former Special Rapporteur on Freedom of Expression, Frank La Rue, stated in his address to the UN General Assembly in 2013, digital technologies such as the Internet not only enhance opportunities for communication and freedom of expression, but it can also serve as a tool to help children claim their other rights, including the right to education, freedom of association, and full participation in social, cultural, and political life. Therefore, Internet should be recognized as an indispensable tool for children.

However, amidst the optimism surrounding the proliferation of digital technology, there is also growing concern that children's engagement with the Internet may affect their lives and well-being negatively. Understandably, parents are increasingly concerned as children spend more and more time on digital technology, as childhood is characterized by a number of social, biological, cognitive, and psychological changes that are critical for children's future development (George & Odgers, 2015).

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That children spend a significant amount of their time with digital technology during this critical developmental period may seem worrying to many parents, and arguments have, for example, been made by some academics that children these days are interacting more with their phone than each other, which causes them to miss out on important social experiences (Turkle, 2011). Indeed, many parents today feel unable to adequately support their children as they use digital technology, while at the same time recognizing the many benefits it can bring them (Kardefelt-Winther, 2017; Phyfer, Burton, & Leoschut, 2016). It is clear in this respect that parents face an increasingly difficult task as they need to parent their children in a digital age without necessarily having the confidence or perceived skills to do so.

One of the explicit purposes of this book is to make this task slightly easier, by providing an overview of research evidence regarding many of the common claims about harmful effects of digital technology, with a specific focus on video games. In this chapter, we will focus on one of the more common and persistent debates around video games: the question of whether video games are addictive. This particular question has received plenty of attention in the scholarly community over the past several decades, resulting in a great number of published research articles, books, and new journals dedicated to this topic. However, we argue that the scholarly community involved in gaming addiction research has become too inward-looking, more concerned with producing studies for the academic community rather than engaging with the very real questions and challenges that some families experience. One example is that the research community for the past decade has focused on determining whether excessive video gaming can be considered addictive in a way similar to substances, but far less attention has been paid to the more pertinent question of whether excessive video gaming is actually harmful in the longer term (Kardefelt-Winther, 2017). This is unfortunate, as the relevance of the former question depends directly on the findings of the latter. Furthermore, it is the question of whether excessive gaming is actually harmful that parents – and in some respect wider society – grapple with on a daily basis, as they see their children spend increasing amounts of time playing video games but lack robust research to determine whether this is good or bad for them.

In a day and age where video games form an important part of children's lives, the message that video gaming is addictive can have unintended consequences. Indeed, scholars warn that immersion and engagement with video games are frequently misinterpreted as addiction (Cover, 2006; Charlton & Danforth, 2007), which might be used as an excuse to restrict access and undermine children's rights. As La Rue notes, while nobody questions the importance of protecting children from harm, too often the possible risks are overstated and used as an excuse for various restrictions (2013). In this respect, it is clear that our perspective on children's engagement with video games matter: if we believe that video gaming is potentially addictive, then we might consider professional treatment or restrictions for those who play excessively. On the other hand, if we believe that sometimes playing extensively is part of a new way of life that adults have yet to fully understand, then restrictions might be ineffective or even harmful for children, limiting their opportunities to benefit from digital technology (for an overview of the positive effects of games, see, e.g., Granic et al., 2014).

In the following sections, we outline three concerns that are commonly voiced by parents who worry that video gaming might be addictive and harmful for their children. We then present research evidence that can shed some light on the relevance of these concerns. Our position is that the evidence base in support of gaming addiction as a concept and as a mental disorder similar to alcohol and substance use disorders is considerable in size but severely lacking in terms of theoretical quality and methodological rigor. We will expand on our position in the next sections.

Common Concerns

"My children spend all of their time playing video games. Clearly this is addictive behavior!"

It makes intuitive sense that children who play video games a lot do so at the expense of other activities; after all, there are only so many hours in a day. This might lead to the concern that children who play computer games fail to engage in other activities which are needed in order to become well-formed individuals. However, this common-sense conclusion might not hold true. In an early study, Durkin and Barber (2002), in a sample of 16-year-old high school students, found no evidence of negative effects of computer game play. To the contrary, they found that computer-game-playing high school students scored higher on measures of positive psychological development than did their nonplaying peers. Since this study was correlational in nature, it is impossible to say whether well-adjusted students are drawn to computer games or whether playing computer games contributes to making students more well-adjusted. For the purposes of the study, the researchers divided students into three groups: those who never play computer games, those who play a little, and those who play a lot. The striking result was that the two groups of students that played computer games, when compared to their nonplaying counterparts, appeared to be closer with their families, more involved in social activities, more engaged with school, had stronger ties to friends, used less psychoactive substances, held better self-concepts, and were less disobedient. This research, and more like it, is an example of evidence that goes against the commonly held beliefs that video games make people less active, socially inept, and overweight. Similarly, Przybylski (2014) found in a study of 10–15-year-olds that playing video games for less than an hour everyday was associated with many benefits, such as higher life satisfaction and prosocial behavior, but lower levels of conduct problems, hyperactivity, peer problems, and emotional problems. These results are in line with a recent large-scale, preregistered study with 120,000 15-year-old British children by Przybylski and Weinstein (2017), who found that children who spent a moderate amount of time playing video games everyday had higher mental well-being than children who did not play at all. However, it's worth noting that the positive effect of playing a moderate amount of video games was weak. Overall, gaming appears to have little relationship with well-being, whether positive or negative.

Durkin and Barber (2002) argue that computer games may play a positive role in youth development because they offer unique opportunities to engage with intrinsically motivating challenges, which follows on Przybylski's (2014) suggestion that computer games may function similarly to traditional forms of play. To achieve a different understanding of video games, parents might try to talk to their children about how video games provide similar experiences as activities they themselves are more familiar with; we would argue that video games to some extent can have the same positive influence on the younger generations that older generations more commonly associate with being in a band, playing sports on an athletic team, or playing chess (which, of course, many in the younger generation still do!).

No activity is healthy in excess, of course, and any activity can evolve to become an obsession. The question is whether or not an activity or substance is harmful in and of itself. While we are not trying to promote excessive behavior of any kind, we do maintain that there is little evidence to support the claim that extensive video gaming is inherently harmful for children's well-being (see Kardefelt-Winther, 2017, for a review). This is not to say that future research will not find negative effects of some kind, only that the evidence as yet is not good enough, which we will illustrate further in the next section. As this question receives increasing attention, we recommend researchers to focus on whether excessive behaviors in general are the cause of a problem or a symptom of an underlying problem (see, e.g. Bean, Nielsen, van Rooij & Ferguson, 2017; Kardefelt-Winther et al., 2017), as this determines how we might best help children achieve a good life balance (Kardefelt-Winther, 2017).

"Playing video games is unhealthy. It does not matter whether they are addictive or not; children should play as little as possible and preferably not at all"

Most research on video game addiction does not follow their subjects over time; research articles usually take the form of a questionnaire study that probes physical and psychological well-being as well as gaming behavior. Some of these studies find a correlation between playing video games and negative psychological states. Others fail to find such a correlation. Very few longitudinal studies (i.e., studies that follow people over a period of time) exist. One such study from the United Kingdom investigated whether time spent watching TV and playing video games at age 5 predicts psychosocial adjustment at age 7 (Parkes, Sweeting, Wight, & Henderson, 2013). The study found that children who watched TV for 3 h a day or more at age 5 were slightly more likely to exhibit conduct problems at age 7 than those who watched less than an hour of TV, although this effect was very small. The study did not find any such correlation for playing electronic games. Neither TV nor electronic games were associated with changes in hyperactivity, inattention, emotional symptoms, peer relation problems, or prosocial behavior. Of course, all such studies come with limitations, but it does indicate that electronic games may not play a causal role on the mental health of children.

It may be, as one study has shown (Przybylski, Weinstein, Ryan, & Rigby, 2009), that high amounts of time spent playing are only associated with negative psychological outcomes for players who play obsessively because of low levels of need satisfaction in their off-screen life, not for players who play for high amounts of time due to harmonious passion. A large-scale longitudinal study found that not only did none of the respondents who met a diagnostic threshold for "Internet gaming disorder" meet those criteria 6 months later but also that meeting that diagnostic threshold did not predict lower levels of health at the time of the follow-up (Weinstein, Przybylski, & Murayama, 2017). The study also found that those who exhibited more symptoms of being addicted to video games at the beginning of the study did not report changes in the levels of social or physical activity at the end of the study. These, perhaps surprising results from an American sample, are in line with those of a large longitudinal study of a German sample that could not link "problematic gaming" with differences in life satisfaction (Scharkow, Festl, & Quandt, 2014). Weinstein et al. (2017) argue that video games only indirectly affect mental and physical health if they undermine basic psychological needs. This pattern was found also in a cross-sectional study of online gamers and online gamblers, suggesting that problematic online engagement in general may occur because individuals are looking to compensate for something, or as a form of self-medication (Kardefelt-Winther 2014a, b). We carefully suggest that one reason for why studies fail to find direct correlations between "video game addiction" and poor health may be because video games, unlike most substances, are not harmful in and of themselves. A qualitative study of the experiences of "pathological video game players" found evidence to suggest that playing *World of Warcraft* (Blizzard Entertainment, 2004) can be experienced as a successful coping strategy to deal with anxiety (Nielsen, 2015). It is clear that video games, like drugs, can be used as tools for coping with psychosocial challenges. But unlike drugs, video games do not seem to be harmful in and of themselves, even though some people under some circumstances may exhibit somewhat excessive and possibly unhealthy usage patterns. In this sense, video games appear to be no different than other interests or hobbies. It has yet to be demonstrated by rigorous research that games cause more problems than other leisure pursuits (van Rooij et al., 2018). This is one reason why some researchers prefer not to use the label of "addiction" for video games, reserving it for substances that have a direct negative physiological impact on the body.

Looking at the scientific literature on the subject as a whole, we can determine that claims about negative long-term consequences of video game playing are not well substantiated. Partly this is because of the lack of longitudinal studies but also because some studies find an association between poor mental and physical health and high levels of playing while others do not. Given the evidence at hand, we tend to agree with Kowert, Vogelgesang, Festl, and Quandt (2015) who argue that online games do not have negative effects on the psychosocial well-being of their players. They find that individuals play online games to compensate for preexisting difficulties and may in some cases lead to problematic outcomes, but they may also experience a net benefit. Taken together, we suggest that parents should concern themselves with the overall well-being of their children rather than focusing only on the time they spend on video games. For parents of children who seemingly spend an excessive amount of time playing, we suggest that they first talk to their children about their lives in general, initially leaving their concerns about video games aside.

"I took an online test that shows that my child is addicted to video games!" It is easy to find online tests, questionnaires, or even apps that offer laypeople a way to quickly figure out if they, or someone they know, are addicted to video games. These Web resources give the false impression that video game addiction is an officially recognized disorder. However, this is only a half-truth. While video game addiction is officially recognized as a disorder in some Eastern countries, such as China, according to the American Psychiatric Association (2013), it is still not recognized as a mental disorder in the West. The only officially recognized behavioral addiction is gambling. Though people often claim to be addicted to sex, work, food, exercise, etc., these are not officially recognized disorders. Indeed, the claim that behaviors might be addictive is "a highly controversial topic" even according to the researchers who created the category for these "behavioral addictions" (Petry & O'Brien, 2013, p. 1187). We fear that creating such categories and diagnoses without strong evidence will become self-fulfilling prophecies. We, and other scholars, have argued that applying diagnostic criteria from substance use disorders (or chemical addictions, in layman's terms) is an inappropriate way to investigate a new phenomenon as it is confirmatory rather than exploratory in nature (Aarseth et al., 2016; Bean et al., 2017; Kardefelt-Winther et al., 2017). The World Health Organization (WHO) is set to publish the 11th edition of the International Classification of Diseases (ICD-11) in 2018. The ICD is a manual that describes all currently recognized disorders. The current draft includes two categories related to video games an addictive disorder called "gaming disorder" and a category for people who are at risk called "hazardous gaming" (World Health Organization, n.d.). This has spawned considerable debate in the scientific community, with some researchers opposed to, and others in favor of, this new diagnostic category. Those who are in favor of the diagnostic category argue that it will reduce stigma around excessive gaming and benefit patients because it makes them eligible for insurance and financial support for treatment services. Those who argue against the disorder point to the lack of evidence that the disorder classification is accurate and meaningful, as well as caution against pathologizing a popular hobby as this may increase stigmatization of millions of regular gamers. The debate is still ongoing and seems difficult to resolve, as the two camps tend to prioritize different aspects of the debate. This polarization is not new. In fact, research on video game addiction has been controversial from the beginning. Research started from the premise that video game addiction existed and that it could be measured using questionnaires developed for substance and gambling addiction. In other words, initial research started by trying to confirm that some people in the population exhibited certain symptoms that they assumed would represent video game addiction, rather than exploring which symptoms a video game addict might experience. Many researchers since have argued that this approach was entirely inappropriate for exploring a new mental disorder (Billieux, Schimmenti, Khazaal, Maurage, & Heeren, 2015; Kardefelt-Winther, 2017). Screening or diagnosing people for behavioral addictions using diagnostic criteria alone is ill-advised because it will without a doubt result in false positives (i.e., labeling people who are not sick as being sick). This is because there are other requirements that have to be met in order for something to be classified as a disorder.

According to the DSM-5, a mental disorder is characterized by clinically significant disturbance in the way an individual thinks, regulates their emotions, or behaves. This disturbance needs to be a reflection of psychological, biological, or developmental dysfunction, which is not easily captured outside of a formal clinical interview. Furthermore, mental disorders are usually associated with significant distress in social, occupational, or other important activities. Importantly, an expectable or culturally approved response to a common stressor or loss, such as the death of a loved one, is not a mental disorder: "Socially deviant behavior (e.g., political, religious, or sexual) and conflicts that are primarily between the individual and society are not mental disorders unless the deviance or conflict results from a dysfunction in the individual, as described above" (American Psychiatric Association, 2013, p. 20).

Therefore, while some researchers believe that video game addiction exists and that the evidence behind the disorder is sound, others claim that most of the existing evidence stands on such shaky grounds that it should not be used to inform policy or treatment or even be used as a starting point for future research. In our view, what has been lacking in the field from the beginning are qualitative investigations with regular and excessive gamers and their families focused on their lived experiences, which is necessary to draw out an accurate description of the concept of video game addiction. We are only aware of one such study, which found that people who are passionate about games are easily mislabeled as addicts (Nielsen, 2015). This suggests that online questionnaires or diagnostic apps directed at the public are unreliable and also influences negatively the validity of most researcher-led population-based surveys. For this reason, some researchers have criticized the field for basing too many of its assumptions on unreliable survey data and argue that the existing evidence base is flawed (Billieux et al., 2015; Kardefelt-Winther et al., 2017; van Rooij & Kardefelt-Winther, 2017).

"Video games are digital cocaine. They hijack the brain's reward system (actually the dopamine system), so they are addictive by design"

Modern science's interest in the neurological underpinnings of pleasure can trace its roots back to the 1950s and an accidental discovery made by two young psychologists, James Olds and Peter Milner (Gade, 2002). Olds and Milner stumbled on what Olds would later call "pleasure centers in the brain" (Berridge & Kringelbach, 2015) when they accidentally inserted an electrode into the wrong area of a rat's brain. Given the ability to stimulate itself, a hungry rat would choose electrical stimulation over food (Berridge & Kringelbach, 2015), and some would continue to the brink of death from exhaustion. The areas of the rat brain that elicits this type of behavior are areas where electrical stimulation causes surges of dopamine release. Dopamine is also released in the human brain when stimulants such as cocaine are ingested. The parallel between rats who push levers in order to get electrical stimulation and people who give up everything they have for drugs was too obvious to ignore. For many years it was believed that the psychological experience of pleasure was mediated through dopamine release. When researchers demonstrated that dopamine was released when people play video game to earn money (Koepp et al., 1998), many researchers took this as evidence of the mechanism that causes video game addiction. It seemed obvious that a link should exist between the euphoric rush of drugs and drug addiction to the euphoric rush of playing video games and video game addiction. For many years, dopamine was the prime candidate for such a neurobiological link. Textbooks were written describing dopamine as the pleasure hormone. However, those textbooks now have to be rewritten.

The idea, that dopamine is the brain's pleasure mechanism, is known as the "dopamine hedonia" or "dopamine pleasure" hypothesis (Berridge & Kringelbach, 2015, p. 15) and was put forward by Roy Wise in the 1980s. By the mid-1990s, however, Wise had already abandoned the hypothesis and no longer believed that the amount of experienced pleasure was proportional with the amount of dopamine secreted in the brain. With Wise, the field of neuroscience has all but completely abandoned the idea that dopamine release alone causes pleasure (Berridge & Kringelbach, 2015). In a recent review of 40 years of research on the dopamine theory of addiction, Nutt and colleagues (2015) confirmed that the release of dopamine was unlikely to be solely responsible for the euphoric feeling of taking drugs. However, even if dopamine was solely responsible for substance addiction, video game play does not cause a dopamine release as strong as cocaine or methamphetamine. Rather, it is on par with other pleasurable behaviors, which means that if the dopamine theory of addiction holds for video games, it would also apply to all other behaviors we find pleasurable. Clearly, this is an unreasonable proposition. The field of video game addiction research has still not caught on with these new developments, and many studies still point to dopamine as the reason why video games are rewarding and also why they are addictive.

There is a larger issue to be discussed in relation to the neuroscience of video games, namely, the ontological status of video games or, in other words, the question of whether human experiences in video games are "real" or "artificial." Psychoactive drugs are generally considered to be alluring because they offer rewards that activate the same neurological pathways as "natural" rewards such as sex, food, and social interaction. For people to completely eschew natural rewards and focus solely on drugs is obviously detrimental to their psychosocial well-being, not to mention their ability to sustain life. When it comes to video games, a central question is an ontological one: are the experiences of friendship and love that people experience with and in games (see, e.g., Enevold & MacCallum-Stewart, 2015) "natural rewards" or "unnatural" substitutes? We would argue that friendships formed online are no less real than those that are formed offline. In fact, the distinction between offline and online friendships seems arbitrary and unhelpful as because the two categories in some cases overlap completely (see, e.g., Nielsen, 2015).

Conclusions

We argue here that the term "addiction" is not well suited to describe the complex interaction that most children have with digital technologies, even when their engagement seems excessive. As the United Nations Children's Fund (UNICEF) stated in a recent report (2017), "Applying clinical concepts to children's everyday behaviour does not help support them in developing healthy screen time habits."

In the psychiatric vocabulary, the word "addiction" usually refers to a chronic disease state, which is caused by dysfunction and that has severe negative effects. Video game addiction has not yet been shown to cause negative effects that are comparable to those of other addictions. As we have discussed in this chapter, many studies not only fail to find a causal relationship but also fail to find a simple association. The term video game addiction, which is perhaps practical in terms of conveying a point, does not seem well suited to describe children's everyday interaction with video games simply because there is little evidence of long-term harm.[1] Work addiction, exercise addiction, food addiction, sex addiction, etc. are not currently recognized as addictions, presumably because all of these activities are part of most people's daily lives, and mostly beneficial (if not instrumental) for human flourishing, and do not necessarily cause problems. We would argue that video games, just like the abovementioned activities, are everyday activities which should not be unduly problematized and stigmatized. They may constitute a problem for some people under some circumstances, but this seems likely to have more to do with the individual and the social circumstances rather than the activity of gaming or a specific game.

We would argue that if we, in the scientific community, want to understand excessive or problematic use of video games better, then the phenomenon needs to be explored in its own right and not forced into a framework of addiction. We believe that contemporary research into video game addiction is marred by confirmation bias because screening tools used to measure game addiction lack validity (Kardefelt-Winther, 2014b; Nielsen, 2015). One researcher has proposed that we should talk not of problem gaming, because we do not know if it is actually a problem; rather we should call it problematized gaming, because all we know is that it is perceived to be a problem (Brus, 2015). As a starting point, rigorous, preregistered longitudinal studies of children's engagement with video games would be helpful.

We believe that negative stereotypes about gamers in general and the social stigma applied to individual gamers do far more damage to the psychological development of young people than video games ever could on their own. Until evidence exists of a direct link between video games and harmful outcomes, such stigmatization should be avoided.

[1] Unless, of course we adopt the thinking that addictions can be either positive or negative as some authors have done (Glasser, 1976). In such a framework, one early theoretician describes "gaming and simulation" as an addiction that might best be understood as a "Mixed Blessing Addiction" (Brown, 1991, p. 112).

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The Digital Dilemma: Why Limit Young Children's Use of Interactive Media?

Sierra Eisen and Angeline S. Lillard

The headlines are dire: "Are Touchscreens Melting Your Kid's Brain?" (Honan, 2014). "Are Touchscreens Ruining Our Children?" (Pogue, 2015). As interactive touchscreen devices have become highly popular, concerned parents, educators, and community members have voiced apprehension about the consequences of children using them extensively. Media anxiety is not new. Every major media innovation has been greeted with criticism and even alarm. Popular radio music, comic books, movies, video games, and television have all been on the receiving end of fearmongering from people who claim that time spent with these media is time ill spent (Anderson & Kirkorian, 2015; Wartella & Jennings, 2000). Concern is currently being directed at interactive touchscreen media, with accusations that it warps children's minds and behavior.

In this chapter, we will examine whether this fear is warranted by reviewing research on young children's use of touchscreen devices and their impact on cognition and behavior. We will first discuss the prevalence of interactive media in children's lives and the activities that children engage in. Next, we will examine early childhood as a critical period of physical and cognitive development and consider how interactive media may impact this. We will specifically focus on the effects of interactive media on two domains: learning and sleep. Since research on interactive media is a new and developing field, we will use existing research on noninteractive media, like television, to highlight the unique influence of interactive media.

The age of digital media dawned more recently than is often realized. Apple released the first iPhone just 11 years ago (2007), revolutionizing and popularizing touchscreen media far beyond any previous technology. Apple then released the first iPad in 2010. The iPad, although functionally similar to the iPhone, opened the door

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to a wide array of applications (apps) that took advantage of its increased screen size. Children's apps particularly benefitted from the affordances of the iPad. Compared to computers, which require the manual dexterity to manipulate a keyboard and mouse, touchscreen devices rely on simple and intuitive actions known as gestures. Children as young as 2 are adept at gestures like tapping, swiping, and dragging (Ahearne, Dilworth, Rollings, Livingstone, & Murray, 2016; Cristia & Seidl, 2015), and by age 3, they can perform more advanced gestures like pinching and spreading (Cristia & Seidl, 2015).

A vast market for children's apps has formed since the iPad was released, and the educational domain in particular has seen remarkable growth. Apps for toddlers and preschoolers were more popular than apps for adults in 2012, with 80% of the top-selling apps in the Education category of the Apple App Store aimed at children and adolescents (Shuler, 2012). Nearly half of the top 100 selling apps in 2009 were created for preschool- or elementary-aged children; by 2012, that number had increased to 72%. Around 70% of parents report that they have downloaded apps specifically for their children's use (Rideout, 2017).

Children's use of interactive media has grown with this market. A recent survey reported that 96% of children under the age of 4 have used a mobile device (Kabali et al., 2015), although children under the age of 1 are much less likely to have used mobile devices than children over the age of 2 (Bedford, Sauz de Urabain, Cheung, Karmiloff-Smith, & Smith, 2016; Cristia & Seidl, 2015). The frequency with which young children use mobile devices increases with age, as does their ownership of devices (Bedford et al., 2016;Kabali et al., 2015 ; Rideout, 2017). For example, children under the age of 4 spend an average of 50–60 min a day on mobile devices (Kabali et al., 2015; Rideout, 2017). Kabali and colleagues (2015) report that 75% of children under the age of 4 own a mobile device and 81% use such devices on a daily basis. In comparison, Rideout (2017) reports that 45% of children under the age of 8 own mobile devices and 28% are daily users. Despite differences in specific estimates, researchers agree that mobile media use is on the rise, even for young children.

With the swift ascent of interactive media and concern about potential harm, the American Academy of Pediatrics (AAP) has generally taken a conservative approach in its media recommendations (2013; AAP, 2011). Parents were once advised to allow no screen time for children under the age of 2 and only limited screen time for older children, regardless of whether the screen was a television, computer, or touchscreen device. More recently, the AAP (2016) has acknowledged that touchscreen devices differ from traditional screen media specifically because of their interactivity. The guidelines now state that screen use for children between 18 and 24 months may be acceptable under certain circumstances, namely, when parents choose "high-quality apps" and co-use them with their children. Parents of 2–5-year-olds are recommended to limit their children's screen use to an hour a day, but limitations for older children have been removed. Parents are still advised to keep children younger than 18 months away from screens, except for video chatting, which is commonly used by families to stay socially connected around the world (McClure, Chentsova-Dutton, Barr, Holochwost, & Parrott, 2015). The changes in the AAP recommendations reflect a growing understanding that not all screens are alike (National Association for the Education of Young Children and the Fred Rogers Center, 2012).

There are many ways that interactive media differs from noninteractive media like television. First and foremost, noninteractive media is passive and unresponsive, even when it appears to be interactive. Dora the Explorer does not use children's responses to her questions as a guide for her actions. Children cannot interact with video characters or change the content provided. In contrast, interactive media devices like tablets and smartphones rely on physical contingency (Troseth, Russo, & Strouse, 2016). When a child acts upon the device by tapping or swiping, the device responds accordingly. This contingent responsiveness requires that children be active participants rather than passive observers. Interactive devices also offer a tremendous range of activities. A television can be used for watching videos, and a book can be used for reading, but an iPad can be used for both, as well as for drawing, taking pictures, talking to other people, looking up information, and engaging with an endless array of apps. Children as young as 4 recognize that a mobile device can be used for many purposes, while objects like a television or a book have a singular purpose (Eisen & Lillard, 2017). Finally, the mobility of touchscreen devices is both a defining feature and a major difference from televisions and desktop computers. Interactive devices can be carried anywhere and used at any time, which contributes to their widespread use. This has direct implications for cognition and attention, as well as essential activities like sleep, a topic we will return to later in the chapter.

To understand the effects of interactive media use, we must first examine the activities that children engage in with these devices. Parents report that their children most often use interactive devices to watch videos, play games, or look at photographs (Cristia & Seidl, 2015; Rideout, 2017). Another common shared activity on interactive devices is video chatting with applications like Skype or FaceTime (see McClure & Barr, 2017). A recent study found that 85% of 6- to 24-month-olds have used video chat and 60% use it several times a month (McClure et al., 2015). Educational apps are also very popular. Parents report that their children use educational apps frequently, though less frequently than they watch educational television (Rideout, 2013). Children over the age of 2 are more likely to use educational apps, as are children from higher-income families. Because educational apps are often structured as games, it is unclear whether children recognize their educational purpose. Indeed, Eisen and Lillard (2017) found that children did not generally think that iPads and iPhones were used for learning, despite considering both to be useful for playing games. Thus, children may not recognize that they are learning when they engage in educational activities on an interactive device.

It is important to consider not just children's overall media use but the content of the media they encounter. In a recent review article, Hirsh-Pasek and colleagues (2015) argue that educational apps fail to make use of the existing research on how children learn, referred to as the Science of Learning. The authors note four crucial components for optimal learning: children must be mentally active, engaged, and learning personally meaningful information in a socially interactive environment.

App content should be challenging (but not too challenging) and require active thinking, while also limiting distracting elements so that children stay on task. Apps should link their content to children's lives to make the content relevant and should also allow for co-use by others. Finally, apps should allow for open-ended exploration but with scaffolding incorporated to direct the child toward learning goals. These components can appear in both the content the app provides and in the context in which learning occurs (Zosh, Lytle, Golinkoff, & Hirsh-Pasek, 2017).

The mobility and flexibility of interactive devices allows for them to be used in a wide variety of contexts, including places where screen media was previously uncommon (Lauricella, Blackwell, & Wartella, 2017). Over 60% of parents give their children mobile devices when they are running errands or to keep them calm in a public place, and 28% use a mobile device to help put children to sleep (Kabali et al., 2015). Interactive media is also increasingly found in classrooms. Fifty-five percent of early childhood educators report having access to tablets, and, on average, they use them 12 days per month (Blackwell, Wartella, Lauricella, & Robb, 2015). Educators use tablets mainly to teach science, math, and literacy curriculum, although 56% also use tablets for social-emotional learning (Wartella, Blackwell, Lauricella, & Robb, 2013). However, many educators seem skeptical about the utility of technology in the classroom. Blackwell and colleagues (2015) demonstrated an increase in teachers' negative attitudes toward technology between 2012 and 2014, perhaps due to the increased presence of technology in the classroom.

As we have shown, interactive media is ubiquitous in the lives of young children. What impact does it have on their cognition and behavior? Infancy and early childhood are critical periods of development for many domains, including language, attachment, motor development, and learning (for a review, see Lillard & Erisir, 2011). When children spend time with interactive media, they are immersed in a virtual world instead of the real world. How does this affect their understanding of the real world and their interactions within it? Researchers are just beginning to understand the short- and long-term impacts of interactive media use. For example, recent studies have examined how children's physical interactions with touchscreens relate to fine and gross motor skills and learning. Bedford et al. (2016) examined developmental milestones of 19–36-month-olds and found a correlation between touchscreen scrolling and earlier development of fine motor skills (stacking blocks) but not gross motor skills (walking) or language. With 2–4-year-olds, Russo-Johnson, Troseth, Duncan, and Mesghina (2017) found that particular gestures aid learning, although the effects differed by gender: girls learned novel words better while using a dragging motion versus a tapping motion, while boys learned more from passively watching on a touchscreen. Together, these studies suggest that children's fine motor skills relate to their touchscreen use and how they manipulate touchscreens impacts how they learn from them. Future research should explore the long-term motor effects of early touchscreen use.

Much of the prior research on interactive and noninteractive media has focused on how children transfer information learned from a screen to the real world, mainly with regard to television (for a review, see Anderson & Hanson, 2010; Anderson & Pempek, 2005; Wartella, Richert, & Robb, 2010). Anderson and Pempek (2005) coined the term "video deficit" to describe children's difficulty learning from television. In comparison to live, in-person interactions, infants and young children consistently struggle to apply information from a screen to the real world. This is true of imitation (e.g., Barr & Hayne, 1999; Hayne, Herbert, & Simcock, 2003), word learning (e.g., Kuhl, Tsao, & Liu, 2003; Strouse & Troseth, 2014), and object retrieval (e.g., Schmitt & Anderson, 2002; Troseth & DeLoache, 1998; Troseth, Saylor, & Archer, 2006) and can be seen in children as young as 9 months (Kuhl et al., 2003) and as old as 30 months (Hayne et al., 2003). Although the video deficit originally served as a comparison between television screens and live interactions, the phenomenon has recently been characterized more broadly as a transfer deficit, since similar limitations apply to young children's learning from interactive touchscreen media (Moser et al., 2015; Zack et al., 2009; Zack, Gerhardstein, Meltzoff, & Barr, 2013; Zimmermann et al., 2017).

Barr (2013) theorizes that infants have difficulty applying learned information from touchscreens to the real world because of the transfer distance between touchscreen and live contexts. Infants must encode information from one medium and then transfer it to another medium at the time of retrieval, which requires memory specificity and flexibility (Barr, 2013). There are several barriers to success at such a task. One barrier is that 2D images are more perceptually impoverished than 3D objects. Touchscreens and other screen media lack important perceptual features, like depth cues, which could aid infants in recognizing the similarity between real objects and their screen counterparts. There is also a contextual mismatch between the source of learning (touchscreen) and the point of retrieval (real world). Applying information learned from a touchscreen to the real world (or vice versa) is an example of far transfer, which is when the disparity between the learning source and the point of retrieval is the greatest (Barnett & Ceci, 2002). In contrast, near transfer is when there is little or no disparity between the source and retrieval contexts, i.e., both learning from and being tested on a touchscreen. Due to the memory requirements of far transfer tasks, infants and young children may have particular difficulty applying information from 2D to 3D sources, even when the 2D source is an interactive form of media rather than a video screen.

Research on learning from touchscreens is just beginning, but the initial findings show that infants do demonstrate a transfer deficit between 2D touchscreens and 3D objects. Zack et al. (2009) showed 15-month-old infants a simple action of pressing a button on either a 2D touchscreen or a 3D button box. Infants were then tested on their ability to reproduce the action in either a near transfer condition (2D-2D or 3D-3D) or a far transfer condition (2D-3D or 3D-2D). Infants imitated much more in the near transfer condition than in the far transfer condition. Because children were capable of learning the action from and then applying it to the 2D touchscreen, it seems likely that perceptual impoverishment is not the core issue. Although language cues have been found to ameliorate the transfer deficit in some studies (e.g., Barr, 2010; Roseberry, Hirsh-Pasek, Parish-Morris, & Golinkoff, 2009; Simcock, Garrity, & Barr, 2011), Zack et al. (2013) found no benefit to adding language to the transfer task from their previous study. Moser and colleagues (2015) demonstrated the same transfer deficit for 2.5- and 3-year-olds with a more complex puzzle task.

Both ages performed better on near transfer tasks than far transfer tasks. Interestingly, they also found that children were no better at transferring from a touchscreen to a 3D source than from a video to a 3D source. This supports the idea that far transfer is difficult because of contextual mismatch between the 2D source and the 3D world, regardless of the type of 2D screen used.

The memory constraint theory of 2D learning applies mainly to infants and toddlers (Barr, 2010, 2013). Can older children successfully learn from interactive media? Several researchers have found the answer to be yes. Berkowitz and colleagues (2015) explored whether first graders' math achievement could be increased with regular use of a math app. Parents and children engaged with the app several times a week for approximately 6 months. They found that the more families used the app, the better their math achievement at the end of the year after controlling for beginning of year math skills—particularly when the parents were anxious about math. Huber et al. (2015) looked at the problem-solving abilities of 4–6-year-olds using app and physical versions of the Tower of Hanoi, a puzzle commonly used to assess planning and executive function (e.g., Bull, Espy, & Senn, 2004; Lillard & Peterson, 2011). Huber and colleagues found that children became better at the task with practice, regardless of the medium they used to practice. They also found that children who practiced with the app successfully transferred their skill to the physical version. Another recent study examined whether children learn more from face-to-face instruction or interactions with a touchscreen app (Kwok et al., 2016). Four- to 8-year-olds were introduced to four novel animal facts by either a live female experimenter or by a touchscreen app designed by the researchers that featured a talking cartoon llama. They found that children learned equally well from either a live person or a touchscreen app, with an average two facts learned across either condition.

Yet others have found that toddlers and preschoolers do not learn very well from touchscreens without additional scaffolding from an adult. Zimmermann et al. (2017) examined the ability of 2.5- and 3-year-olds to transfer learned information about a puzzle to a touchscreen after a "ghost demonstration" where puzzle pieces moved across the touchscreen on their own. Children did not transfer after observing the ghost condition, even though it was a near transfer task. However, when an experimenter moved the pieces on the touchscreen, children's performance greatly improved. Similarly, 5-year-olds learned less from a geography app on their own than they did using the app with a social partner (Eisen & Lillard, 2016). The burgeoning research on children's ability to learn from apps does not yet have clear answers about whether learning from touchscreens is comparable to learning from other mediums, but co-use of interactive media is an intriguing avenue for new research.

Currently, social interaction is rarely incorporated into children's apps (Hirsh-Pasek et al., 2015). Yet video chatting is a promising application of interactive technology. Video chatting can connect children with family members who live far away (McClure & Barr, 2017). It can also serve as a more developmentally appropriate form of communication than audio-only phone calls, which can be difficult for children up to 7 years of age (Ballagas, Kaye, Ames, Go, & Raffle, 2009). The social contingency of video chat seems to aid learning. Two-year-olds who interact with an experimenter via video chat are just as successful at object retrieval tasks (Troseth et al., 2006) and word learning (Roseberry, Hirsh-Pasek, & Golinkoff, 2014) as children who interact with the experimenter in person. Myers, LeWitt, Gallo, and Maselli (2017) found that children slightly younger than 2 could learn new words from video chat, and children as young as 17 months recognized and preferred a social partner they had interacted with over video chat during the previous week. These studies suggest that social interactivity, which is a core aspect of video chat but is often lacking in standard educational apps, boosts children's learning in similar ways to face-to-face interactions.

It is debatable whether touchscreen media are more similar to noninteractive screen media or to actual physical objects. On the one hand, both interactive media and other forms of screen media are fundamentally 2D. Although touchscreens allow more manipulation of objects than does television, they still do not enable children to explore objects with the full range of sensory and spatiotemporal information they would get in the real world. Manual exploration of objects, as opposed to only visual exploration, promotes children's learning (e.g., Bara, Gentaz, & Colé, 2007; Kalenine, Pinet, & Gentaz, 2011; Lillard, 2017). On the other hand, a touchscreen does allow for manipulation of objects on a 2D plane. For example, one can rotate an object, viewing it from all angles. But most children's apps are built to do much more than present objects to children. They can be advanced mini-worlds, with games and activities built into every crevice. The important question for researchers is whether the apps that children regularly encounter are optimal for teaching, since they are so often used for this purpose.

Thus far we have focused mainly on infants' and children's learning from interactive media and compared this to learning from noninteractive media and social interactions. Yet there are many ways that interactive media use may impact children's cognition and behavior. One important consideration is how touchscreen use affects children's sleep. Media use of televisions, computers, video games, and mobile telephones has long been linked to poor sleep quality for children and adolescents (see Cain & Gradisar, 2010, for a review), and a recent meta-analysis shows this is the case for touchscreen media as well (Carter et al., 2016). Across a wide variety of studies, frequent media use is associated with later sleep onset times, shorter total sleep duration, and poorer sleep quality among children 5–18 years of age. Researchers have proposed several potential mechanisms for this effect (Cain & Gradisar, 2010; Cheung et al., 2017). First, media use may directly displace sleep, with children choosing to stay up later when engaged with media. Second, media use may heighten children's physiological, mental, or emotional arousal, making it difficult for children to fall asleep (Anderson & Bushman, 2001). Third, the blue light from screen media can affect children's circadian timing through melatonin suppression, which could indirectly affect their arousal levels (Chang, Aeschbach, Duffy, & Czeisler, 2015). Fourth, heritable traits such as hyperactivity or other behavior problems may lead to inconsistent sleep patterns (Sneddon, 2007). These hypotheses are not mutually exclusive, and several may apply to a particular child's sleep problems.

Only one study thus far has examined the effect of touchscreen use on infant and toddler sleep. Cheung and colleagues (2017) surveyed parents of 6–36-month-olds and found that higher levels of touchscreen use were associated with longer latency to fall asleep, decreased nighttime sleep, and increased daytime sleep. It is unclear whether poor sleepers were more likely to be given touchscreen devices or whether the devices caused the poor sleep. The authors argue that the displacement theory is unlikely to explain their findings, since infants and toddlers have less control over their bedtime schedule and media use than older children and adolescents. However, mobile devices are portable and may more frequently be used as a method of soothing young children who have difficulty sleeping. Since this study is correlational and based on parent report at a single time point, future research should examine the longitudinal relationship between interactive media use and sleep using objective measures of sleep quality. Longitudinal research is rarely found in the literature on interactive media, likely because technology changes so quickly. However, increased use of longitudinal designs would greatly strengthen the growing research on interactive media and its long-term cognitive and behavioral outcomes.

At the beginning of this chapter, we addressed public concern that touchscreen devices are negatively impacting today's youth. Although touchscreen use has rapidly increased in recent years, researchers are only just beginning to examine how children use touchscreens and the influence touchscreens have on children's cognition and behavior. As with other forms of media, it is likely that the effects of touchscreens depend on the way they are used. Touchscreen interactions cannot replace live social interactions with a responsive caregiver. Infants and toddlers do not learn as well from interactive touchscreen media as from live people, just as they learn less well from noninteractive screen media. Although older children may be better able to learn from touchscreens due to their more advanced memory abilities, it is an open-ended question whether learning from touchscreens is comparable to learning from more traditional means, such as direct instruction with physical objects. There are also many unanswered questions about the effects of interactive media on children's behavior, with sleep behavior being just one example of a critical domain for future research. Because the medium is still understudied, it is wise to be cautious when recommending touchscreen devices to parents and educators.

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Children Should Not Be Protected from Using Interactive Screens

Christopher J. Ferguson

Many parents labor under the question of whether to allow their young children to access interactive screens such as those on computers, games, tablets, or smartphones. The decision of how to involve young kids with screens has been fraught for decades, particularly since the advent of television. Unfortunately, the path to reasonable, data-based, objective answers has been difficult, and parents often must contend with fear-based messages that demand unrealistic limitations on kids' screen time. Ultimately, this environment of moral panic over screens may create more confusion and guilt in parents rather than provide guidance that will help children.

Screen Time

Perhaps most famous (or infamous depending on one's perspective) in regard to screen time recommendations have been those of the American Academy of Pediatrics (AAP). Historically, the AAP had recommended that screen time for children, including adolescents, be limited to 2 h, with complete or near abstinence for children under the age of 2 (e.g., AAP, 2011). These recommendations often proved to be controversial, however, with parents complaining they were unrealistic (e.g., Poniewozik, 2011) and scholars expressing concern that the recommendations were not data-based (Linebarger & Vaala, 2010). Thus, in 2016, the AAP released new recommendations, removing the 2-h limit for older children. For children aged 2–5, the AAP recommended no more than 1 hour/day of "high-quality" programming and also minimal interactive screen use with parents for infants 18–24 months. Total abstinence was recommended under 18 months. This still raises the question of

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what data support the 1-h cap for children 2–5 and whether total abstinence for the youngest children makes sense or is realistic for parents.

By contrast, recommendations from another organization *Zero to Three* (2014) focused less on hour per day caps and more on the quality of programming. Zero to Three suggests that screen use, even for young children, can be positive so long as it is strategic and particularly focuses on opportunities for children and parents to interact via screens. In that sense, screens can be another type of game or activity parents and children share.

Granted, many parents are probably clamoring for black/white answers to questions such as how many hours per day of screens should be allowed or what types of programs are ok. But it's less clear that black/white recommendations are sensible or data-based, particularly given that every child and family is different. It's also not clear that decisions regarding screen time are among the most critical that parents must make for the welfare of their children. In that sense, groups like the AAP have largely failed to put the degree to which screen time is a concern in proper perspective.

The issues with the AAP recommendations largely stem from the "all or nothing" thinking which seems to prevail in these recommendations. For instance, the 2016 recommendations state that "Children younger than 2 years need hands-on exploration and social interaction with trusted caregivers to develop their cognitive, language, motor, and social-emotional skills. Because of their immature symbolic, memory, and attentional skills, infants and toddlers cannot learn from traditional digital media as they do from interactions with caregivers and they have difficulty transferring that knowledge to their 3-dimensional experience." While it is undoubtedly true that parent-child interactions provide an essential foundation for infant learning, the implications of this statement that young children *never* learn from digital media appear to be a broader conclusion than research data would allow. This conclusion appears to be based on two assumptions.

1. *A zero-end sum game*. Although there are indeed only 24 h in any day (and young children are awake for only a proportion of this), the assumption appears to be that any interaction with digital media *must* subtract from more valuable time with parents and thus is inherently harmful.
2. *Babies and their parents must always be "on."* The AAP recommendations assume that infants must *always* learn and that parents must *always* focus on teaching. This might be called the "worker bee" assumption, that children's entire existence should be focused on learning and that children (and their parents) are capable of functioning as continuous learning machines. The equivalent assumption for adults might be that adults should *always* be working other than when attending to essential life functions (e.g., sleeping, eating, etc.) When put in such terms, it becomes clearer that this view endorses a life perspective that would be exhausting, unenjoyable, and unrealistic for both infants and parents alike. Even infants deserve a fair amount of "silly time" where they needn't be continuously learning, and parents likewise need time to attend to their own needs.

When looked at closely, it becomes apparent that the screen time recommendations of the AAP and the assumptions that underlie them are problematic. The worker bee model of infant learning imposes a machine-learning model onto children for whom life must be focused on living up to the AAP's standards for maximized productivity.

The Impact of Interactive Screens on Young Children

The degree to which screens can hinder children's academic achievement is not a new issue. Indeed, the term "boob tube" reflects a prevailing view that too much exposure to television drains intellectual capability. However, good data connecting television watching to poor academic performance hasn't always been available. Probably the most concise way to summarize the existing literature on television viewing is that small correlations (typically around $r = 0.10$ or so) exist between hours spent on television and reduced language and academic performance but that these correlations appear to be due to other factors, not television watching itself. For instance, children from lower socioeconomic status (SES) homes tend to both watch more television and have fewer educational opportunities. But it appears to be the latter, not television watching, that explains reduced academic achievement. The work of Schmidt, Rich, Rifas-Shiman, Oken, and Taveras (2009) is a prime example of this. Once SES and other family factors were controlled, television viewing was no longer predictive of education outcomes in children. This highlights the need for researchers to focus on theoretically derived multivariate analyses of predictors rather than bivariate correlations.

In some cases, policymakers may have been misinformed by poor-quality research and problematic data analysis. One example of this was a study by Zimmerman, Christakis, and Meltzoff (2007) which purported to find a link between watching baby videos such as "Baby Einstein" videos and reduced language development in infants and toddlers. In a resultant press release, the authors claimed such videos harmed children, setting off a long and acrimonious debate that ultimately ended in court with the makers of Baby Einstein suing for access to the Zimmerman et al. (2007) data (see Lewin, 2010). Once the data was released, a reanalysis revealed that it was fundamentally flawed and the data treated in sloppy fashion (e.g., in the original paper, Zimmerman et al. claimed to have control for a variable that did not exist in the dataset). The reanalysis found that baby videos did not appear to be associated with language delays and, in fact, infants and toddlers who avoided screens altogether actually had the worst language outcomes (Ferguson & Donnellan, 2014). This latter finding specifically challenges the AAP's continuing prohibition of screen time for young children, suggesting this recommendation may be counterproductive. This also was not the first time that an article purporting to link screen use with negative outcomes didn't survive scrutiny on reanalysis (Foster & Watkins, 2010).

Among older children, screen use generally appears to be a poor predictor of behavioral and academic outcomes (e.g., Ferguson, 2017; Przybylski, 2014). This dawning awareness is likely what led the AAP to drop the 2-h maximum screen time limit for older children. But it is still possible that negative impacts could occur from too much screen use for younger children. Indeed, few scholars suggest infants and toddlers should have limitless access to screens, but debate remains whether abstinence is the key to success as implied by the AAP under current guidelines or ultimately counterproductive and potentially harmful.

The potential negative impact of screen use for young children can be understood in two ways. Most often this is conceptualized under the "zero-end sum game" as described above. Namely, time spent on screens detracts from more productive activities, particularly time spent with caregivers. However, potential impacts could also be understood from an attentional perspective. This approach suggests that the fast pacing of digital media entertainment (the reader could watch a SpongeBob SquarePants cartoon and notice how quickly frames change) creates an expectation of fast-paced stimulation that detracts from the child's ability to focus on slower-paced interactions more typical of real life.

One of the most notable studies to suggest this latter effect was that of Lillard and Peterson (2011). In an experimental study, the authors randomized a small group of children (n = 60) to watch a fast-paced cartoon (none other than SpongeBob SquarePants) or to control conditions of an educational show or drawing. Results indicated that, immediately afterward, the executive functioning (i.e., ability to plan ahead) of the children who watched SpongeBob SquarePants was impaired relative to children in the other groups. Though small, this was a generally well-designed study, and it is possible that such short-term effects exist after watching a highly exhilarating show. However, it is less clear that such effects persist long-term or cause any real-life harm parents need to be concerned about. Indeed, evidence for an epidemic of executive functioning problems in children during the SpongeBob SquarePants (and similar cartoons) era is lacking, and youth educational achievement as indicated by standardized testing has not shown evidence of a decline since data were first collected in 1992 (childstats.gov, 2017).

Questions about the impact of interactive technology on children go back at least two decades (e.g., Griffiths, 1997), and then, as now, the answers are complex. Part of the issue is that interactive technology does not exist as a uniform construct and quality-based difference exist between interactive toys and screen tools (Luckin, Connolly, Plowman, & Airey, 2003). Thus, and which seems to be a larger point of the Zero to Three policy statement, quality rather than presence or absence of screen technology may be a key issue to consider.

That having been said, some of the work on interactive screen technology has suggested positive potential for the use of this technology with young children. Some scholars have suggested that interactive screens could be harnessed for positive development, ranging for academic achievement through exercise through therapy in youth of all ages (Read & Shortell, 2011). More crucially, recent research has indicated that young children can learn equally well from interactive screen technology as they can through face-to-face interactions (Kwok et al., 2016).

A recent review by Linebarger (2015) likely sums up the current research on interactive screens and cognitive development in children quite well. Ultimately, there can be little question that time with caregivers is the epitome of learning opportunities, and few scholars would seriously suggest that screens should replace caregivers for the majority of an infant's learning time. Part of the issue comes from what is called the "video deficit" in that young children have difficulty translating information in 2D learning environments to 3D real life (Barr, 2010). However, it's not clear that total abstinence (or any relatively arbitrary time limit) is helpful. Linebarger notes that, while infants don't learn as well from screens as from caregivers, that's also true for non-screen media such as books. Parental co-use and content specifically tailored to what infants are capable of learning can enhance the educational opportunities gained by interactive screen media.

Thus, research seems to indicate that a "middle-of-the-road" perspective on young children and screen use is the correct one. Undoubtedly, some media producers have exaggerated claims of the benefits of screen technology for infant learning, and there's little reason to believe that screen learning can replace learning with caregivers. On the other hand, it's equally uncertain that infants should be required to *learn endlessly* and that the occasional silly diversion is harmful. Or put another way, evidence is lacking that small amount of screen time is harmful for infants and toddlers, and there is some evidence that total abstinence, as recommended by the AAP, may be associated with negative rather than positive outcomes.

In the following sections, I consider a few issues related to screen youth in children that may take us to older childhood and adolescent years but which are still important to consider under the general concern about screen time.

Social Media and Smartphones

At the time of this writing, old moral panics over issues such as violence in video games appear to be slowly replaced by newer concerns such as whether children should be allowed access to social media or smartphones. These fears reached a fever pitch when psychologist Jean Twenge wrote an article for the Atlantic asking "Have Smartphones Destroyed a Generation" in 2017 (Twenge, 2017). These types of hyperbolic headlines undoubtedly help sell books but do little to actually inform parents about the pros and cons of social media and smartphone use.

Part of the issue is the tendency for psychologists to gloss over issues of effect size, failing to inform the general public when studies achieve "statistical significance" but have effect sizes that are so tiny they'd be unlikely to be noticed in real life. One infamous example of this occurred with a Facebook study of over 600,000 users (Kramer, Guillory, & Hancock, 2014). The authors manipulated the emotional content of users' news feeds (without their knowledge) and claimed that this resulted in "massive-scale emotional contagion." Naturally, this provoked serious concern, particularly given the ethics of failing to inform the participants they were in an experiment that could impact their mood. However, although the effects on mood (as measured by typed words by the users in their own posts) were "statistically significant," the effect sizes were so miniscule as to be entirely negligible, a point often missed in the discussion (Grohol, 2014). It is an unfortunate element of statistics that very large studies (such as those with 600 k + participants) often produce spurious "statistically significant" results that are of no value whatsoever to the real world. Unfortunately, psychologists do not always have a good track record of communicating this very effectively.

This problem also becomes apparent with Twenge's claims about smartphones and social media. In one analysis of over 500,000 adolescents, Twenge claimed that smartphone and social media use were linked to increases in depression and suicide among youth (Twenge, Joiner, & Rogers, in press.) However, this observation was based on effect sizes so small as to be arguably miniscule and trivial. Indeed, one scholar examining the same dataset noted that the correlation between eating potatoes and suicide/depression was about as large as for smartphones/social media (Gonzalez, 2018). Thus it is clear that parents and the public are getting considerable misinformation about the impact of new technology on young children and adolescents.

In fact, the data on new technology such as social media use is nuanced. Recent evidence is making clear that screen time is a poor predictor of mental health outcomes in children (Przybylski & Weinstein, in press). Nor has evidence found that use of social media is clearly associated with problem outcomes such as body dissatisfaction (Ferguson, Munoz, Garza, & Galindo, 2014). However, that is not quite the same thing as saying that screen use has no associations with behavioral outcomes. What appears to be clearer is that *how* youth use screens can have some influence on their well-being.

What is sometimes called *authentic self-presentation* appears to be associated with positive mental health outcomes (Reinecke & Trepte, 2014). Authentic self-presentation is more or less what it sounds like: using social media to maintain a positive but accurate portrayal of oneself used to keep in touch with others. By contrast, evidence suggests that ruminating over negative comparisons with others (Davila et al., 2012) or vaguebooking (making vague references of despondency; Berryman, Ferguson, & Negy, in press) is associated with negative psychological well-being.

Naturally, we would not typically expect very young children to have Facebook or Instagram accounts (though some might!). However, parents may wonder at what age such accounts might be appropriate. Further, some forms of social media, such as YouTube, may have content that, on first blush, appears to be kid-friendly but which actually is adult-oriented material spoofing kids' entertainment. Thus there are legitimate concerns about some social media and kids regarding issues ranging from privacy, catfishing (adults posing as children on social media, although this appears to be fairly uncommon…no wave of mass child exploitation has developed during the internet age), inappropriately labeled adult-oriented content, as well as issues such as cyberbullying. Some content providers may provide sites specifically designed for kids or youth. There probably is not a one-size-fits-all recommendation for when it's appropriate for parents to allow their kids to use social media, but parents would do well to be informed about the risks that come from social media use for kids, particularly to privacy and related issue, and have a plan for how to monitor their kids' use of social media.

13 Reasons Why and Suicide-Themed Media

One other issue worth briefly considering is that of whether suicide-themed media may promote suicide behaviors in older children and teens. This issue exploded on the scene in summer of 2017 with the release of the Netflix show *13 Reasons Why*, a fictional account of a teen suicide. Many clinicians and professional groups such as the National Organization of School Psychologists (2017) expressed concern that such a show might provoke suicide behaviors among vulnerable teens.

This concern echoes past concerns regarding heavy metal music. In the late 1980s, musicians such as Ozzy Osbourne and Judas Priest were sued by families of suicide victims for allegedly contributing to those suicides through their music. These lawsuits were not successful, but is there any research evidence to support such claims?

Research in this area comes in two forms. Those include studies of suicide rates before and after a popular suicide-themed television show is broadcast and more traditional psychological studies of convenience samples. Most of the former categories of studies were done in the 1980s when the limited selection of TV channels ensured clearer saturation of viewing for any particular show.

To examine this issue, I recently conducted a meta-analysis of 20 published research studies in this realm (Ferguson, 2018). Overall, results did not support the belief that fictional suicide-themed media contributes to youth suicides. There certainly was some variation among studies, with some finding effects, some not, but overall evidence could not support the concerns of some clinicians and professional groups. Further research with more sophisticated designs would definitely be welcome, but caution is suggested regarding clinicians making causal links between fictional media and actual suicide behaviors.

Concluding Thoughts

Parental and policymaker concerns about children's early exposure to screens are unlikely to subside in the near future, particularly as technological innovations continue to occur at breakneck pace. However, it is clear that the news media environment is replete with exaggerated claims of potential harms. Unfortunately, this misinformation is sometimes promoted by professional guild organizations such as the American Academy of Pediatrics. At present, there is little evidence to suggest that moderate screen use in the early years is associated with harm to young children and some evidence to suggest that total screen abstinence may actually backfire. By contrast, parents are well advised to consider the use of screens strategically, focusing on well-designed educational content, parent/child interaction with screens, and balancing screen use with real-life activities. Nonetheless, parents can also rest easy that occasional, brief use of "silly" screens to entertain young children is unlikely to result in noticeable deficits to those children's learning. Parents would benefit from a more cautious and nuanced discussion of screen effects than as often taken place among policymakers, news media, and scholars themselves.

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Playing Action Video Games Boosts Visual Attention

Jing Feng and Ian Spence

Introduction

Video gaming has become one of the most popular leisure activities for children as well as adults. According to a survey by Pew Research Center (Lenhart, Jones, & MacGill, 2008), half of American adults play video games and more than a fifth play every day or almost every day. Even among older adults, nearly a quarter play video games. However, the numbers are substantially higher among teens (97%). Recently, researchers have been investigating the effects of video gaming on cognitive processes and brain functioning. Evidence has pointed toward a specific genre—action video games—linked to enhanced visual attentional capabilities. While much about this specific type of cognitive training still remains to be understood, current evidence suggests a causal relation between action video game playing and improvements in visual attention. Theories have been proposed to account for why action video games provide benefits with visual attention, advancing our understanding of brain plasticity and cognitive intervention. In this chapter, we first review evidence from cross-sectional and training studies, followed by discussions of methodological considerations. We then present existing understandings of neural mechanisms that have been developed by playing action video games. We describe two different proposed theories of learning, and we conclude that playing action video games *does* boost visual attention.

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Playing Action Video Games Boosts Visual Attention

Evidence from Comparing Gamers to Non–Gamers

Group Differences Many studies examining group differences reported differences between action video game players and non-players on various visual attentional processes (for reviews, see Green & Bavelier, 2012; Green, Gorman, & Bavelier, 2016; Spence & Feng, 2010). For example, compared to non-players, action video game players showed greater abilities to instantly enumerate several items (Green & Bavelier, 2003, 2006), to localize a target among distractors across a large field of view (Dye & Bavelier, 2010; Feng, Spence, & Pratt, 2007; Green & Bavelier, 2003; West et al., 2008), to simultaneously track multiple dynamic items (Dye & Bavelier, 2010; Green & Bavelier, 2006), to allocate attention temporally (Dye & Bavelier, 2010; Green & Bavelier, 2003; Pohl et al., 2014), to search for targets in visual displays (Greenfield et al., 1994; Hubert-Wallander, Green, Sugarman, & Bavelier, 2011; Wu & Spence, 2013; Chisholm et al., 2010), and to select a response (West, Al-Aidroos, & Pratt, 2013), with overall faster reaction times in many tasks (e.g., Cain, Prinzmental, Shimamura, & Landau, 2014; Castel, Pratt, & Drummond, 2005; Hubert-Wallander et al., 2011; Wu & Spence, 2013).

A set of investigations on the differences between gamers and non-gamers further explored potential group differences on the top-down or bottom-up aspects of attention. The former are determined by the specific goals (sometimes described as "endogenous") of the observer, while the latter are determined by the salience of objects (sometimes described as "exogenous"). An example of both top-down and bottom-up processes is given when you are searching for a friend's face in a crowd (endogenous goal) and your attention is involuntarily drawn to a sudden movement of a few individuals in the crowd (exogenous stimulus). While there have been mixed findings on the role of bottom-up attentional processing (Dye, Green, & Bavelier, 2009; Hubert-Wallander et al., 2011; West et al., 2008), evidence for superior capabilities in top-down modulation of attention and oculomotor behaviors among action video game players is more consistent across studies (Cain et al., 2014; Greenfield et al., 1994; West, Al-Aidroos, & Pratt, 2013; Wu & Spence, 2013). For example, several studies demonstrated that action video game players were less susceptible to visual distraction than non-gamers in both abstract search stimuli (Chisholm et al., 2010; Chisholm & Kingstone, 2012, 2015a) and more complex and biologically relevant stimuli (Chisholm & Kingstone, 2015b). In another study, action video game players were better at top-down guidance of attention to locate a peripheral target (Wu & Spence, 2013). Similarly, action video game players demonstrated a stronger inhibitory control in oculomotor behavior when searching for a target in the presence of distractors (West, Al-Aidroos, & Pratt, 2013). When performing a task that requires divided attention, action video game players showed superior capability in simultaneously performing two tasks (Strobach, Frensch, & Schubert, 2012; Wu & Spence, 2013) as well as efficiently switching between tasks (Colzato, van Leeuwen, van den Wildenberg, & Hommel, 2010; Green, Sugarman, Medford, Klobusicky, & Bavelier, 2012; Strobach et al., 2012).

Methodological Considerations Comparing action video game players and non-gamers on tasks demanding particular visual attentional processing has been used to study the relation between action video game experience and attentional capabilities. These cross-sectional studies involve careful selection of participants into groups according to their video game experience. One criticism of this method is the lack of blind recruitment that may have led to observed group differences (Boot, Blakely, & Simons, 2011; Kristjánsson, 2013). It is noteworthy that several studies have practiced blind recruitment (Chisholm & Kingstone, 2015b; Clark, Fleck, & Mitroff, 2011; Dye, Green, & Bavelier, 2009; Donohue, Woldorff, & Mitroff, 2010; Hubert-Wallander et al., 2011) and still observed significant differences between gamers and non-gamers in visual attentional capabilities. A more important methodological consideration is that although well-designed observational studies are informative and often suggest further directions of investigation, causation cannot be established without a well-controlled training design.

Evidence from Training Non-gamers Using an Action Video Game

The training method has been used in many studies to determine the causality of action video game playing and changes in attentional capabilities. These training studies typically involve randomly assigning non-gamers to an experimental group and one or several control groups (for examples, see Green & Bavelier, 2003, 2007; Feng, Spence, & Pratt, 2007; Oei & Patterson, 2013; Wu & Spence, 2013) or sometimes even matching the participants between groups for improved precision (for an example, see Spence, Yu, Feng, & Marshman, 2009). This method is important to rule out the possibility that any difference between the pre- and post-tests is merely due to simple repetition or regression to the mean (Barnett, van der Pols, & Dobson, 2005). By comparing participants' performance on the pre- and post-tests and across the experimental and control groups, researchers can determine whether a training effect exists.

Spatial Attention A number of training studies have shown that, with 10 to 30 h of action video game playing, non-video game players improved performance (speed and accuracy) in localizing a target among distractors across a large field of view (Feng, Spence, & Pratt, 2007; Green & Bavelier, 2003, 2006; Oei & Patternson, 2014; Spence et al., 2009). This improvement in target localization in the presence of distractors may be attributed to improved spatial resolution of visual attention because of action video game playing. In one study (Green & Bavelier, 2007), non-players who were trained using an action video game (Unreal Tournament 2004) demonstrated a greater reduction in the crowding threshold (i.e., greater tolerance of the presence of a distractor close to the target) than non-players who were trained using a non-action video game (Tetris). This finding suggested the greater capability of an action video game to enhance the ability to ignore distractors while finding a target. Wu and his colleagues (2012) further explored bottom-up and top-down attentional processes before and after playing an action video game. Bottom-up attentional aspects were not improved after playing a first-person shooter action game, but top-down aspects in spatial selective attention were enhanced via increased inhibition of distractors.

Visual Search The causal effect of action video game playing on visual search performance has been established by several studies. In Wu and Spence (2013), after 10 h of playing an action video game (either a first-person shooter game or a driving game), non-players became faster on both feature and conjunction search, as well as in a dual search (i.e., searching for a peripheral target in the presence of a central search task). The change indicates an improvement in top-down guidance during visual search. Another study (Azizi, Abel, & Stainer, 2017) examined participants' eye movements, revealing a smaller vertical spread in fixations for a game-related search task in the action-game-trained group (although no reduction in spreads were observed when viewing natural scenes), suggesting that participants were learning the likely distribution of targets. In other words, participants were developing an effective search strategy in the game-related scenes.

Temporal Attention Several training studies also examined temporal allocation of attention via attentional blink and masking tasks demonstrating improvements in temporal attention because of action video game playing. After training with an action video game, participants showed reduced effects of a preceding stimulus on the following target (i.e., attentional blink; Green & Bavelier, 2003; Oei & Patternson, 2013) and a following stimulus that masks the preceding target (i.e., backward masking; Li et al., 2010), suggesting increased capacities in the temporal allocation of attention.

Response Selection After training with an action video game, participants were more accurate and quicker in resolving interference when selecting a response, thus demonstrating stronger attentional control (Hutchinson et al., 2016). In contrast, no change was observed in the sight-training and no-training control groups. This finding suggests enhanced conflict resolution during response selection and execution after action video game training.

Multiple Object Tracking Multiple object tracking requires prolonged allocation of attention to several targets. Improvement in this ability was observed in participants after action video game playing (Green & Bavelier, 2006; Oei & Patterson, 2013, 2015). Green and Bavelier (2006) conducted a training study in which participants played either an action video game or a non-action control game. Participants who played the action video game showed a marked enhancement of their capability to track multiple dynamic items. In contrast, participants who played the non-action game did not show much change in performance on the tracking task. In a more recent study by Oei and Patternson (2013), young adults were trained using an action video game for a total of 20 h over 4 weeks. Other groups played games emphasizing deliberate visual search or spatial memory. The researchers found that participants trained with the action video game eliminated attentional blink, improving their cognitive control and the ability to track multiple objects. Interestingly, training using other games led to enhanced visual search performance and working memory, suggesting the importance of shared common underlying demands between the training game and tasks showing cognitive improvements when considering cognitive benefits from video game training (the "common demands" hypothesis; Oei & Patterson, 2014, 2015; see the *Mechanisms of Learning* section in the chapter). In a follow up study (Oei & Patterson, 2015), the researchers examined the training effects of four action video games with varying speed, visual, and attentional demands. The level of training benefit was associated with the demands of a particular action game: the greatest attentional improvement resulted after participants played the most demanding game; smaller effects were produced when participants played a game with fewer attentional demands; and, finally, no training effect resulted when the action game was not demanding.

Dual Tasking and Task Switching Strobach et al. (2012) had participants play either an action video game or a puzzle game for 15 h or had no game training. Only the group trained with the action video game had significant improvements in both dual tasking and task switching. Further analyses of participants' response times revealed much greater gains on dual-task than single-task performance after playing an action video game, implying an enhancement of executive skills rather than an exclusive speedup in mapping stimuli with responses. Green et al. (2012) also explored training effects on the cost to switch between tasks. After playing a video game for 50 h, non-game players who were trained with an action game demonstrated much reduced task-switching costs than those who played a slow-paced non-action game. When a correction to the baseline response time was applied, the training effect was weaker, suggesting a moderate improvement on the task-switching skill, while a strong overall reduction in response time as a result of action video game playing was observed.

Using visual search tasks, Wu and Spence (2013) examined training effects from two action video games and a puzzle game. Non-players were trained using either a first-person shooter action game, a driving action game, or a non-action puzzle game. After 10 h of game playing, participants who played an action game (either the shooter or driving action game) showed much greater gains than participants who played the puzzle game, in searching for a peripheral target in a dual-search task. In addition, gains in speed and accuracy in visual search were found regardless of whether the peripheral stimulus was similar to, or different from, the central stimuli, suggesting improved top-down guidance in visual search.

Methodological Considerations Several important considerations in the design and execution of training studies were discussed by Green et al. (2014), including expectation effects, test-retest effects, the number of cognitive tasks, group selection and assignment, and the interpretation of results. Their paper reviewed various methods used in existing studies, discussed standards, and proposed revisions to some traditional methods to address the noted considerations.

While the field continues to advance with improved methodology, it is encouraging to see that many training studies have already incorporated these improved methods and have shown significant effects of training using various action video games. For example, (because it is impossible to blind participants about the game used for training) adopting a control game that is as similar as possible to the one used in the experimental group is essential to prevent participants from guessing the research hypothesis (as discussed in Green et al., 2014; and Spence & Feng, 2010). In a training study (Oei and Patterson, 2015), a number of action video games emphasizing various cognitive demands were used with one group playing a particular action video game. Training benefits on particular cognitive processes after playing a specific game were identified in this study. Similarly, Wu and Spence (2013) used two intense action games (a first-person shooter game and a driving game) in addition to a puzzle game for training and also found significant training benefits from action game playing. In another study, Anguera et al. (2013) adopted the same driving game for two groups. Participants trained in either the multitasking mode or the single-tasking mode and differential training effects were observed.

Evidence from a Meta-Analysis of Training Studies

While a large body of action video game training experiments have shown significant benefits on visual attentional processes after game playing, there have also been contradictory findings. For example, one training study did not yield significant benefits from action video game training (Boot et al., 2008): it is possible that such differential findings could be due to the discrepancies in methodology (e.g., see discussions in Strobach, Frensch, & Schubert, 2012; Green, Sugarman, Medford, Klobusicky, & Bavelier, 2012; Oei & Patterson, 2014). To further examine these mixed findings among individual empirical evidence on video game training, several studies have used the meta-analytic method (e.g., Bediou et al., 2018; Ferguson, 2007; Powers et al., 2013; Toril, Reales, & Ballesteros, 2014; Wang et al., 2016). Meta-analyses can be used to investigate the training effects based on collective evidence from multiple empirical studies thus providing the benefit of a much larger sample size compared to a single study. Moreover, meta-analyses offer the means to assess the effects of various moderating factors such as training and individual characteristics that may influence the effectiveness of video game training. In a recent meta-analytic study that focused on the effect of action video game training (Wang et al., 2016), a systematic search of studies published between January 1986 and July 2015 was conducted, and 20 training studies that involved action video games were identified. Based on these 20 studies, the meta-analysis included more than 300 participants in each of the training and the control groups. The researchers examined the general effect of action video game training on healthy adults as well as the effect of various moderating factors on the training outcomes including participants' age, education, number of training sessions, session duration, total training duration, and control group type. Among benefits on other cognitive processes after action video game training, the study found moderate enhancements in processing speed and attention in both younger and older adults. In addition, several moderating factors, including years of education, session duration, number of sessions, and total training duration were significantly associated with the size of training effects. Such meta-analytic examination provides insights into potentially important individual and training-related factors that play a role in the effectiveness of action video game training.

Neuromechanisms of Visual Attentional Improvements

Research has explored several neural mechanisms that may underlie training effects from playing an action video game on visual attention (see Green, Gorman, & Bavelier, 2016; for a review on general video game playing, see Palaus, Marron, Viejo-Sobera, & Redolar-Ripoll, 2017). In one study, researchers measured brain activities of action game players and non-players during an attentionally demanding task (Mishra, Zinni, Bavelier, & Hillyard, 2011): game players were faster and more accurate on the attentional task and showed a stronger suppression of brain activities associated with stimuli in areas that were not cued. This finding suggests enhanced suppression of irrelevant distractors among action game players. Similar suppression effects on brain activities related to distracting stimuli were observed by Krishnan, Kang, Sperling, and Srinivasan (2013); action video game players exerted increased suppression with greater task demands. An event-related potential (ERP) component (P3) indexing attentional control has also been examined in relation to action video game playing. Action video game players demonstrated greater P3 amplitudes than non-players (Mishra et al., 2011), and a later training study (Wu et al., 2012) established the causal link. After initial training, participants who had played an action video game and also demonstrated greatest improvement on the attentional task showed significantly increased amplitudes in the later ERP component (P3). In addition to EEG, brain imaging was also used to understand the recruitment of attentional neural networks and distractor processing in action video game players and non-players (Bavelier, Achtman, Mani, & Föcker, 2011). Compared to non-players, action video game players showed less activation of the visual cortical area (MT) for processing motion and less engagement of frontoparietal network during an attentional task. These results are in line with the hypothesis of greater attentional capabilities, better distractor suppression, and improved top-down attentional control among action video game players. The neural evidence is highly consistent with behavioral findings, suggesting improved top-down attentional control.

Mechanisms of Learning

It is widely agreed that video games—in general—provide personalized learning opportunities (e.g., tailored learning speed and task difficulty), a highly engaging environment, and strong reinforcement, all of which are critical to successful learning. An important exception has been documented by Ferguson (2015), who reviewed several studies demonstrating that children *do not learn aggression* from playing action video games and *do not subsequently engage in violence* in the real world proportional to their action video game experience.

Based on much evidence suggesting cognitive effects that result after playing action video games, two hypotheses have been proposed to explain these training effects. The major debate between the two hypotheses is whether the training effects are task-specific or more general. In most training studies, the tasks used for testing training effects usually engage cognitive processes that are relatively similar to those involved in action video game playing; it has been speculated that a common demand between the tasks and training is a possible mechanism of many observed training effects (Oei & Patterson, 2014). Meanwhile, as the benefit from playing action video games has been shown on a wide range of tasks, of much greater breath and more profound than the traditional perceptual learning literature suggests, some researchers have proposed that the attentional enhancements could also be a result of general improvements in attentional control and the ability to learn (Bavelier et al., 2012; Green & Bavelier, 2012). In the following sections, we briefly review two hypotheses proposing learning mechanisms to account for the visual attentional training effects observed after action video game playing.

Common Demand Hypothesis

According to the *common demand hypothesis*, training effects from video game playing are task-specific, with cognitive improvements only on tasks that share common elements or demands with the game used for training. Evidence supporting this hypothesis comes from findings showing that cognitive improvements were not limited to action video games but rather depended on the characteristics of a particular game. In a training study, Oei and Patterson (2013) used five different video games including one action game and other non-action games intensely involving processes such as memory and visual search. Their experiment found visual attentional improvements after playing action video games. Interestingly, playing non-action video games also led to various cognitive improvements in the mental processes recruited during game playing. Similar results of specific training benefits linked to particular game characteristics were found using four different action video games (Oei & Patterson, 2015). Another training study found enhancements in visual attention reflected in eye movements only when participants viewed game-related images but not when they viewed natural scenes (Azizi et al., 2017). This finding suggests benefits limited to a task highly similar to the game, although cross-sectional studies have shown the difference between action game players and non-players in tasks using abstract stimuli as well as more complex and biologically relevant stimuli (see Chisholm et al. (2010) and Chisholm and Kingstone (2012, 2015a, 2015b) for examples). In support of the same view, neuroimaging evidence suggests that transfer is more likely when training and tasks for testing transfer recruit overlapping brain regions (Dahlin et al., 2008). This hypothesis highlights the importance of understanding the training components of specific games rather than merely focusing on a particular genre of games.

Learning to Learn Hypothesis

The learning to learn hypothesis proposes a general improvement in attentional control, which allows action video game players to extract patterns from a given task more effectively, therefore enabling more efficient learning on the task (Bavelier, Green, Pouget, & Schrater, 2012; Green & Bavelier, 2012; Green, Gorman, & Bavelier, 2016; Green, Pouget, & Bavelier, 2010). In contrast to task-specific learning (including learning the specific statistics in the practiced tasks), the *learning to learn hypothesis* posits no performance difference between action video game players and non-gamers at the beginning of a task. However, action game players master the task more quickly as they experience it. More specifically, the hypothesis proposes various channels through which learning takes place. These include enhanced attentional capacity, better allocation of a limited attentional resource, changes in the knowledge representation of a task, and modification to learning rules (for a detailed discussion, see Bavelier et al., 2012).

To examine this hypothesis, one study compared action video game players and non-gamers on their performance on a new orientation discrimination task and found comparable performance by the gamers and non-gamers in the first few trials of the task but more rapid learning among gamers later in the task (Bejjanki et al., 2014). Another study (Gozli, Bavelier, & Pratt, 2014) used a movement tracking task and demonstrated overall superior performance by gamers than non-gamers with similar initial performance. Interestingly, superior performance among action game players was only present when the target motion was consistent across trials; thus, the task had a consistent and predictable structure. When the target motion changed every trial, no differences between gamers and non-gamers were identified. This finding is consistent with the proposed learning mechanism that action video game players' enhanced capability to learn is more effective in tasks when perceptual templates can be extracted and remains informative.

Conclusion

The growing body of literature on attention and gaming suggests a connection between action game playing and improved visual attentional performance, particularly on aspects that involve top-down control of attention. Because they are engaging and moldable, video games provide a unique window into brain plasticity and how we learn highly complex tasks. As video games become pervasive in education, healthcare, and even the workplace, applications of action video gaming in cognitive training could be profound. It is important to continue investigations in the cognitive effects of action video game playing, with evolving methodology and advanced cognitive and neuroscience techniques.

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Action Video Games *DO NOT* Promote Visual Attention

Nelson A. Roque and Walter R. Boot

Introduction

In recent years, the idea that perceptual and cognitive abilities are malleable (and trainable over a short period of time) has received a great deal of attention and has been the subject of intense controversy. In 2014, a group of over seventy scientists with expertise in learning, skill acquisition, and neuroscience published a consensus statement. This consensus statement concluded that current evidence did not support the claim that cognitive interventions, including interventions involving commercial and custom video games, can meaningfully improve cognition or stave off cognitive decline (Stanford Center on Longevity, 2014). In the months following this initial consensus statement, another group of researchers and practitioners (over 130 in all) published a *counter*-consensus statement. Although this group admitted that marketing claims by brain game companies frequently go beyond the evidence, they also made the strong claim that behavioral interventions, including brain games currently on the market, have been proven effective and are worthwhile (Cognitive Training Data, 2014). Interestingly, some individuals endorsed both statements. The safest conclusion that can be drawn from these conflicting statements is a general lack of consensus.

How did two camps of researchers and practitioners arrive at opposing conclusions after viewing the same large body of research? Discrepant views appear to derive largely from what each side considers compelling evidence for brain game benefits (see Simons et al., 2016, for an extended discussion). The US Federal Trade Commission has weighed in as well. In 2016, the FTC fined Lumos Labs (makers of the brain game software package Lumosity) 50 million dollars for deceptive advertising. The FTC did not find what it considered compelling evidence that their games could meaningfully improve cognition, make Lumosity users better athletes,

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or make them more successful at school or work. The FTC has lodged similar charges against companies claiming that their intervention can improve vision or IQ. The idea that training on one task (e.g., a brain training video game) can improve the performance of other untrained tasks (e.g., driving) by improving general perceptual and cognitive abilities is not only controversial, it is also inconsistent with much of what we know about how people learn (i.e., that training gains appear to be very specific to the trained task).

In the context of this broader debate, there have been strong claims made regarding a specific type of training and its potential to improve a variety of perceptual and cognitive abilities: action video game training. Action video games, typically defined as fast-paced games that place high demands on vision and attention, have been proposed to improve the performance of a host of different tasks. This could only be true if, similar to claims regarding brain games, action game training is capable of improving general abilities instead of just the performance of the trained games.

Research on the cognitive effects of action video games goes back nearly three decades (e.g., Clark et al., 1987; Greenfield, DeWinstanley, Kilpatrick, & Kaye, 1994). Much of the recent research on action video games has been inspired by groundbreaking studies conducted by C. Shawn Green and Daphne Bavelier, starting with studies first reported in a highly influential paper published in *Nature* 15 years ago (Green & Bavelier, 2003). These studies demonstrated that on four laboratory measures tapping the breadth, capacity, and flexibility of visual attention, habitual action video game players (who played action games 1 h per day for at least 4 days each week over the past 6 months) significantly outperformed non-gamers (individuals with minimal or no video game experience over the same period). The paper goes on to report that non-gaming participants who were randomly assigned to receive 10 h of action game experience (first-person shooter) improved significantly more on three of these tasks compared to participants who received training on a non-action game (Tetris). A number of follow-up studies appear to confirm similar differences between action gamers and non-gamers and also action game training effects for a diverse number of laboratory tasks measuring vision, attention, executive control, visual short-term memory, and more (e.g., Blacker, Curby, Klobusicky, & Chein, 2014; Green & Bavelier, 2006a; Green & Bavelier, 2006a; Green & Bavelier, 2007; Green, Pouget, & Bavelier, 2010; Li et al., 2009; Li et al., 2010; Strobach, Frensch, & Shubert, 2012).

If it is true that visual and attentional abilities are highly malleable, and can be improved with as few as 10 hours of action video game training, this represents an exciting opportunity. These abilities are fundamental to our successful interactions with the world (e.g., crash avoidance while driving; Owsley, McGwin, & Ball, 1998). Further, there may be exciting opportunities for the rehabilitation of clinical populations experiencing visual deficits or problems with attention (e.g., patients experiencing visual neglect after stroke). However, just as some have criticized the evidence that brain games can improve perceptual and cognitive abilities, some researchers have also questioned the robustness of the evidence that action video games can improve visual and attentional abilities. Given the importance of these findings for our theoretical understanding of perceptual learning and training, and also the applied implications of these findings for how we might go about improving the performance of important and sometimes safety-critical tasks, it is vital that the conclusions regarding action video game effects be based on consistently reproducible and methodologically sound studies.

The previous chapter by Spence and colleagues discussed evidence that video games DO promote visual attention. We will not reiterate that evidence here, but instead we provide an alternative interpretation of this evidence and a more detailed discussion of findings inconsistent with this view. In this chapter, we make the argument that action video games DO NOT promote visual attention, consistent with the debate format of this book. However, in reality, our view is more nuanced; the studies that have been conducted on this subject to date do not unambiguously support this claim, and there are enough studies in the literature that have not found action game effects to suggest that if action game effects exist, they are much smaller and more fragile than originally thought.

A Critical Review of the Evidence for Action Game Effects

What types of studies do proponents of action game effects cite to support their claims, and what kinds of conclusions can be drawn from these studies? Many studies in the literature are cross-sectional in nature and compare the cognitive abilities of gamers and non-gamers or try to associate the amount of experience an individual has with action games and their performance on tests of cognition. This constitutes the majority of the evidence linking action video game play to superior perceptual and cognitive abilities. In addition to cross-sectional studies, proponents of action game effects also cite intervention studies. These are studies in which participants are randomly assigned to receive action video game training or not. These studies are much more difficult to conduct and are unsurprisingly rarer. As we will discuss later, there are clear advantages to intervention studies with respect to being able to make claims that action video game play *caused* superior perceptual and cognitive abilities. However, a number of other important conditions must be met (but unfortunately rarely are) in intervention studies in order to make strong causal claims.

The Limits of Cross–Sectional Action Game Studies

Many of the studies in the literature compare the visual and attentional abilities of gamers and non-gamers and then suggest (or sometimes erroneously state) that action games improve these abilities based on this comparison. Take, for example, a study by Wilms, Petersen, and Vangkilde (2013) titled "Intensive video gaming improves encoding speed to visual short-term memory in young male adults." The use of the verb *improves* is notable here, in addition to the statement that their study was designed to "measure the effect of action video gaming on central elements of visual attention…." A cross-sectional study design cannot provide evidence that action video games improve abilities, nor is it an appropriate design to measure the effect of action video games. This is just one of a number of cross-sectional gaming studies that discusses *improved* or *enhanced* abilities, uses causal verbs such as *reduces*, or claims to examine the *impact* of action video games (e.g., Blacker & Curby, 2013; Cain, Landau, & Shimamura, 2012; Vallett, Lamb, & Anetta, 2013). Despite the use of imprecise language that implies causality, most of these studies rightfully acknowledge the limits of cross-sectional study designs. It is important to keep these limitations in mind both when discussing and interpreting observed perceptual and cognitive differences between action gamers and non-gamers.

Directionality and Third Variable Problems

Imagine a study that measured the heights of basketball players and non-basketball players and concluded that playing basketball makes people taller. Most readers would not be convinced by this argument; being taller provides certain advantage in the game of basketball, and taller people are more likely to play and succeed in the sport. A similar argument can be made regarding cross-sectional action video game studies. Fast reflexes and good vision and attention are required to succeed at these visually and attentionally demanding games, and people with the abilities to succeed at these games may gravitate toward them and continue to play them over an extended period of time. Game play in this case doesn't necessarily cause superior perceptual and cognitive abilities; it may be a consequence of them. In the absence of additional evidence, we should be skeptical regarding claims based solely on cross-sectional studies.

In addition to this directionality problem (does game play cause superior abilities, or do superior abilities cause game play?), potential third-variable problems cloud the interpretation of cross-sectional video game findings. That is, there could be other differences between gamers and non-gamers (besides their game play habits) that influence both the degree to which they play games and their performance on measures of cognition. Unfortunately, most cross-sectional studies do little to control for the potential effect of these "third variables." At most, these studies typically control for gender, age, and education (most participants are college-aged students), but some studies fail to match action game and non-action game participants even on these basic demographic variables. For example, Morin-Moncet et al. (2016) compared a 17% female action game group to a 58% female non-game group. Cain, Landau, and Shimamura (2012) compared an all-male action game group to a 62% female non-game group. Gender may or may not influence performance of the task of interest in these studies, but these studies highlight that frequent gamers and non-gamers may in fact differ on variables other than their game experience. A major limitation of cross-sectional studies is that some unmeasured third variable might cause both more game play and better perceptual and cognitive abilities in the absence of a direct causal link between game play and cognition. Similar arguments have been made regarding the potential relationship between violent video game play and aggression (e.g., Ferguson et al., 2008).

Overt Participant Recruitment

Another criticism that has been leveled against a large number of cross-sectional studies is the manner in which participants have been recruited (Boot, Blakely, & Simons, 2011; Kristjánsson, 2013). The most common form of recruitment is posters, flyers, and advertisement that specifically mention the fact that action gamers (or non-gamers) are sought. Boot, Blakely, and Simons (2011) argue that if gamers know they're being recruited for their expertise in fast-paced visually and attentionally demanding action video games, they may be biased to perform better on fast-paced visually and attentionally demanding laboratory tasks. In other words, demand characteristics created through recruitment materials may be responsible for observed differences in performance. Kristjánsson (2013) points to evidence that most overtly recruited action game participants can correctly guess the hypothesis that they are expected to perform better in the laboratory. Further, Dale and Green (2017) reference an unpublished meta-analysis showing that whether participants are recruited overtly or covertly does make a difference, potentially inflating the size of game effects (though they claim the effect is relatively small). These concerns are worth further exploration in order to rule out the possibility that overt recruitment may be responsible for all or part of the observed differences between gamers and non-gamers.

Action Video Game Intervention Studies

Intervention studies, in theory, can allow strong causal conclusions to be drawn regarding the effects of action video game play (i.e., action video games caused vision and attention to improve). These studies often involve non-gamers being randomly assigned to receive action game experience (intervention group) or not (control group). Random assignment (on average) makes it unlikely that any performance differences between the intervention and control groups are the result of pre-existing differences, and random assignment also overcomes any potential self-selection effects. However, strong causal conclusions also depend on a strong control group, one that can adequately address the problem of potential placebo effects. Unfortunately, evidence suggests that the control groups typically used in action game studies are not adequate. This calls the conclusions of action game intervention studies into doubt.

Control Groups and Placebo Effects

Simons et al. (2016) conducted a comprehensive review of the evidence that a variety of interventions are capable of improving cognition. What they found was that many studies did not adequately control for placebo effects. Placebo effects are improvements not due to the treatment itself but because one expects to improve after undergoing some kind of treatment. Receiving no treatment at all is unlikely to generate any expectation of improvement, and many of the studies reviewed involved cognitive or game training compared to control groups that did nothing at all. This would be analogous to being in a drug trial and being assigned to a condition that did not receive a drug. Would you expect to improve? Most likely not. Any observed difference in these studies between the intervention group and control group is plausibly explained by a placebo effect.

The action video game literature is notable for using much better control groups compared to many brain training studies. Action game studies often compare a group that receives action game training to one that receives the same amount of non-action game training. Tetris and The Sims training are two of the most common control conditions. Active control groups that engage in some kind of alternative activity have much greater potential with respect to equating expectations between intervention and the control groups (since doing something is likely to generate a greater expectation for improvement compared to doing nothing). However, is the mere presence of an active control group enough to ensure that the expectation of improvement for the intervention and control groups is equated? If the control condition involved watching 10 hours of reality television, would the group receiving this treatment expect that their cognition will improve? If expectations differ between intervention and control groups, and these expectations coincide with study outcomes, any observed effects are nearly impossible to distinguish from placebo effects.

Boot, Simons, Stohart, and Stutts (2013) explored whether participants might have similar expectations regarding action game training involving first-person shooters and training involving the two most common control games used in the action game literature (Tetris, The Sims). In these studies, participants watched a video of one of these games and then watched videos and read descriptions of common outcome measures used in action game studies (e.g., Multiple Object Tracking, Useful Field of View). Participants were then asked to indicate whether they expected training on the game they viewed to improve performance of each cognitive measure. What was found was a remarkable congruency between expected improvements and actual improvements observed in the action video game literature. Participants expected significantly greater improvement on the Useful Field of View and Multiple Object Tracking tasks from action game training compared to non-action game training, consistent with previous action game studies (e.g., Green & Bavelier, 2003, 2006a, 2006b). Participants also expected a high degree of improvement on a Mental Rotation task from Tetris training and significantly more improvement from Tetris training compared to action game training, also consistent with previous findings (e.g., Boot et al., 2008; Okagaki & Frensch, 1994). Finally, it was observed that expectations were specific. In general, participants expected very little effect of any type of game training on episodic memory. Given these differences in expectations between intervention and control groups, Boot et al. (2013) raise the possibility that many of the observed effects in the literature can plausibly be explained by placebo effects.

Can expectations really influence the performance of laboratory measures of cognition? Foroughi et al. (2016) recently tested this idea. They recruited participants using either generic flyers seeking participants or flyers that specifically mentioned participants were sought for a brain training study. These latter flyers also mentioned the benefits of brain training. Cognitive performance was assessed using a standard measure of reasoning before and after all participants received a trivial amount of brain training (1 h). Critically, participants who responded to the brain training flyer improved after training, while participants who responded to the generic flyer did not. Since all participants received the exact same training (and an implausible dosage to generate any real benefit), the most plausible explanation is that differences in improvement were driven by differential expectations. Either the brain training flyers generated an expectation for improvement in the participants who responded to them, or individuals with greater expectations for the efficacy of brain training differentially responded to these flyers. This effect, like all effects, needs to be replicated to ensure that they are robust and other cognitive tests need to be explored in order to understand their susceptibility to placebo effects. However, given that action games generate differential expectations for improvement and that action game studies rarely measure and control for participants' expectations, placebo effects must be ruled out before definitive conclusions can be drawn regarding the efficacy of action video game training.

The Importance of Replication

Currently psychology is in the midst of what some are calling a replication crisis. Many studies in the psychology literature, even studies considered so fundamental as to be taught in introductory psychology textbooks, do not appear to replicate. This may partly be due to questionable research practices such as "p-hacking" (conducing multiple analyses until a significant result is found; Simmons, Nelson, & Simonsohn, 2011) and harking (hypothesizing after results are known; Kerr, 1998) but also to a more general bias in which chance findings (Type I errors) are more likely to be published compared to null results (Francis, 2012; Ioannidis, 2005). Given the recent emphasis on replication in psychology and other fields, it is important to consider whether action video game effects represent a replicable phenomenon.

Replication Failures (Intervention Studies)

Published failures to replicate cross-sectional and intervention studies need to be considered when evaluating the claim that action video games are associated with or cause superior vision and attention. For example, Boot et al. (2008) conducted a fairly close replication of the study conducted by Green and Bavelier (2003) and found no action game training effects even though participants underwent twice the number of hours of training. It's possible that methodological differences (e.g., three assessment points instead of two and small differences in properties of the outcome measures) can account for the different results of these two studies. However, if true, this highlights the fragility of action game effects, and these findings are not encouraging with respect to claims that action game training results in generalizable ability changes. Van Ravenzwaaij et al. (2014), inspired by the results of Green, Pouget, and Bavelier (2010), aimed to replicate and extend the finding that action video game training can increase the speed of visual information processing. In two training studies, one involving 10 h of training and the other involving 20 h of training, no action game effects were observed. This study cleverly attempted to bypass expectation effects by telling participants that the outcome measure was the training task and performance on their assigned video game was the primary measure of interest (when the reverse was true). A study of older adults by Belchior et al. (2013) found no difference in the amount improvement on the Useful Field of View task between action and non-action game trained participants (though both groups improved more than a control group that received no training at all). Finally, as reported by Simons et al. (2016), Wu, Cheng, Feng, and D'Angelo (2012) examined 10 h of training on an action game compared to a non-action game, with the outcome measure being performance of the Useful Field of View task assessed before and after training. Though the time by condition interaction needed to support an action game effect was not reported in the published paper, Simons et al. (2016) calculated the p values for relevant interactions to be non-significant (0.29 and 0.49 for stimuli appearing at near and far eccentricities). This experiment, like the study by Boot et al. (2008), does not appear to provide strong evidence for action game training effects.

Replication Failures (Cross–Sectional Studies)

A number of cross-sectional failures to replicate have been published as well. Although not a direct replication of any previous finding, Unsworth et al. (2015) conducted a set of studies exploring the relationship between experience with different types of video games and working memory, fluid intelligence, and attentional control in a conceptual replication. Two studies included over 800 participants. These studies were also notable in that they assessed cognitive abilities using multiple measures of each cognitive construct (analyses were performed at the latent construct level). Experiment 1 ($N = 252$) found no association between experience with first-person shooters or action games and attentional control. The same was true of Experiment 2 ($N = 586$). In the end, the authors conclude that there was little or no evidence to support associations between any type of game experience and cognitive abilities (but see Green et al. (2017) for a critique of these studies and Redick et al. (2017) for a response).

More direct failures to replicate cross-sectional effects can be observed in the literature as well. Gasper et al. (2014) examined whether action games might be associated with better dual-task performance (talking while crossing a busy simulated intersection). This hypothesis was not supported. This study also included a battery of cognitive tests that assessed Useful Field of View, attentional control, and short-term memory. Action game experience was not associated with the performance of any of these measures even though previous studies have reported performance differences between action gamer and non-gamers. Donohue, James, Eslick, and Mitroff (2012) also examined potential differences between gamers and non-gamers with respect to dual-tasking ability. No differences were observed between action gamers and non-gamers, and no differences were observed on single or dual-task measures of Multiple Object Tracking (MOT) or visual search. This is notable since previous game effects have observed differences between action gamers and non-gamers on measures MOT. Murphey and Spencer (2009) and Irons, Remington, and McLean (2011) found limited evidence that action game play was associated with better performance on some of the same measures reported by Green and Bavelier (2003). Cain, Prinzmetal, Shimamura and Landau (2014) explored differences between action gamers and non-gamers using a number of measures. While some attentional differences were observed, no differences were observed on the Attention Blink task, a measure of the temporal limits of attentional processing. This was despite the fact that a robust difference was observed by Green and Bavelier (2003). Consistent with the study by Cain and colleagues (2014), Boot et al. (2008) also did not observe a difference between action gamers and non-gamers on this task.

Recently, Dale and Green (2017) examined whether real-time strategy players or action game players differed on a number of measures of attention compared to non-gamers, using tasks that have previously been shown to be sensitive to action game effects including the Useful Field of View, Attention Blink, and Multiple Object Tracking tasks. Although this study found a significant difference between action gamers and non-gamers on the Useful Field of View task, previously reported effects on Multiple Object Tracking and Attention Blink task performance were not observed (though an unplanned analysis showed that for one condition out of five, there was a significant action game effect in the Multiple Object Tracking task). Action gamers were, however, overall faster in their responses and demonstrated smaller switch costs in a task-switching paradigm. This particular paper presents a complex picture, with some action game effects replicating and other effects not replicating.

Publication Bias

It is well known that positive results are more likely to be published than null results (Rosenthal, 1979), possibly resulting in an overly optimistic view of the effects of video games on perception and cognition. A number of meta-analyses find evidence for publication bias in the video game literature and that game effects shrink when publication bias is taken into account (e.g., Bediou et al., 2018; Ferguson, 2007; Powers et al., 2013). Bediou and colleagues (2018) estimate that published action game effect sizes may be inflated by 32%. Interestingly, this same meta-analysis finds that action game effects are reliably associated with one lab. Studies from the Bavelier lab find a large and significant game effect ($g = 1.03$, $p = 0.001$), but studies conducted by other labs do not ($g = 0.20$, $p = 0.11$). This raises concerns about the robustness of action game effects. One of the most comprehensive meta-analyses of the subject to date, Sala, Tatlidil, and Gobet (2018), finds a small action game effect ($g = 0.10$, $p = 0.068$) that shrinks to zero when publication bias corrections are applied. Meta-analyses provide an overall picture of the literature and at a minimum point to the fact that action game effects may be smaller than reported, and some analyses are more consistent with no effect at all.

Conclusion

After reviewing the large body of literature exploring the potential effects of video games on cognition, we are still left with a burning question: Do action video games promote visual and attentional abilities? The simple answer – considering the current methodological landscape of the literature – is: we cannot say for certain. Methodological challenges make previously reported findings difficult to interpret (for more detailed discussion, we refer the reader to the following: Boot, Blakely, Simons, 2011; Boot, Simons, Stohart, and Stutts, 2013; Green, Strobach, and Schubert, 2014; Kristjánsson, 2013; and Simons et al., 2016). Cross-sectional studies cannot provide evidence that action games improve cognition and recruitment strategies used by these studies have the potential to bias results in favor of better performance by action gamers. Intervention studies can overcome many of the problems associated with cross-sectional studies, but it's unclear whether these studies use appropriate control groups. Almost no action game studies measure expectations during the design phase of the study or as part of the intervention protocol. As a result, placebo effects cannot be ruled out. In addition to these methodological challenges, a number of failures to replicate action game effects in the literature (cross-sectional and intervention studies) call into question the size and robustness of action video game effects. Until these issues are resolved, we urge skepticism regarding the ability of action games to improve cognition and recommend against using action game interventions to improve everyday performance or as rehabilitation tools.

Proposed Solutions

In this section, we make recommendations for how to provide more definitive evidence that action video games improve a variety of perceptual and cognitive abilities. Game intervention studies are cognitive intervention studies, and Simons et al. (2016) provide comprehensive guidelines to follow. We summarize a few of those points here, in addition to points related to cross-sectional studies and the communication of results.

1. To facilitate accurate communication of results to scientists, the public, and the media, use precise language when discussing study findings. Do not use language that implies causation when discussing cross-sectional results (e.g., improved, enhanced, reduced).
2. When feasible, use covert recruitment strategies to rule out potential bias. This may be accomplished through a prescreening phase that is often a component of many large undergraduate participant pools. This may involve having all participants answer some basic questions about themselves early in the semester. This prescreening might include a few questions related to game experience, and participants can then be invited to the laboratory based on their game experience without them knowing why they have been selected.
3. Whenever possible, confirm cross-sectional results with intervention studies.
4. To better rule out placebo effects, measure and equate expectation effects during the pilot phase of a study. Expectations can also be assessed during or after an intervention. This is less preferred, as these questions may bias participants, and if asked at the end of a study, answers may reflect a participant's accurate perception of their own improvement (resulting in a correlation between expectation and improvement that is not driven by a placebo effect). See Rabipour and Davidson (2015) for a recent attempt to design a measure of cognitive intervention expectations.
5. Whenever possible, run large sampled studies (100 participants or more per group). In addition to being able to detect relatively small effects, and providing more precise estimates of effect size, large samples facilitate the exploration of moderator effects (individual difference characteristics that may determine whether an individual will show a game effect or not).
6. To increase confidence in reported results, preregister the study design, all outcome measures, and the analysis approach that will be used (http://osf.io).
7. Acknowledge all outcome measures collected and the connection between different publications if the results of a single study are split across several papers. Not doing so creates an inaccurate perception in the literature that more independent replications of game effects exist than actually do (Boot, Blakely, and Simons, 2011).

By following these guidelines, we can begin to understand the true potential of games to improve perceptual and cognitive abilities, expand our knowledge of the principles guiding learning and transfer, and potentially design effective interventions to improve cognition and reduce age-related cognitive decline if game effects survive greater scrutiny. If they do not, this pushes researchers toward more promising approaches to answering important questions with significant theoretical and practical implications.

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The Concerns Surrounding Sexist Content in Digital Games

Jessica E. Tompkins and Teresa Lynch

A considerable amount of academic research has observed patterns of sexist and stereotypical portrayals of male and female characters in digital games (Beasley & Standley, 2002; Burgess, Stermer, & Burgess, 2007; Dietz, 1998; Downs & Smith, 2010; Williams, Martins, Consalvo, & Ivory, 2009). The objective of this chapter is not to rehash these findings; indeed, other scholars have provided comprehensive literature reviews on this topic (Lynch, Tompkins, van Driel, & Fritz, 2016; Martins, Williams, Harrison, & Ratan, 2009; Martins, Williams, Ratan, & Harrison, 2011). In sum, the general conclusion of such reports is that digital game characters very often signify aspects of sexism. Female digital game characters are more likely to be sexualized than male characters and are underrepresented (Beasley & Standley, 2002; Downs & Smith, 2010), are frequently portrayed with unrealistic bodies by design (Martins et al., 2009), and have been observed in sexist roles, ranging from evil seductresses to damsels in distress (see Dietz, 1998; although, there have been contrary findings to the observation surrounding submissive damsel characters in more recent games, cf. Jansz & Martis, 2007; Lynch et al., 2016). For these reasons, feminist critiques of games and the medium's role within the broader media ecology raise legitimate concerns about women's portrayals and how these portrayals may contribute to/reinforce negative beliefs about women in contemporary society (see Salter & Blodgett, 2012).

Male characters in digital games also embody sexist traits. Masculine portrayals are often consistent with "hegemonic masculinity" or the cultural ideals for the male gender which subordinate women at a global level (Connell, 1987). Male characters, more frequently featured in digital games (Williams et al., 2009), are commonly

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presented as hypermasculine and violent (Burgess et al., 2007). The prototypical sexist male character is embodied by the iconic Duke Nukem of the *Duke Nukem* series (1991–2016). Duke Nukem's characterization features bulging muscles, an A-shirt colloquially referred to as a "wife-beater" tank top, and lewd remarks during gameplay such as "my balls, your face" in 2011's *Duke Nukem Forever*.

Yet the question remains if sexualized and sexist portrayals influence players of digital games. In this chapter, we will draw on evidence from empirical research (e.g., Behm-Morawitz & Mastro, 2009; Fox & Bailenson, 2009; Fox, Bailenson, & Tricase, 2013) to argue that critiques of sexist character portrayals have legitimacy and that this content may undesirably influence some players' cognition, attitudes, and behaviors both during and after gameplay. What we do not intend to do, in this chapter, is make claims of direct effects or demonize an entire media industry or its audience. Indeed, direct effects perspectives of media influence (e.g., the magic bullet theory) have long been laid to rest, and today, most social scientists agree that many factors contribute to the likelihood that media content will influence an individual in positive or negative ways. Additionally, we recognize as members of both the video game industry's audience and critics that the industry has made strides to address issues of sexism (e.g., Lara Croft's less sexualized portrayal in the 2013 reboot of *Tomb Raider*). Nevertheless, sexist patterns persist in content and broader gamer culture. In this chapter, we aim to articulate a dispassionate, evidence-supported argument that sexist content in games does contribute problematically to perceptions of women and their status in contemporary society.

Sexualized Content = Sexist Game?

Sexism is conceptualized as stereotypes, prejudice, or discrimination against one sex as inferior than the other (Abrams, Viki, Masser, & Bohner, 2003). Sexism emerges, in part, due to observations of the activities and roles of men and women in society (Glick et al., 2000; Wood & Eagly, 2012). In patriarchal societies, women typically hold inferior status and privilege relative to men (Swami et al., 2010). Digital games often feature male and female human characters, presenting opportunities for players to make such observations. Although sexual objectification of female characters remains a much-considered concern, sexualization is only one possible dimension of sexist portrayals. For instance, sexism seems apparent when the sexualized female is portrayed as helpless and/or as an object, such as the school girls used for awarding points to players in *Duke Nukem Forever's* "capture the babe" game mode (developed by 3D Realms and Gearbox Software, 2011). Depending on the context, sexualization may not necessarily be interpreted as sexist if a virtual heroine, such as *Tomb Raider's* Lara Croft, is perceived as a feminist icon because she subverts expectations of female capability in games (Kennedy, 2002).

So, what distinguishes a digital game that features sexist content from one that simply features sexy and/or sexual content? Sexually provocative imagery and sexist content are sometimes conflated in discussions surrounding the issue of sexism in digital games. Whether sexism is inherently present within digital games that feature sexy and powerful characters may be open to subjective interpretation. Female characters in the Japanese fighting game series *Soul Calibur* (Capcom) are a good example of sexually provocative and powerful avatars. Concerns of sexualized female characters in digital games usually argue that such representations reduce women to the status of mere sexual objects. Yet, although most of the female characters in a digital game series like *Soul Calibur* are indeed dressed in skimpy, impractical clothing, the game also depicts female characters as extremely skilled fighters and dominant beings. Consequently, it becomes difficult to imply the game entirely reduces them to objects. By enacting both femininity and masculine qualities such as strength, portrayals of powerful and idealized female characters have the potential to disrupt traditional gender beliefs (Kennedy, 2002). Indeed, the opportunity to take on the role of a powerful character is one that female players have reported as an important means of transgressing prescriptive gender norms (Taylor, 2003). Notably, however, many of those same women expressed dismay at the sexualized characters that, in some cases, were their only options available for female avatars (Taylor, 2003).

While featuring sexy/sexualized characters in any digital game can be problematic, sexually provocative attire should not constitute the singularly defining trait of a *sexist* game (i.e., prejudice based on sex). Ferguson and Donnellan (2017) noted that scholarly identification of sexist video games are somewhat inconsistent along this line. For instance, scholars have applied the term *sexist video game* to games featuring sexualized content and to games without sexualized content that portrayed a "damsel in distress" trope (Ferguson & Donnellan, 2017). Such inconsistency warrants scrutiny; especially, in survey work where player interaction with sexist content is unknown (e.g., Breuer, Kowert, Festl, & Quandt, 2015). However, this also underscores the broader definitions of sexism identified by prominent gender scholars and that game scholars are finding tractable (e.g., Summers & Miller, 2014). Ambivalent sexism, notably, is a framework that encompasses dualistic attitudes of women either as sexually manipulative usurpers of men's power *or* as passive recipients of men's protection and affection (Glick & Fiske, 2001). Thus, in this chapter we review the possible effects of interacting with sexist game content both in terms of sexually provocative/sexualized avatars and games with sexist themes/mechanics.

Another observation by Ferguson and Donnellan (2017) was that many experimental studies on sexism in digital games employ sandbox-style, open-world games in which players have the freedom to engage with sexist content or avoid it (e.g., women working as strippers and prostitutes in a *Grand Theft Auto* game). However, no empirical observations of differences in players' interactions with sexist content exist. Research findings in game violence concluded that higher skill players encountered more violent content than lower skill players (Matthews & Weaver, 2013). The authors of that study concluded that it is likely that higher skill players' ability to move more quickly and efficiently through the game meant that they experienced more content generally. Thus, it is possible that this argument extends to encountering sexist content when it exists in games. In natural settings (i.e., nonexperimental), players interact with content at their own behest, making choices that suit them. Thus, just because a game includes sexist content, that does not imply that all players will interpret it as such or even encounter it at all.

Despite these moderating factors, sexist content in digital games remains a cause for concern because of the way that humans perceive, retain, and incorporate information relevant to gender. In the social sciences, scholars have applied a number of social psychological perspectives in studying the processing and effects of sexist content. These theoretical vantages provide frameworks for understanding the influence of such content on players' thoughts, feelings, and behaviors.

Social Psychological Theories for Understanding Harmful Effects of Sexist Content

Cognitive and Affective Theories

Scholars have applied several theories as frameworks for exploring the impact of sexism in digital games with respect to individuals' feelings about themselves. Playing as a sexualized character, for instance, might influence one's self-perception by distorting their body image. Body image is the psychological experience of embodiment that encompasses one's body-related self-perceptions and self-attitudes (Cash, 2004). Social cognitive theory, social comparison, and sexual (self-) objectification are three prominent theories in the field of social psychology that scholars have employed when examining negative effects on self-perception after interacting with sexist depictions in digital games.

Social Cognitive Theory Humans learn socially from one another and internalize attitudes/behaviors. Bandura's (1986) social cognitive theory posits that individuals learn from observations of others, including mediated models. Bussey and Bandura (1999) argued that media messages provide a salient source for "the development of gender-linked knowledge and competencies," (p. 686). Accordingly, interaction with gender information in games could shape perceptions of appropriate gender-based conduct, normative gender roles, self-evaluative gender-specific standards, and self-efficacy beliefs (Behm-Morawitz & Mastro, 2009). An experiment employing Bandura's social cognitive theory in the context of gender stereotypes learned from media found that women exposed to sexualized female victims within Hollywood superhero movies reported less egalitarian beliefs about women's roles in society in comparison to a control condition (Pennell & Behm-Morawitz, 2015). Such studies suggest that stereotypes of women as victims and sex objects in media may have negative consequences for beliefs about women in the real world. Given that a significant portion of women in digital games have been portrayed as victimized damsels and/or as sexualized beings (e.g., Dietz, 1998), social cognitive theory has been used to theorize that female bodies in digital games "may be used to help form an individual's social and moral standards about gender-appropriate dress, ideal female body-type, and even evaluations of female (self-)worth" (Behm-Morawitz & Mastro, 2009, p. 810).

Social Comparison Theory Another means of learning with respect to self-perception is by social comparison. Festinger's social comparison theory (SCT; 1954) posits that individuals use social cues and information to model their behavior when objective comparisons are difficult or impossible to determine. SCT theory explains that an individual's evaluation of their own qualities, abilities, and behavior is dependent to a large extent on the opinions of others as well as available models, mediated or otherwise (Festinger, 1954). Importantly, SCT processes may be *upward* or *downward* in nature. Upward comparison involves feelings of insufficiency when an individual compares themselves to a model perceived as superior to themselves. Downward comparison involves positive feelings when an individual perceives themselves as superior to a model. For instance, women have reported experiencing upward comparison when prompted to compare their own bodies to thin female models in advertisements but have reported experiencing downward comparison when prompted to compare their *intelligence* with the same models (Tiggemann & Polivy, 2010). Thus, SCT articulates the process through which individuals compare their bodies and abilities with onscreen game characters during or after exposure.

Experimental research has employed SCT for testing the effects of sexualized digital game character bodies on female players. Women reported significantly lower body esteem after playing a body-emphasizing beach volleyball game as a thin, bikini-clad female character (Barlett & Harris, 2008). Matthews, Lynch, and Martins (2016) discovered that women exposed to playable female characters with sexualized and hyper-idealized bodies (i.e., exaggerated busts) felt marginally better about their weight and marginally more sexually attractive than women who were exposed to female characters with nonsexualized and ideal (i.e., non-exaggerated) physiques. The authors attributed this outcome to the possibility that the bodies of the sexualized characters used as stimuli were perceived as over the top by female players and, as a result, had improved feelings about their bodies via downward social comparison (Matthews et al., 2016). Although the experiment undertaken by Matthews and colleagues did not find harmful effects among female players, they did find that males *low* in trait social comparison (e.g., low tendency to compare themselves to social others) experienced worsened body image disturbance and body attitudes after gameplay with hyper-idealized male characters (e.g., extreme musculature). Therefore, these men – despite self-reporting themselves as less likely to engage in social comparison – perceived the hyper-idealized male characters as desirable models for comparison and subsequently felt worse about their own body image (Matthews et al., 2016).

Sexual (Self-)objectification Social cognitive theory explains that humans learn social beliefs and standards though observation of others, including mediated representations, which contribute to gendered beliefs and gendered perceptions of self-worth. Social comparison explains this process at the interpersonal level. A socially learned phenomenon related to the perception of female bodies is sexual objectification. Sexual objectification occurs when a "woman's body, body parts, or sexual functions are separated out from her person, reduced to the status of mere instruments, or regarded as if they were capable of representing her" (Fredrickson & Roberts, 1997, p. 175). As detailed by Fredrickson and Roberts (1997), visual media featuring women often spotlight bodies and body parts as objects of an implicitly sexualizing gaze (Mulvey, 1975). Such images have been repeatedly observed in high frequency within video game promotional media.

A content analysis of video game characters as represented in images from top-selling North American digital game magazines found that female characters were more likely than male characters to be portrayed as sexualized and scantily clad (Dill & Thill, 2007). Another systematic study of 1054 digital game advertisements from popular game magazines found that males embodied hypermasculine qualities (e.g., very muscular, in pursuit of danger), while female characters wore tight-fitting clothing, showed cleavage, or otherwise had emphasized breasts (Scharrer, 2004). An examination of 225 video game covers revealed that female characters were less likely to be featured than male characters, and when they did appear, 32.7% of the female characters were portrayed with an exaggerated, objectified sexiness (Burgess et al., 2007). Taken together, the objectifying visuals of women in digital game advertisements and covers (another form of advertising, as box art is used to promote games in brick-and-mortar stores) suggest that such portrayals within gameplay are also common. Even individuals who casually encounter such images by skimming a digital games magazine or perusing the shelves of a commercial games retail store may come to associate women's bodies in games with sexual objectification. Social comparison processes would suggest that some self-identified women may suffer from a negative self-evaluation when confronted with such idealized images.

The Proteus Effect The previously discussed theories originated in the social sciences to explain the relationship between human cognition, perception, and learning (of the self and of others) in social encounters. The notion that embodiment within virtual worlds, including digital games, alters our socially learned behavior in unexpected ways is outlined in the notion of the Proteus effect (Yee, 2014). The central hypothesis is that an individual's behavior is shaped by their digital self-representation, regardless of how others may perceive them (Yee & Bailenson, 2007). The seminal research that explored this theory found that participants using attractive avatars within an immersive virtual environment were more intimate with other users than participants assigned to less attractive avatars (Yee & Bailenson, 2007). Likewise, participants assigned to taller avatars were more confident in a negotiation task than users embodying shorter avatars who performed the same task (Yee & Bailenson, 2007).

Fox and colleagues demonstrated that the Proteus effect also occurs during embodiment of sexualized avatars. Female participants entered a fully immersive virtual environment where they viewed themselves as either a nonsexualized or sexualized avatar with similar or dissimilar facial features (Fox et al., 2013). Participants in the sexualized avatar conditions reported significantly more objectification than participants in the nonsexualized avatar conditions. When comparing the findings between the similar face and non-similar face conditions, participants who viewed themselves as an avatar with similar facial features and a sexualized body reported greater rape myth acceptance than the participants who viewed themselves as a non-similar, sexualized avatar (Fox et al., 2013). These findings suggest that immersive virtual environments may produce augmented effects, such that "women who wear sexualized avatars may internalize the features of their avatars and start perceiving themselves in a sexually objectified manner" (Fox et al., 2013, p. 935).

The Proteus effect explains how virtual objects, despite not being "real" in a traditional sense, are capable of shifting self-perception, which may influence behavior (Yee, 2014). Likewise, theories of social comparison, social cognition, and objectification suggest one's self-concept is influenced by the social environment. Since mediated representations in the form of personified computers and virtual characters are typically perceived as human-like and real (Reeves & Nass, 1996), then it stands to reason that individuals will process sexist depictions in digital games as socially real constructs. Processing such information at the individual level also has implications for broader social attitudes.

Social Attitudes

Social Identity Theory Social identity theory explains that part of an individual's self-concept stems from the groups to which they belong (Tajfel, 1978). A positive self-concept is thus partially influenced via social comparison with one's in-groups (as well as with one's out-groups). This means that female-identifying individuals may struggle to relate their self-concept to sexist, objectifying depictions of women in digital games. In other words, some women may perceive their in-group as portrayed offensively in games and may thus distance themselves from digital games culture.

A disinterest in games has broader ramifications in society beyond any individual. Williams et al. (2009) argued, when women and minorities fail to see themselves accurately represented in digital game content, they may lose interest in playing and subsequently pursuing careers in game development. When diverse individuals pass up on opportunities to work within the digital games industry, it contributes to a cycle in which those voices are likely to be left out of the creative process of game development (Williams et al., 2009). The relative lack of female characters in games may thus be reflective of the low numbers of women involved in the international video game industry relative to men (Weststar & Legault, 2016). When games portray female characters as sexist tropes – either as a patronizing fantasy of the ideal women or as the embodiment of the manipulative seductress – then female-identifying individuals (and potentially allies and LGBTQ+ gender minorities) may seek out other sources of media entertainment, since people tend to avoid derogatory depictions of their social groups in media (Mastro, 2003). In our own work, we have suggested that the changing representation of female characters in more recent games potentially corresponds to both the legitimization of feminist critiques and increasing presence of women professionals in the industry (Lynch et al., 2016).

Ambivalent Sexism Ambivalent sexism is a theoretical framework which argues that sexism is more than mere antipathy toward women but, rather, encompasses two coexisting and broadly occurring prejudicial attitudes toward women: hostile and benevolent sexism (Glick & Fiske, 2001). Hostile sexism is an adversarial perspective of gender relations in which women are believed to seek control of men, usually by means of attractiveness, sexuality, and/or feminist ideologies (Glick & Fiske, 2001). Women who are targets of hostile sexist sentiments are viewed as challenging or manipulatively stealing men's power (Glick & Fiske, 2001). Benevolent sexism characterizes women as innocent, pure, and in need of a man's protection (Glick & Fiske, 2001). Women who reinforce traditional gender relations and serve men as romantic partners commonly elicit benevolent sexism. Sexist representations of female game characters often symbolize qualities derived from benevolent and hostile sexism, which limits portrayals to simplistic stereotypes of "good" and "bad" girls (Fox & Bailenson, 2009; Summers & Miller, 2014).

When digital games portray a large percentage of female characters with qualities stemming from the gender stereotypes of ambivalent sexism, women players may feel that their gender is poorly represented within the medium. Indeed, a writer for the *International Business Times* observed ambivalent sexist portrayals in the two female romantic pursuits available to the male hero Vince in the 2011 game *Catherine* (developed by Atlus). On these delimiting portrayals of women, they articulate the lack of nuance represented in the two female love interests, Katherine and Catherine:

> Vince can choose a life with Katherine, who represents a boring, matrimonial trap that will last forever, or he can choose Catherine, an evil, crazy, real life succubus that kills men in their sleep… Good or bad. Innocent or trashy. Boring or exciting. When most women, *most humans,* fall somewhere in between. (Elise, 2014).

Ambivalent portrayals in games are arguably offensive at their worst and dishearteningly predictable at best. These representations potentially galvanize wider sociocultural beliefs about women and have been linked to digital gameplay. Survey research conducted by Stermer and Burkley (2015) and Fox and Potocki (2016) argued that cultivation theory has implications for exposure to sexist content in digital games and beliefs about women. Cultivation theory posits that repeated media exposure fosters beliefs that are analogous to the mediated messages rather than reality (Gerbner, 1998). Stermer and Burkley (2015) conducted an online survey that asked participants to identify the three digital games they played the most and to self-report the extent to which the game contained sexist content. Then participants responded to a series of questions measuring hostile and benevolent sexism. They found that men who played video games high in perceived sexism reported greater benevolent, but not hostile, sexist beliefs than men who played games low in perceived sexism. The researchers did not find the same effect for women (Stermer & Burkley, 2015). Fox and Potocki (2016) surveyed participants using Amazon's Mechanical Turk and asked them to report lifetime video game consumption. The authors found that digital game consumption throughout the lifetime was associated with interpersonal aggression, hostile sexism, and rape myth acceptance. Rape myths underscore hostile sentiments about women by attributing blame to the survivors of sexual assault.

Sexist portrayals of women in games are likely to map onto notions of hostile and benevolent sexism (Fox & Bailenson, 2009; Lynch et al., 2016; Summers & Miller, 2014). The effects of these representations in digital games was found to be linked to sexist attitudes (Fox & Potocki, 2016; Stermer & Burkley, 2015), indicating that associations exist between sexist attitudes and experience with digital games. However, the presence of these associations found via questionnaires does not confirm a causal relationship of sexist content on players' orientations toward women. Experimental research has provided evidence supportive of the position that sexualized portrayals and sexist content in digital games may elicit undesirable outcomes.

Sexist Game Content and Effects on Players

Games with Sexualized Avatars

We have provided a series of social psychological theoretical frameworks and relevant research examples to highlight why sexist content in digital games are problematic for players. We continue by reviewing more experimental studies that examine the effects of sexualized avatars on players as well as the effects associated with games containing sexist themes and mechanics. Studies have linked interacting with sexualized female characters in digital games to negative effects on women's self-concepts and attitudes toward women in general.

Although sexualization is not the singularly defining attribute of a sexist game, per se, avatars are among the most salient and persistent content features in many games. Thus, findings related to the negative influence such portrayals have on players warrant cause for concern. Dill, Brown, and Collins (2008), for instance, found that men exposed to static images of gender-stereotyped digital game characters, as compared to images of women and men professionals, reported greater tolerance for sexual harassment when asked to consider a scenario between a female student and an older male college professor. Men who viewed the objectified female digital game characters reported the most tolerance of sexual harassment of any of the groups (Dill et al., 2008). Notably, Dill and colleagues did not find evidence of predicted differences in support of rape by condition in their study. This null finding suggests that the effect of the content was possibly too subtle to influence participants' attitudes along a more extreme dimension of sexism, but it is also the case that college students demonstrate socially desirable answers to overt measures assessing attitudes toward rape (McMahon & Farmer, 2011).

Dill and colleagues' study used static images and did not expose participants to actual gameplay, but it suggests that images of sexist character designs *alone* have the potential to increase tolerance toward sexual harassment. Similarly, exposure to sexualized female avatars in virtual worlds lacking combative gameplay and strong narratives has been shown to increase women's self-objectification and endorsement of rape myths. Female participants who controlled sexualized avatars within the online virtual world of *Second Life* (2003) reported higher levels of objectification than women who controlled nonsexualized avatars in the same virtual space (Fox, Ralston, Cooper, & Jones, 2015). Women who controlled sexualized avatars experienced higher levels of self-objectification which led to higher levels of rape myth acceptance (Fox et al., 2015). Acceptance of rape myths attributes blame to survivors of sexual assault. The findings of higher self-objectification and higher rape myth acceptance implies that women may form sexist attitudes about themselves as well as about *other* women after playing as a sexualized avatar in a virtual setting (Fox et al., 2015).

A more recent experiment conducted by Read, Lynch, and Matthews (2018) found that participants playing under high cognitive load compared to low load – that is, having to remember a sequence of seven symbols during gameplay compared to two symbols – reported *lower acceptance* of rape myths and hostile sexism when playing as a sexualized character. This finding suggests that, when task demand is high (or for lower skill players who might be overwhelmed by the demands of gameplay), players may be cognitively buffered from the negative influence of sexist depictions. In that study, playing as a sexualized character did not influence players' self-objectification – a finding that stands in contrast to what others have observed using different frameworks. It may be the case that, given the stability of one's self-concept, brief periods of gameplay under cognitive load may not produce powerful enough effects to elicit self-objectification, which would explain why inconsistencies primarily exist between immersive virtual environments and digital games. To make robust conclusions, we need more work on self-objectification.

Aside from an increased propensity to self-objectify, scholars have found that sexualized avatars can influence self-perceptions in other ways. Behm-Morawitz and Mastro (2009) predicted a variety of negative outcomes for players after exposure to a sexualized female character. Participants played *Tomb Raider: Legend*, a third-person shooter, for 30 minutes in either one of two levels that varied by Lara Croft's attire. A level set in Japan that depicted Lara wearing a revealing party dress was used as a highly sexualized condition and a level based in Kazakhstan that portrayed Lara wearing a form-fitting winter jacket and pants served as a less sexualized condition. Women who played as a more sexualized Lara reported lower self-efficacy and less favorable judgements about female physical capabilities compared to participants exposed to the less sexualized Lara. Women and men who played as more sexualized Lara reported less favorable attitudes toward women's cognitive capabilities than participants who did not play the game. This finding suggests that playing as a sexualized and powerful heroine negatively effects women's self-concepts as well as women's and men's beliefs about women more generally.

Beyond traditional digital game environments, research using avatars in immersive virtual environments (i.e., virtual reality) has found similar negative outcomes related to sexist portrayals. Men and women who entered virtual environments and interacted with stereotype conforming female agents reported more sexism and greater rape myth acceptance than participants who encountered non-stereotyped female agents (Fox & Bailenson, 2009). Such research suggests that viewing sexist agents in virtual reality has similar outcomes related to traditional digital games with sexist depictions, but more work is needed in this area. To the authors' knowledge, the virtual reality research involving sexualized avatars typically limits users' actions to looking at other avatars or looking at their own avatar. Research in this area typically does not involve demanding tasks or high levels of interactivity in the virtual environment, which might produce different outcomes.

Games with Sexist Themes

Some digital games not only represent women in demeaning ways but may also feature interactions and game mechanics that signify sexism toward women. Research has less extensively explored exposure to games with sexist themes beyond the mere presence of sexualized female game characters. Games with explicitly sexist themes may dehumanize women as sex objects by other means than their appearance. The nearly exclusive portrayal of women as prostitutes and strippers in *Grand Theft Auto* games provides a prominent example. An experiment tested the effects of digital games with violent and sexist content (*Grand Theft Auto* games) compared to violent games (*Half Life* games) and neutral games (one of two puzzle games) on participant's levels of empathy for female victims of violence. Gabbiadini, Riva, Andrighetto, Volpato, and Bushman (2016) found the effects were statistically significant only for highly identified male participants who played the violent-sexist *Grand Theft Auto* games. While the findings of this study were recently critiqued for using experimental groups that differed significantly by age (moreover, reanalysis of the data found different conclusions than the original study; Ferguson & Donnellan, 2017), this finding suggests that identification with a male hero in a violent-sexist digital game may increase the likelihood that male players will endorse sexist attitudes.

Another experiment randomly assigned male participants to play either a sexually explicit game with simulated social interaction (*Leisure Suit Larry: Magna* Cum *Laude*), a social simulation game without sexual themes (*The Sims II*), or a control game (*Pacman*). Results revealed that playing a digital game with the theme of female sexual objectification (*Leisure Suit Larry*) may prime thoughts related to sex, encourage men to view women as sex objects, and lead to self-reported tendencies to behave inappropriately toward women in social situations (Yao, Mahood, & Linz, 2010). *Leisure Suit Larry* features sexist content beyond the mere presence of sexualized female characters – the main character, Larry, is a nerdy college student with the objective of winning female tokens of affection on his quest to get "laid." Conversational gameplay consists of mini-games in which players navigate a sperm-shaped avatar at the bottom of the screen toward objects that attribute either successful or unsuccessful dialogue exchanges with other characters. Other mini-games include mixing drinks and serving them to the suggestively clad women that Larry is pursuing as well as playing drinking games to boost Larry's confidence. For instance, after successfully chatting up a scantily clad female student, the player-as-Larry can best her in a drinking game involving tossing coins into a glass. With the female student fully intoxicated following the player-as-Larry winning the drinking game, a cutscene plays in which Larry brings her back to his dorm room for intercourse. While Larry is ultimately unsuccessful in having intercourse with the female student, the game nonetheless provides a sexist ruleset that suggests to players that women are eager for intercourse (and should be taken advantage of) after several alcoholic beverages. Game mechanics that simulate sexist social relations between male and female game characters serve as a form of procedural rhetoric – or game rules and mechanics that make claims about how the real-world functions (Bogost, 2007). Such mechanics might be particularly persuasive in a sexually provocative context. Games like *Leisure Suit Larry* present a troublesome worldview which players may find persuasive via game mechanics, which is supported by the findings of Yao et al. (2010).

Conclusion

Sexist representations and content in digital games have been linked to endorsement of ambivalent sexist attitudes about women (Stermer & Burkley, 2015), negative beliefs about women's abilities (Behm-Morawitz & Mastro, 2009), and increased support of rape myths that attribute blame to survivors of sexual assault (Fox et al., 2013; Fox & Bailenson, 2009). Playing as a sexualized female avatar has also been linked to lowered self-efficacy (Behm-Morawitz & Mastro, 2009) and objectifying thoughts (Fox et al., 2015). Taken together, the negative effects related to self-concept as well as attitudes toward women suggest that the presence of sexualized female characters in digital games is worthy of concern. Likewise, sexist content in the form of sexualized imagery and gameplay mechanics that reinforce notions of women as sexual objects (e.g., *Leisure Suit Larry*) may prime men to harbor sexist attitudes about women and facilitate their feelings to behave inappropriately toward women in social situations (Yao et al., 2010).

Although the extant line of scholarship on sexist game content has some lack of uniformity regarding the operationalization of a sexist digital game (Ferguson & Donnellan, 2017), advances in prejudice research have produced frameworks that, going forward, may prove helpful in shoring up such inconsistencies. It is crucial for scholars to carefully consider and distinguish sexist content, themes, mechanics, and platform features that may contribute to sexist thoughts, attitudes, and behaviors. Scholars might explore imagery (e.g., character design) and mechanics (i.e., the rules of interaction) as operationally discrete variables in sexist games effects research. For instance, outcomes related to gameplay with sexualized/nonsexualized character designs with little to no capability (e.g., lacking combat abilities) might be compared to sexualized/nonsexualized character designs with high capability (e.g., combat abilities). Such a study might shed light on the factors that contribute to positive/negative outcomes related to sexualized imagery and game mechanics. In the above example containing four conditions for comparison, the sexualized character design lacking combat abilities might be the most sexist representation, while the nonsexualized character design with combat abilities might be the least sexist representation.

Correlational studies (i.e., cross-sectional surveys) are indeed helpful in identifying possible connections between sexist attitudes and other negative effects in digital games. However, scholars should continue conducting rigorous experimental and longitudinal research in order to identify cause and effect relationships. To date, only one empirical, longitudinal study exists assessing the influence of digital gameplay on sexist attitudes (Breuer et al., 2015). The authors of this study found no evidence for long-term effects on participants' attitudes toward women's roles as leaders and within family life, but these dimensions constitute only one small component of gendered attitudes.

Another consideration for interpreting the data from the reviewed literature in this chapter is that the experimental studies involved convenience samples of college students – many of whom may not be regular game players. Due to sexist imagery being propagated in games, researchers and concerned individuals have questioned the role of digital games in influencing sexist attitudes among gamers. The GamerGate controversy represents a possible manifestation of misogyny among gamers and within gamer culture. While seemingly a movement advocating for ethics in video game journalism, several women in the digital games industry were targets of online harassment following a smear campaign against game developer Zoë Quinn. Feminist media critic Anita Sarkeesian also received online harassment and death threats from hostile GamerGate supporters angered by her feminist, progressive commentary about tropes of women in video games (Wingfield, 2014).

Other similar incidents have occurred since GamerGate erupted in late 2014. *Mass Effect: Andromeda* launched in March 2017 to public criticism surrounding the game's character animations and other issues related to buggy gameplay. When a woman was identified by a GamerGate supporter as having worked on *Andromeda's* facial animations, she was solely blamed for the poor animations and was relentlessly harassed with aggressive and sexual remarks through social media (Mascarenhas, 2017). While GamerGate was in part a reactionary movement against critics like Sarkeesian who advocated for progressive representations in digital games, the hostility and misogyny espoused by gamers have expanded to include female developers who simply work in games and female scholars who study them. With a vocal proportion of gamers lashing out against women, it stands to reason that researchers and the public will be concerned about sexist content in digital games and whether the medium is responsible for impacting misogyny in broader culture.

Indeed, gamers found to be high in pre-existing sexist attitudes might be more easily influenced/affected by sexist content. In an online questionnaire, Fox and Tang (2014) found that social dominance orientation (i.e., a preference for hierarchy in social groups and the dominance over low-status groups) as well as conformity to some masculine roles (e.g., the desire for power over women) predicted greater sexist beliefs about women and gaming. Likewise, in Read et al.' (2018) gameplay experiment with sexualized and nonsexualized avatars, participants higher in social dominance orientation who played as an avatar (compared to watching an avatar) reported greater rape myth acceptance following gameplay. As such, study populations and their pre-existing beliefs should be kept in mind when considering the circumstances under which exposure to sexist content in digital games may be a cause for concern.

On the other hand, some women do play games with apparently sexist depictions of female characters and apparently do so out of enjoyment. *Senran Kagura: Peach Beach Splash* (developer Tamsoft, 2017), a video game where players assume the role of a bikini-clad *anime* girl and shoot water pistols at other bikini-clad female characters, hardly registers as a typical female-friendly video game. Yet *Peach Beach Splash*'s marketing manager reported that approximately 30% to 40% of the game's fanbase is female (Batchelor, 2017), subverting assumptions that such content does not attract a sizeable female audience.

Beyond industry data, scholars have reported that female power users of video games (i.e., playing video games from 3 to more than 10 h weekly) purposively choose and create sexy female characters (Royse, Lee, Undrahbuyan, Hopson, & Consalvo, 2007), with one participant quipping: "when I create a character in an RPG, I like to make them as sexy as possible. Haha! I love a sexy and strong female character" (p. 564). While some scholars might argue that such women have internalized these images of female game characters as acceptable – even desirable – another possibility is that female gamers feel empowered when assuming the role of an attractive and powerful female character within an interactive game world that otherwise lacks sexist themes and mechanics (Matthews et al., 2016).

Evidence from industry and academia suggests that some women take pleasure from playing as/embodying an attractive and sexualized female character in digital games. Therefore, certain personality dimensions and/or differences in sexual expression (i.e., liberal vs. conservative) may play a role in shaping such preferences. These factors within female populations of players may be additional variables for future research projects to explore. Still, while some women (and assumedly other genders) may enjoy the visual aesthetics of sexually provocative female characters, interacting with them seems to contribute to undesirable outcomes for women and promotes sexism. As such, we caution character designers and game developers, more broadly, to consider the ramifications of portraying women and men as sexist tropes that reinforce pre-existing beliefs and attitudes about gender roles in society.

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Blame the Players, Don't Blame the Games: Why We Should Worry Less About Sexist Video Game Content and Focus More on Interactions Between Players

Johannes Breuer

Misogyny and – more broadly speaking – sexism are important issues for both research and society as a whole, and they certainly also exist and are visible in video games, player communities, and video game culture (for an overview, see Kowert, Breuer, & Quandt, 2017; Fox & Tang, 2017). Dozens of content analyses have consistently shown that women are largely underrepresented in video games, and that female characters are less likely to appear as protagonists and more likely to be portrayed in a sexualized fashion (see, e.g., Beasley & Collins Standley, 2002; Burgess, Stermer, & Burgess, 2007; Dietz, 1998; Downs & Smith, 2009; Lynch, Tompkins, van Driel, & Fritz, 2016; Van Reijmersdal, Jansz, Peters, & Van Noort, 2013; Williams, Martins, Consalvo, & Ivory, 2009). And both the collections of reports by players, many of which are documented on websites like *Not in the Kitchen Anymore* (www.notinthekitchenanymore.com) or *Fat, Ugly, or Slutty* (www.fatuglyorslutty.com), as well as academic surveys (Brehm, 2013; Fox & Tang, 2016) and field experiments (Kasumovic & Kuznekoff, 2015; Kuznekoff & Rose, 2012) show that sexism and sexual harassment are quite common in online games and that female players are far more likely than male players to have such unpleasant experiences.

Unlike in research on violence in video games, there at least seems to be agreement among researchers regarding the basic diagnosis that sexism is an issue in video games and video game player communities. This basic consensus, however, ends when it comes to the identification of causes and the suggestions for potential cures (to stay within this medical metaphor). Although it certainly seems logical to assume that sexist content in video games and sexist behavior of video game players are directly related, the available empirical evidence for this is far less clear than one would expect. Whereas this is not meant to imply that there is no link whatsoever between the use of video games and sexist attitudes or behavior, this relationship is

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very likely to be more complex and less direct than some statements by researchers, in news reports or discussions within and outside the gaming community suggest. Taking into account theoretical and methodological considerations as well as the available evidence from empirical studies, this chapter will discuss why the knowledge we have about the relationship between sexist content in video games and misogynist attitudes and behavior in real life is still limited and propose some ideas on how to address this. In homage to (as well as in the spirit of) the highly recommendable blog post *Everything is F*cking Nuanced: The Syllabus* (Ledgerwood, 2017) – which itself was an homage to the equally readable (and more tongue-in-cheek) blog post *Everything is f*cked: The syllabus* (Srivastava, 2016) – the aim of this chapter is to describe why the theories and methods used to study the links between video games and sexism are or should be more nuanced.

Video Game Content Is Nuanced

Even though there certainly are important differences between research on violence and sexism in video games, there are several striking similarities, especially in the theoretical underpinnings or – more generally – the underlying assumptions, and the methods of these two lines of research. One of the similarities that concern both the terminological and the methodological level is the definition and treatment of violent/sexist content. Just like violence, sexism is a "many-splintered thing" (Tamborini, Weber, Bowman, Eden, & Skalski, 2013), meaning that sexism in video games is neither unidimensional nor dichotomous (in the sense that a game is either sexist or not). Although most researchers are aware of this and this is in many cases also reflected in the operationalization of sexism in content analyses, surveys, and experimental studies, these nuances often get lost in titles, abstracts, and especially in press releases and news reports (e.g., the use of the general term sexism in the title and abstract of a study by Bègue, Sarda, Gentile, Bry, & Roché, 2017, that measured attitudes toward gender roles with a single item and a news article that interprets these cross-sectional findings causally by using the headline "Playing video games can lead to sexist attitudes," Boult, 2017).

Sexist content can differ on a number of dimensions, including, e.g., realism and graphicness, which Tamborini et al. (2013) identified as relevant for violent media content. And the dimension of realism can even be further broken up into different categories relating, e.g., to the audiovisual representation, the (narrative) setting, or the behavior of characters (see, e.g., Breuer, Festl, & Quandt, 2012; Galloway, 2004; Malliet, 2006). As numerous content analyses clearly indicate, there are also several different types of sexism in video game content. It is quite likely that the underrepresentation of females, the low prevalence of female protagonists, and the (hyper-)sexualized depictions of female characters (in video games in general or particular genres and games) have differential effects on the players. This is especially relevant for research that takes a cultivation perspective and looks at the relationship between video game use and sexist attitudes and beliefs (e.g., Breuer, Kowert, Festl, & Quandt, 2015; Fox & Potocki, 2016).

Another factor besides the different types and dimensions of sexist video game content that makes it difficult to draw conclusions from and compare individual studies is the diversity in the methods used to assess and quantify exposure to sexist video game content. In general, the degree of sexist content in a specific game or a particular genre can be assessed via self-reports from study participants, expert, or agency ratings (e.g., ratings by the ESRB or PEGI). Despite that Busching et al. (2015) found that those three types of ratings are strongly correlated for violent content, they are affected by interindividual and cultural differences. If agency ratings are used, the question is what information is used specifically. Age ratings might not be a good choice as each rating system has its own categories and there are many other characteristics and types of content that determine them, and the weighting of those also differs between cultures and rating systems (Hyman, 2005; Wedell & McMillan, 2013).

The use of content descriptors is also not without problems. Whereas the European rating system PEGI only has the content descriptor sex (defined as "Game depicts nudity and/or sexual behaviour or sexual references," see http://www.pegi.info/en/), the US rating system ESRB has several descriptors that could be considered relevant for the categorization of sexist content (including, partial nudity, sexual violence, strong sexual content, or crude humor; see http://www.esrb.org/ratings/ratings_guide.aspx#descriptors). If studies rely on self-report ratings of sexist content by the users (as was, e.g., done in the study by Stermer & Burkley, 2015), these may not only be influenced by social desirability but also by genuine differences in the perception and evaluation of this type of content. Research on media violence found that those depend on (the salience of) moral values (Tamborini, Eden, Bowman, Grizzard, & Lachlan, 2012) and personal experience or frequency of use of the medium/genre in question (Breuer, Scharkow, & Quandt, 2014). Using the popular *Grand Theft Auto* series that is often discussed in the context of both violence and sexism in video games as an example, it is reasonable to assume that it makes a difference for any potential persuasive or cultivation effects, if the player understands the game as satire or views it as a realistic depiction of a "gangster lifestyle."

Despite the similar challenges in defining and categorizing the particular content of interest in research on video game violence and sexism, experimental studies on the effects of sexist content seem to be slightly less prone to or affected by methodological problems on the side of the independent variable compared to studies on violence and aggression. Unlike many experimental studies on video games and aggression that compare a "violent" to a "nonviolent" game, while largely neglecting that these games also differ in various other regards that may affect aggression, many experimental studies on sexist content use the same game or virtual environment and, e.g., vary the appearance of the avatar that the player controls (typically sexualized vs. nonsexualized; see, e.g., Behm-Morawitz & Mastro, 2009; Driesmans, Vandenbosch, & Eggermont, 2015). Studies by Breuer et al. (2016) and Bowey, Depping, and Mandryk (2017) also followed what several researchers have suggested for studies on video game violence (Elson & Quandt, 2016; Mohseni, Liebold, & Pietschmann, 2015) and used mods (i.e., modifications) of the same game. Even experimental studies on sexism that do use different games (e.g., Yao, Mahood, & Linz, 2010) should be less problematic than the ones that do the same thing for aggression as sexist attitudes or behaviors are far less likely to be directly influenced by factors that commonly vary between games and can affect aggressive outcomes, such as competitiveness (Adachi & Willoughby, 2011), pace of action (Elson, Breuer, Van Looy, Kneer, & Quandt, 2015), or the outcome of the game (Breuer, Scharkow, & Quandt, 2015). Nevertheless, considering the various types and dimensions of video game content in general and sexist video game content in particular, it is not advisable to treat (and speak or write of) sexism in video games as a dichotomous category (sexist vs. nonsexist). To be able to make proper predictions and interpret findings correctly, it is recommendable to specifically define what kind of sexist content is considered, what effect(s) this is assumed to have, and why. A related methodological issue is that in many games that feature specific types of sexist content, players might not experience it due to their playing style or choices made in the game. This is particularly true for so-called sandbox or open-world games, including the *Grand Theft Auto* series that is often discussed or even used (see Gabbiadini, Riva, Andrighetto, Volpato, & Bushman, 2016) in research on video games and sexism. While this can potentially be controlled in laboratory studies (although even that is challenging and might not work), this is a big problem for survey-based research. Asking participants to rate who sexist the content of a game they played is one way to take this into account, but this is, of course, affected by the usual issues of self-report (social desirability, false recollection, differences in the understanding and evaluation of sexist content, etc.).

Sexist Attitudes and Behaviors Are Nuanced

The neglect of the different types and facets of sexist video game content in some publications is all the more surprising, given that it is common among researchers to differentiate between types of sexism on the side of what is typically considered as the dependent variables. Many studies refer to the concept of ambivalent sexism (Glick & Fiske, 1996) and distinguish between hostile and benevolent sexism in their measurements (e.g., Stermer & Burkley, 2015; Tang & Fox, 2016). Another frequently used measure in this area is rape myth acceptance (e.g., Dill, Brown, & Collins, 2008; Fox & Potocki, 2016; Fox et al., 2015). Unlike research on video games and aggression where the distinction between different kinds of aggression as well as cognition, affect, attitudes, and behavior is often glossed over or ignored, research on video games and sexism is generally clearer on the variables and types of effects or relationships it wants to investigate. Of course, it is always possible to further distinguish between types of sexist attitudes, beliefs, or behaviors, but most of the available studies make it clear that they look at one specific type and not "sexism as a whole." However, something that receives less attention than it should in research on video games and sexism is the role of relevant third variables. Although the majority of studies incorporate the biological sex of the players/participants/respondents as a potential confound, there are several other variables that are likely to play a role in/for the relationship between video game use and sexism. Among those are, e.g., age, education, moral values, or political orientation. What further complicates things is that at least age and sex are also related to video game use (i.e., the variable that is used as a predictor of sexist attitudes in several survey studies). Meta-analyses of studies on video game use and aggression suggest that the associations become substantially smaller or vanish altogether once the relevant third variables are controlled for (Ferguson, 2015; Ferguson & Kilburn, 2009). This might be very similar for the relationship between video game use and sexism.

In addition to inter- and intraindividual differences that may affect both video game use and sexist attitudes, on a macrolevel, there are also the dimensions of culture and time that have an impact on sexist attitudes and how they can be assessed. What counts as a sexist attitude or act strongly differs between cultures (and different subpopulations within cultures) and also changes over time. Though the former is mostly only relevant for comparative cross-cultural research, the latter also means that instruments that were developed several decades ago can or at least should not necessarily be used to assess sexist attitudes today (Walter, 2017). Of course, the researchers who are active in this field are all well aware of these facts and take them into consideration when designing and conducting their studies. However, this is something that also needs to be taken into account when reviewing and interpreting the literature. Similar to what was suggested with regard to the term "sexist game(s)" in the previous section, broad claims about video game use being related to "sexism" are unwarranted and should be avoided. This is of particular importance for causal claims about effects of (sexist) video games on sexist attitudes or behaviors.

Cultivation Research Is Nuanced

A few studies have looked at the relationship between video game use and sexist attitudes and beliefs from a cultivation perspective. Cultivation theory has originally been developed to investigate the effects of television viewing on the beliefs and attitudes of viewers. The general proposition of cultivation theory is that frequent and long-term exposure to certain media (content) affects the perception of social realities (so-called first-order effects) of its users as well as their attitudes toward those (second-order effects) in the sense that both become more aligned with the way things are portrayed in the media (Gerbner, 1998; Gerbner & Gross, 1976). Despite its continuing popularity in media effects research, cultivation theory has been controversial, and the overall empirical evidence is limited and quite mixed (Potter, 2014). The same thing can be said about studies that apply cultivation theory to investigate the relationship between video game use and sexist attitudes. Two cross-sectional studies found that men who play video games featuring sexist content show higher levels of benevolent sexism but not hostile sexism (Stermer &

Burkley, 2015) and that video game use is related to rape myth acceptance via interpersonal aggression and hostile sexism (Fox & Potocki, 2016). Another cross-sectional survey study found a small relationship between video game exposure and sexist attitudes (Bègue et al., 2017). However, the only longitudinal study found no evidence for a relationship between overall video game use and sexist attitude toward gender roles (Breuer, Kowert, et al., 2015). An experimental study that does not explicitly use cultivation theory as its framework but looks at effects of sexist (and violent) content on empathy toward female violence victims via masculine beliefs (Gabbiadini et al., 2016) reported such an effect for male adolescent players who strongly identified with the main character in the game. However, a reanalysis by Ferguson and Donnellan (2017a) revealed that the study showed several important methodological shortcomings (including problems with randomization) and that the overall evidence provided by the original study was quite weak and not robust when other theoretically plausible alternative models were tested. Although Gabbiadini, Bushman, Riva, Andrighetto, and Volpato (2017) responded to the criticisms and provided explanations for some of them, Ferguson and Donnellan (2017b) note that the flaws or at least questionable decisions that were made in the collection and analysis of the data warrant that the findings are interpreted with extreme caution (by taking the identified limitations and their meaning for the results into account) at the very least.

Also for cultivation research on video games in general, the evidence is quite limited. Some studies found limited first-order effects in the area of violence, crime, and risky driving behavior (Beullens, Roe, & Van den Bulck, 2011; Gabriel Chong, Scott Teng, Amy Siew, & Skoric, 2012; Van Mierlo & Van den Bulck, 2004; Dmitri Williams, 2006), whereas others found no indications of first- or second-order effects for crime, feelings of safety, and militarism (Anderson & Dill, 2000; Festl, Scharkow, & Quandt, 2013). Although notably, only the studies by Anderson and Dill (2000) and Van Mierlo and Van den Bulck (2004) were based on cross-sectional survey data, the longitudinal experiments by Williams (2006) and Gabriel Chong et al. (2012) exclusively looked at the effects of one particular game. Despite the prevalence of violent and sexist content in video games that content analyses have identified, the limited evidence for cultivation effects is not that surprising, if the methodological difficulties of cultivation research in general and on video games in particular are considered. Even if you leave aside questions regarding the reliability and validity of self-reported exposure to a specific type of media content (see, e.g., Fikkers, Piotrowski, & Valkenburg, 2015), a major issue that has also been identified by several researchers in this area (Breuer, Kowert, et al., 2015; Gabriel et al., 2012; Van Mierlo & Van den Bulck, 2004) is the large variety of games, user preferences, and playing styles. Not only do people play different genres and games (on different platforms) with different intensity, they are also exposed to different things in the same game; especially in complex nonlinear and open-world games, such as the popular *Grand Theft Auto*, *Mass Effect*, or *The Witcher* series.

At the time when cultivation theory was first developed, it was much more reasonable to assume that there is something like a “TV reality” as well as a more uniform “media diet” (in terms of channels and programs/shows) than it is today.

With the (increasing) diversity of games, genres, gaming platforms, and modes of play, however, it would be very bold to assume that anything like a "video game reality" (that real-world beliefs can become more similar to) exists. Such assumptions are even more problematic for video games as the vast majority of them have completely fictional content, and the large majority of (adult) players are well aware of that. This is very different from TV which has nonfiction formats, such as news, documentaries, talk shows, or reality shows. Given these issues as well as the challenges in defining and operationalizing sexist video game content, it seems legitimate to ask if or how cultivation research on video games can be a worthwhile endeavor. Although it certainly reduces the generalizability of the findings, it seems more viable and sensible to look at specific cultivation effects (e.g., on beliefs about female body ideals or gender roles in particular domains of society) and genres or even games than to cast a broad net and set out to test cultivation effects (in various domains) of video game use in general. If researchers wish to continue and extend cultivation research on video games, it would also be worthwhile to explore the relevance of the different types of realism that have been identified in previous research (see section on video game content in this chapter).

Research on Video Games and Sexism Needs More Nuance

The previous sections should have served to illustrate the intricacies of research on video games and sexism, how they are handled or neglected, and what this means for this research and the researchers who are involved in it. Although many researchers who are active in this field are well aware of this and have found some good ways to address and deal with it, this line of research could benefit from some more nuanced and focused approaches. Some of the methodological challenges and limitations in studies on sexism in/and video games are comparable to those in research on video game violence and aggression. Also similar to research on video games and aggression, the evidence for effects of sexist game content is mixed, at best. The relationships that have been found are short term (laboratory studies) and/or small (laboratory and survey studies) and/or restricted to specific (sub)dimensions of sexism and particular games or genres (laboratory and survey studies), and the only longitudinal study in the field found no evidence for a relationship between video game use and sexist attitudes.

In order to more rigorously test the relationship(s) between video game use and sexism, both survey and experimental studies should take into account relevant third variables, such as age, education, moral values, or political orientation, and be explicit and specific about what types and dimensions of sexism or sexist content they want to assess and why. Another similarity between research on violence and sexism is that many studies ignore or downplay the possibility of selection effects (or selective exposure) as the reason for associations between sexist attitudes and a preference for sexist video game content. Of course, media/socialization and selection effects can only be properly tested in longitudinal studies, but in those, they can easily be tested simultaneously. The added value of testing both media and selection effects within the same study is that it also allows investigating whether a downward spiral exists (i.e., a combination of media and selection effects, see Slater, Henry, Swaim, & Anderson, 2003); although, ideally, this requires more than two measurement points (or waves in a panel study).

Besides the effect of video game use in general and sexist game content in particular, a good number of studies have also investigated the frequency, nature, predictors, and consequences of (sexual) harassment in online games (e.g., Brehm, 2013; Fox & Tang, 2014, 2016; Kasumovic & Kuznekoff, 2015; Kuznekoff & Rose, 2012; Tang & Fox, 2016). These studies show the prevalence of sexist behavior and (sexual) harassment in certain gaming communities and the consequences of harassment for the victims and also provide some helpful suggestions on how these issues can be addressed in practice. Considering the limited evidence as well as the methodological problems of research that seeks to investigate the effects of video game use on sexist attitudes, beliefs, or behaviors (especially within a cultivation framework), it seems much more worthwhile to focus (more) on interactions between players instead. James Ivory (2014) summed this up nicely in the newsletter of the International Communication Association by stating that "Interactions Need Attention, Not Just Effects." Of course, as the studies mentioned above clearly demonstrate, these interactions have effects on those involved (especially those at the receiving end of sexism and sexual harassment). Hence, to be more precise, the word "effects" could be replaced by "(media) content." For the purpose of understanding sex differences in video game use and reasons and solutions for the prevalence of sexism in video game content, culture, and communities, focusing on real interactions between real people with real consequences promises to be a much more productive approach than probing for potential effects of fictional contents on real-world attitudes and behaviors (on theoretically and methodologically shaky grounds).

Where to Go from Here?

In view of the criticism of research on video games and sexism presented in the previous sections, the question that necessarily follows from this is "What should we do (differently)?". Of course, the first answer to this is the mantra of all empirical research that "more research is needed." However, this is both unsatisfactory and imprecise. To be more precise, it would be necessary to at least outline what kind of research is needed and why. In general, all research in this area should be clear about the exact questions it wants to answer. This is also helpful for choosing or developing appropriate methods. For example, it is not sufficient to ask broadly whether (sexist) video games cause sexism but important to clarify what types or dimensions of sexist content in video games should affect which types and dimensions of sexist attitudes, beliefs, or behaviors as well as what the proposed time frame for such effects is. If despite the essential concerns about this line of research presented above, researchers wish to further investigate potential cultivation effects, additional longitudinal studies are needed to tease out the temporal order of any associations and, thus, find indications for patterns of causality.

Another desideratum besides more longitudinal research is the systematic synthesis of the available empirical evidence via meta-analytic techniques. Despite the fact the number of available studies on video games and sexism might not suffice for some meta-analytic approaches yet, and meta-analyses are not well-suited to settle ideological debates (Ferguson, 2014), they can provide a quantitative summary of the existing findings and also allow for the detection of and correction for publication bias by means of funnel plots, p-curving (Simonsohn, Nelson, & Simmons, 2014), or PET-PEESE meta-regression (Stanley & Doucouliagos, 2014). Finally, future research on video games and sexism should also be informed by the larger context of the replication crisis and the call for open and reproducible research in psychology and the social sciences in general. Since being reproducible and replicable always increases the reliability and evidential value of research, what Przybylski, Weinstein, and Murayama (2017) wrote about internet gaming disorder research is also true for research on video games and sexism: "Open scientific practices are the way forward."

The concerns and suggestions discussed in this chapter are also relevant for the practical implications of research on video games and sexism. Also here, the focus should be more on the players and their interactions than on the content of the games. Instead of thinking about censorship, stricter age regulations, or other forms of controlling (the distribution of) video game content by legal or political means, the ultimate goal should be to break the cycle of exclusion and sexism (Kowert et al., 2017) by pursuing changes in the (media) education and socialization of children and teenagers as well as enacting pressure on video game companies to punish sexual harassment and sexist behavior among players (e.g., by banning them or revoking rewards, points, or status) and promoting measures to increase diversity in the workforce of the video game industry (Fox & Tang, 2017). The latter should, ultimately, also increase the diversity in video game content. Although sexist video game content may not foster sexist attitudes, there is ample evidence that it is off-putting for many players (particularly female players). One may decry this, but there will always be people who enjoy sexist video game content; so there will continue to be a market for that. However, if there are alternatives (of equal quality and quantity) without sexist content, this will appeal to a greater number of players and, thus, reduce exclusion. Coming back to the medical metaphor from the beginning of this chapter, such a perspective would treat sexist video game content not as a cause, but as a symptom of a more deeply rooted set of problems. And, in the end, while it is always easier and quicker to combat symptoms, it pays off in the long term to properly identify and tackle the root causes of a problem.

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Brain-Training Games Help Prevent Cognitive Decline in Older Adults

Soledad Ballesteros

Introduction

Increasing longevity and falling birth rates are leading to an unprecedented increase in the percentage of older adults in relation to the total population in western societies. This rapid demographic change is accompanied by a vast rise in the number of older adults who will suffer cognitive decline and dementia in the next few decades, with an enormous increase in the cost to families and governments of caring for them (Brookmeyer et al., 2011; Hurd, Martorell, & Langa, 2013). Given the connection between the increase in life expectancy and the occurrence of neurodegenerative diseases (Reitz, Brayne, & Mayeux, 2011), researchers are investigating ways to protect older adults from cognitive decline and dementia.

Aging is associated with cognitive and brain changes that produce declines in sensory and motor domains, as well as in a number of cognitive functions that are vital for independent living. As people age, gray and white matter shrink. The most affected brain areas are the lateral prefrontal cortex, the cerebellum, and the medial temporal lobe system, including the hippocampus, with minimal changes in the entorhinal and occipital cortices (Park & Reuter-Lorenz, 2009; Raz et al., 2005). These brain changes are associated with declines in performance in a number of perceptual and cognitive functions, including peripheral vision and dynamic visual acuity (Muiños & Ballesteros, 2014, 2015; Muiños, Palmero, & Ballesteros, 2016), processing speed (Salthouse, 1996), executive functions (Hoyer & Verhaeghen, 2006), working memory (Redondo, Beltrán-Brotóns, Reales, & Ballesteros, 2016; Salat, Kaye, & Janowsky, 2002), and episodic memory (Nilsson, 2003; Park & Gutchess, 2005).

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Crystallized abilities, such as general knowledge, verbal abilities (Hedden & Gabrieli, 2004; Park et al., 2002), and implicit memory (Wiggs, Weisberg, & Martin, 2006), are mostly preserved. Older adults with mild cognitive impairment and patients with Alzheimer's disease have shown preserved implicit memory despite huge deteriorations in episodic memory (Ballesteros & Reales, 2004; Ballesteros, Reales, Mayas, & Heller, 2008). Although behavioral priming for repeated pictures is spared in healthy older adults, reduced neural activation with stimulus repetition, which is a signature of implicit memory, is affected. The relationship between brain function and behavior found in young adults is altered in older adults, although these age-related changes do not affect behavioral facilitation. These findings have implications for the notion that automatic processes, previously thought to be preserved with age, are susceptible to the effects of aging at the neural level. Age-invariant behavioral facilitation as a signature of implicit memory with stimulus repetition is observed as a result of more sustained neural processing of visual stimuli in older adults as a form of compensatory neural activity (Ballesteros, Bischof, Goh, & Park, 2013).

Other studies have shown additional frontal activity in older adults assessed with event-related evoked potentials (ERPs), suggesting a sort of compensation for their lower level of parieto-occipital functioning reflected by smaller P300 amplitudes at posterior sites (Osorio, Fay, Pouthas, & Ballesteros, 2010). Furthermore, although behavioral priming is spared in older adults, normal aging affects ERPs and oscillation responses while performing an incidental symmetry detection task with haptically presented 3D objects (Sebastián & Ballesteros, 2012).

Maintaining Older Brain Functionality

We reviewed theoretical and basic research on seminal intervention and cohort studies aiming to prevent and/or delay age-related cognitive and brain declines, as well as influential cohort studies on well-being and cognitive function (Ballesteros, S., Mayas, J., Prieto, A., Toril, P., Pita, C., Ponce de León, L., et al., 2015). The main focus of this review was on intervention studies conducted to improve cognition in healthy older adults. Among these studies, we focused on the effects of physical activity, including aerobic, resistance, and coordination training, dance and movement interventions, and sport, tai chi, and martial arts. We also reviewed previous findings on computerized training approaches and studies that trained older adults with video games, as well as social engagement approaches investigating its effects on maintaining the cognition, physical health, and independent living of older adults. The studies reviewed suggest that there are protective, although moderate, positive effects of physical activity, cognitive training, and social engagement on counteracting cognitive decline in older adults. Most of the intervention studies focus on a single training domain. There were a few studies (e.g., Barnes et al., 2013; Frantzidis, Ladas, Vivas, Tsolaki, & Bamidis, 2014; Li et al., 2014; Oswald, Gunzelmann, Rupprecht, et al., 2006; Park et al., 2014; Rahe et al., 2015; Shatil, 2013; Theill, Schumacher, Adelsberger, Martin, & Jancke, 2013) that employed randomized controlled trials (RCT) focusing on combined multiple training domains (multi-domain training). The results revealed that combined training might be a promising way to promote cognitive maintenance and independent living among older people.

It is increasingly important to find ways to improve the cognitive functioning of older adults. An approach that has been gaining much attention is video games.

Training Older Adults with Video Games and Other Computerized Programs

Video games and other computerized training approaches are attracting great interest from cognitive psychologists and neuroscientists seeking to find ways of transferring training benefits to untrained tasks (e.g., Anguera, Boccanfuso, Rintoul, et al., 2013; Ballesteros et al., 2014; Ballesteros et al., 2017; Basak, Boot, Voss, & Kramer, 2008; Basak & O'Connell, 2016; Toril, Reales, Mayas, & Ballesteros, 2016). Researchers are increasingly using new technology, including ICT-mediated environments (Ballesteros, Prieto, Mayas et al., 2014; Peter et al., 2013), cognitive training platforms, and video games to investigate their impact on older adults' cognition (Anguera et al., 2013; Basak et al., 2008; Basak & O'Connell, 2016; Hertzog, 2009).

Some relevant questions of great practical relevance are whether training methods including training with video games are effective in older adults, their effect size, and their cost-effectiveness and how they affect untrained tasks, in near (between very similar but not identical contexts) and far transfer (between contexts that appear on the surface to be remote and unrelated to each other). Results suggest that it can be difficult to see training effects from specific to far distal tasks.

An effective cognitive intervention must show that training gains transfer to untrained tasks (Boot, Simons, Stothart, & Stutts, 2013; Buitenweg, Murre, & Ridderinkhof, 2012). Moreover, the intervention design must also encourage compliance, as an important problem with longitudinal training studies is the loss of participants over time. Intervention studies suggest that playing fast-moving action games improves a variety of perceptual and cognitive functions (e.g., Basak et al., 2008; Cain, Landau, & Shimamura, 2012; see Bavelier, Green, Pouget, & Schacter, 2012 for a review). However, these games emphasize peripheral processing and might sometimes be violent (Chisholm & Kingstone, 2012). Older adults prefer games that involve a mental challenge (Nap, de Kort, & Ijselsteijn, 2009).

Results from a systematic review (Kuider et al., 2012) and three meta-analyses (Lampit, Hallock, & Valenzuela, 2014; Powers, Brooks, Aldrich, Palladino, & Alfieri, 2013; Toril, Reales, & Ballesteros, 2014) reported that training older adults with video games and computerized training programs improves several aspects of cognition. The meta-analytic study conducted by Toril et al. (2014) included 20 experimental studies published between 1986 and 2013 that trained older adults with video games (involving 474 trained and 439 healthy older control participants). The results indicated that training older adults with video games has positive moderate effects on several cognitive functions (mean effect size $d = 0.37$), with several methodological and personal variables having moderator effects, including the age of the participants, with larger effects in old-older adults (71–80 years; mean effect size $d = 0.57$) than in young-older adults (61–70 years; mean effect size 0.30). The duration of training also modified significantly the effect sizes of the interventions, with greater training effects when training was short (1–6 weeks) than when it was long (7–12 weeks), perhaps because long training regimes lead to loss of motivation. For older adults, when a long time is spent training before obtaining the expected reward, the motivation to continue training decreases because anticipated returns are less valuable than immediate rewards. These moderators may explain the variability of the results obtained in individual studies. Another important question is whether the effects of training transfer to untrained cognitive processes such as memory, attention, executive functions, or processing speed (the "transfer effect"). Toril et al. (2014) also found that other cognitive processes such as reaction time, attention, memory, and general cognition improved after training, but executive functions did not.

A very recent meta-analysis included 20 intervention studies with training and control groups of healthy older adults and young adults trained with action video games (Wang et al., 2016). The results showed that older adults obtained low to moderate benefits after training in specific cognitive domains including executive function, processing speed/attention, memory, and visuospatial abilities. However, young adults benefited more than older adults, with moderate to large effect sizes. The findings from these meta-analyses suggest the potential of video game training as an intervention tool for improving older adults' cognition.

The results for executive function and working memory are less consistent. It is possible that non-action video games are not effective in improving and/or maintaining these functions in older adults. Games provide an enjoyable way of passing the time and of giving meaning to the day (Buitenweg et al., 2012). Thus, video games can offer important benefits to older adults, bearing in mind that intervention compliance is a key factor in longitudinal training studies (Mozolic, Long, Morgan, Rawley-Payne, & Laurienti, 2011).

A randomized controlled trial (RCT Clinicaltrials.gov ID: NCT02796508) carried out by our laboratory investigated the possible effects of non-action video game training on a series of cognitive functions that decline with age and subjective wellbeing (Ballesteros, Prieto, Mayas et al., 2014). Two groups of older adults participated in the study, an experimental group trained for 20 1-hr sessions with non-action video games in the presence of a trainer and a "passive" control group who attended several sessions with the researchers. Groups were similar at baseline on demographics, vocabulary, global cognition, and depression status. The results of this intervention study showed improvements in the video game-trained group and no change in the control group in processing speed, attention, immediate and delayed visual recognition memory, and a trend to improve in the Affection and Assertivity dimensions of the Wellbeing Scale. Visuospatial working memory (WM) and executive control (shifting strategy) functions did not improve.

A further longitudinal intervention study investigated specifically whether training healthy older adults with non-action games improved visuospatial working memory and episodic memory (Toril et al., 2016). Nineteen volunteers in the trained group learned to play 6 non-action video games from *Lumosity* in 15 1-hr training sessions. Their scores on a series of experimental tasks and psychological tests were compared with those of a control group of 20 participants. The results showed significant improvements in two visuospatial working memory tasks (the Corsi blocks task and the Jigsaw puzzle task), episodic tasks (Faces I and II and Families I and II from the Wechsler Memory Scale), and short-term memory tasks (Digit Span tasks from WAIS III) in the trained group and no changes in the control group. Some of these gains were maintained in the group trained with video games over a 3-month follow-up period, particularly the Jigsaw puzzle task, the Digit forward test, and the Face I and Face II tests.

In both these previous studies, experimental groups were compared with passive control groups. To better attribute training-related improvements to the intervention and to avoid placebo effects (Boot, Blakely, & Simons, 2011), a new RCT compared the performance on a series of attentional and visuospatial working memory tasks of an experimental group trained for 16 sessions with 10 selected non-action video games from *Lumosity* with that of an active control group carrying out the same number of training sessions with *The Sims*, a simulation strategy game in which the player takes control of the life of a character in everyday activities, and *SimCity*, a life simulation game in which the player is the mayor of a city that she or he must develop. Both groups used mobile tablet devices during the training sessions, which were conducted in small groups in the presence of the trainer (Ballesteros et al., 2017).

In sum, this new RCT (Clinicaltrials.gov ID: NCT02796508) was conducted to evaluate the effects of a randomized computer-based intervention consisting of training older adults with non-action video games on brain and cognitive functions that decline with age using behavioral measures and electrophysiological recordings just before and after training and after a 6-month non-contact period. We also explored whether inflammatory mechanisms, assessed with noninvasive measurement of C-reactive protein in saliva, impair cognitive training-induced effects and show pathways that could be targeted in future interventions. Participants in the experimental group attended 16 1-hour training sessions with non-action video games selected from *Lumosity*. Their pre- and post-training performance on two attentional and two working memory tasks was compared with that of an active control group who played simulation strategy games for the same number of sessions. The electrophysiological data, the measurement of the inflammatory mechanisms, and the follow-up assessments are still being analyzed and are not presented here. We examined the effects of playing non-action video games on older adults' performance on tasks designed to assess selective attention (mainly response inhibition, distraction, and alertness) and maintenance and updating in verbal and visuospatial working memory. We also explored whether motivation, engagement, and expectations account for possible training-related improvements (Ballesteros et al., 2017).

Building on previous literature suggesting that training older adults with video games enhances several aspects of cognition, the present RCT examined whether non-action video games could enhance two key aspects of cognition, attentional functions (mainly response inhibition, distraction, and alertness) and verbal and visuospatial working memory (maintaining and updating information).

The study yielded three main results: (1) unsurprisingly, participants improved significantly in the video games across the training sessions; (2) the experimental group did not show greater improvements in measures of selective attention and working memory than the active control group; and (3) a marginal training effect was observed for the group trained with non-action video games on the *n*-back task, but not on the Stroop task, while both groups improved in the Corsi blocks task. The improvement in the practiced video games across the training sessions is in line with previous findings reported in a large number of intervention studies (e.g., Ackerman, Kanfer, & Calderwood, 2010; Baniquet et al., 2014; Ballesteros et al., 2014; Reddick et al., 2013; Toril et al., 2016). However, transfer to untrained tasks in an active control group was modest for untrained tasks in this RCT, in which we tried to equate task factors that might contribute to differential improvements. First, the number of older participants was almost double that of our previous intervention studies. They were randomly assigned to a group trained with video games from *Lumosity* or to an active control group playing *The Sims and SimCity* (simulation strategy games) for the same number of sessions. The inclusion of an active control group is considered critical to infer the specific potential effects of the intervention (Dougherty, Hamovitz, & Tidwell, 2016; Motter, Devanand, Doraiswamy, & Sneed, 2016; Simons et al., 2016). We selected an active control condition as similar as possible to the training condition in that the control group also played non-action games. In several recent intervention studies with young adults investigating whether training with action video games enhances aspects of cognition, including visual WM (Blacker, Curby, Klobusicky, & Chein, 2014), cognitive flexibility (Glass, Maddox, & Love, 2013), plasticity in the visual system (Li, Ngo, Nguyen, & Levi, 2011), or several aspects of perception and cognition (Oei & Patterson, 2013), the active control participants also played non-action strategy video games.

Boot et al. (2011, see also Dougherty et al., 2016; Simons et al., 2016) warned that the use of a control group per se does not preclude the possibility of differential placebo effects contaminating the results of the trained group. The argument is that the experimental group might have higher expectations of their performance on the transfer tasks compared to the active control group. Recently, Blacker et al. (2014) collected measures of expectations in a group trained on action games and in an active control group trained with *The Sims*. Baniquet et al. (2014) used casual video games to train young adults. The intervention included an active *control* group that played several games not related to WM and reasoning and responded to feedback questions about engagement, motivation, enjoyment, and perceived effort.

In order to match the expectations of our experimental group (trained with non-action games) with those of the active control group (trained with a simulation strategy game), we evaluated both groups' expectations for improvement on each outcome measure. Results showed that groups had similar expectations of improvement in the attentional oddball task and the verbal WM *n*-back task, but the experimental group had higher expectations of improvement than the active control group in the response inhibition Stroop task and the visuospatial WM Corsi blocks task. The expectations and outcomes of the two groups were not aligned, so it is unlikely that the results were driven by a placebo effect.

There are discrepancies between the findings of the present training study and those of Toril et al.'s (2016) study, which reported significant improvement by the experimental group after training with non-action video games in two computerized spatial WM tasks (Corsi blocks and Jigsaw puzzle task) and no change in the passive control group. In the present study, both groups improved their performance on Corsi blocks after training. This suggests that playing strategy games also enhances visuospatial WM. This specific difference could be due to the fact that the games played by the active control group involve not only managing the characters' lives or a city but also travelling visually around the city to identify resources and opportunities. This visual navigation may be partly responsible for the results obtained in the visuospatial WM task. The discrepancy between the results of the two studies might thus be due to the type of control group, either passive (Toril et al., 2016) or active (the present study).

Limitations

A number of limitations of the present study need to be acknowledged. First, although the number of participants was greater than in many previously published training studies, it is always desirable to include a large number of participants per condition to increase power. Null effects may reflect the lack of power and variability within the groups. For example, Melvy-Lervag, Redick, and Hulme (2016) advised that studies with small sample sizes (less than 20 participants per condition) and passive (untreated) control groups produce a bias toward significant (although low-powered) results (see also Maraver, Bajo, & Gómez-Ariza, 2016). In the current study, there were more than 20 participants per group, and the active control group was also trained with video games. Secondly, it is possible that the 16 training sessions were insufficient to show transfer and that a longer or denser (more hours per week) training regime could have yielded greater enhancements. However, as mentioned in the Introduction, recent meta-analyses (Lampit et al., 2014; Toril et al., 2014) showed that shorter training regimes were better than longer ones that can lead to loss of motivation. For that reason, we decided to have only 16 training sessions in the current study. Thirdly, we did not include a passive control group to control for unspecific repetition effects, but we did include an active control group and almost doubled the number of participants compared to our previous studies (Ballesteros et al., 2014; Toril et al., 2016). The inclusion of a passive control group would not have determined whether the improvements observed were due to the specific video games used in the training regimes, to the use of iPads, or simply to social interaction with the trainer and the other participants during the training sessions (see Ballesteros et al., 2015; Schmicker, Schwefel, Vellage, & Müller, 2016).

In sum, further research is needed to ascertain whether computerized cognitive training improves cognition, specifically selective attention and working memory, as well as everyday functioning in healthy older adults. Although high levels of mental activity have been associated with both better cognitive performance and reduced risk of dementia (Valenzuela & Sachdev, 2006), more research is needed before we can ascertain whether video games or other types of computerized cognitive training can improve working memory and attention in older adults (Foroughi, Monfort, Paczinski, McKnight, & Greenwood, 2016; Motter et al., 2016; Simons et al., 2016). A second important issue that requires more research is whether there are stable relations between training with video games and cognitive abilities in general (McCabe, Redick, & Engle, 2016).

Conclusion

Video game training is a rapidly developing and exciting area of research but faces significant challenges. Recent intervention studies have started to address these issues in order to improve our knowledge of the cognitive processes that decline with aging. The main objective will be to find efficient ways to maintain or even improve them by designing training interventions that take advantage of brain plasticity. In sum, findings from a number of intervention studies conducted to investigate the effects of video game training are promising and encouraging, despite conflicting results. More research is needed to develop successful interventions that could improve older adults' cognition.

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Games and Dementia: Evidence Needed

Joseph R. Fanfarelli

Games and Dementia: It's Still Too Early

In 2015, an estimated 46.8 million people were living with dementia, worldwide. By 2050, an estimated 131.5 million people are expected to have dementia, making it one of public health's most significant problems (Alzheimer's Disease International, 2016; McCallum & Boletsis, 2013). While common symptoms of dementia include impaired memory, thinking, communication, and personality changes, dementia may manifest in various ways that not only impact a person's ability to cope with daily tasks but also have more acute repercussions (Alzheimer's Disease International, 2016; McCallum & Boletsis, 2013). For example, people with dementia are more likely to be admitted to the hospital and remain there for longer periods than people without dementia (Robert et al., 2014).

There is currently no known methodology for preventing or stopping the progression of the cognitive decline that is inherent in dementia (Fernandez-Calvo, Rodriguez-Perez, Contador, Rubio-Santorum, & Ramos, 2011). Instead, successful research has attempted to delay its progression – the symptoms of dementia patients tend to increase in severity over time (Robert et al., 2014). For example, the neurotransmitter glutamate is useful for normal brain functioning in moderate concentrations but becomes a neurotoxin which contributes to the loss of neurons when levels are too high, worsening the symptoms and progression of dementia. Memantine (commonly sold under the brand, Namenda) is a drug that helps to regulate levels of glutamate, slowing the destruction of neurons, but not repairing or regenerating those that have already been compromised. Beyond regulating the progression of decline, other research has attempted to improve patients' and caregivers' abilities to cope with the challenges posed by the disease, examining a number of novel methodologies and tools, including video games. Games have been

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suggested as a way to diagnose and treat dementia and to promote participation in activities that have been shown to improve symptoms or delay dementia progression (e.g., exercise). However, the effects of video games have thus far received little success, and results primarily remain inconclusive or show games to be ineffective. This chapter will review the evidence and potential to use games for treatment and diagnosis as well as the ways in which dementia game research is currently lacking.

Using Games for Diagnosis and Treatment

Conventional tools and treatments fit within a range of domains related to dementia. However, dementia games have primarily been assessed for two purposes – diagnosis and treatment. This section examines both, identifying the research that has been conducted, and the potential to use games for these purposes.

Diagnosis

Before dementia can be treated, it must first be diagnosed. This is problematic because about half of dementia cases go undiagnosed, worldwide. In low- and middle-income countries, diagnosis rates are especially low, dipping below 10% (Alzheimer's Disease International, 2016). This discrepancy suggests that cost may be a substantial barrier to consistent diagnosis – a likely explanation – given that older people in these countries often have difficulty affording medical expenses in general (Albanese et al., 2011). This poses a problem in the case of using games as early diagnostic tools. Game development is expensive; in order to cover the expenses of development, there is usually a cost required by caregivers or patients associated with acquiring games. Affording games in low-income countries where diagnosis rates are in the greatest need of assistance is likely to be difficult, especially when considering these games typically cannot be played in isolation and require a computing system powerful enough to run them, which further inflates prices. While treatment games could potentially be housed in caregiving facilities to offset patient costs, this is not a viable solution when the game is meant to diagnose. Patients are unlikely to go to caregiving facilities if they do not know they have dementia, yet are unlikely to know they have dementia unless they go to a caregiving facility, proposing something of a circular problem which games do not address.

Professional diagnosis aside, at some point of decline, dementia eventually becomes obvious to the individual and family or friends due to the individual's inability to complete everyday tasks, reduced memory functioning, or hindered interpersonal ability. Low clinical diagnosis rates suggest that even when the onset of dementia becomes apparent, many patients and caregivers decide not to attend healthcare services, particularly in lower socioeconomic environment communities (which would result in a professional diagnosis), meaning that these patients would not have access to the games in clinical settings. Thus, before games can become useful in these low-income countries, the issue of getting patients to seek out healthcare services must first be solved, whether that means expanding access to affordable healthcare or educating patients and caregivers on the importance of receiving healthcare in coping with and moderating dementia. Even then, games may no longer be needed for diagnosis, because other less expensive solutions will have already solved the issue.

Finally, dementia diagnosis is difficult and can require complex subjective judgment, as evidenced by the frequency of diagnosis disagreement between specialists (Alzheimer's Disease International, 2016). Diagnosis requires an examination, medical history, cognitive testing, and functional assessment and must differentiate between dementia, normal aging, and other possible causes of cognitive decline (e.g., depression) and identify the precise form of dementia. Even then, posthumous autopsy is the only way to be 100% accurate; even advanced imaging methods fail to reach 90% accuracy (Thomas et al., 2017). While games and computers, in general, excel at the completion of objective tasks, they are far less successful at completing even the subjective tasks that humans do consistently well, never mind those where humans perform inconsistently (e.g., inferring meaning of language from vocal tone or body language, determining fact from fiction). Thus, even if games were affordable and widespread, their efficacy and accuracy as a diagnostic tool are not only likely to be limited but to potentially be harmful due to high rates of misdiagnosis.

Treatment

Once diagnosed, treatment for dementia can begin. The goals of dementia treatment include preservation of cognitive and functional ability and reduction of symptoms and risks associated with dementia (Odenheimer et al., 2014). To accomplish these goals, games may attempt to treat the physical or cognitive aspects of the disease. However, games are unlikely to be useful in targeting the physical aspects of dementia, because there is currently no known mechanism by which cognitive training, which is frequently used in games, can reduce amyloid buildup, plaques, and tangles associated with dementias like Alzheimer's disease, the most common form of dementia (Ratner & Atkinson, 2015). Thus, this section will focus on the ability of games to treat the cognitive aspects of dementia.

Cognitive training is one methodology that researchers have examined for integration into dementia games, in an attempt to slow cognitive decline. For instance, Finn and McDonald (2011) used the cognitive training found in the Lumosity platform to improve everyday memory functioning and mood. While results showed an increase in performance on game-specific tasks, the researchers observed no significant effects of the training on self-reported memory or mood – suggesting that participants did improve within the game but that this improvement was not linked to extra-game improvement in memory or mood. Prior to this study, cognitive training seemed ripe for inclusion in games, due to initially promising study results – a meta-analysis highlighted results that appeared to show benefit in cognitive training for dementia (Sitzer, Twamley, & Jeste, 2006). However, the authors cautioned that the initial studies it reviewed were of relatively low sample size and differences were minor when compared to attention-placebo control groups; the reduced differences in comparison to this particular type of control groups, according to the researchers, provided evidence that the observed benefit of cognitive training may have been due to the cognitive stimulation that occurred during the interpersonal interactions which took place during experimentation, rather than being attributable to the cognitive training, itself (Sitzer et al., 2006). A more recent meta-analysis, which included 33 studies, confirmed this notion (Huntley, Gould, Liu, Smith, & Howard, 2015), finding significantly positive effect sizes for the effects of cognitive stimulation on general cognition, but not finding evidence that cognitive training within games produced positive effects.

An inability to affect general cognition likely means that cognitive training (and games that attempt to use it) will be unsuccessful in promoting an individual's ability to cope with everyday tasks, which is in line with the results in the study by Finn and McDonald. To further explain the reasoning behind this, everyday tasks that dementia impairs typically require the integration of multiple cognitive domains in order to be effectively completed (Ratner & Atkinson, 2015). For instance, taking a bath requires attention to the task, motor skills to conduct the physical act of washing, spatial ability to guide the motor skills, and memory in order to remember the act of bathing and how far one has progressed in the bathing session (e.g., "did I use soap yet?"), among other memory requirements. Even if cognitive training improves one of these cognitive domains, development in the other domains is still lacking, and the routine task still cannot be completed independently.

Cognitive training is one aspect of dementia game research, but others have been examined, such as games that reduce the secondary risks associated with dementia symptoms. Dementia is associated with elevated risks of falling, infection, and delirium, which may be reduced through maintenance of physical health, nutrition, and hydration (Alzheimer's Disease International, 2016). This aspect of game training is perhaps where major strides could be made. However, there is a general lack of research in this area. Padala et al. (2012) implemented the active video game Wii Fit in experimentation, which resulted in significant improvements in gait and balance for participants. In the same year, Legouverneur, Pino, Boulay, and Rigaud (2011) conducted a study with mild to moderate severity Alzheimer's patients to see if they could learn to learn to play a different active game, Wii Sports. This study was conducted to identify the feasibility of using complex physical games with these populations. While a number of usability challenges were encountered, participants were able to learn to play the game.

Overall, this area of research is quite understudied, and it will be important for researchers to examine these dimensions of dementia treatment more closely. Training patients and caregivers on the importance of maintaining proper hydration and nutrition, for example, could have major impacts on reducing risks associated with dementia. Until this research is explored, games cannot be recommended to mitigate these risks.

More Experimentation Necessary

To those who are familiar with the literature on games and dementia, it may appear as if this chapter has omitted several studies that have had positive results. The counterpart chapter in favor of games for dementia will cover these studies; they are omitted, here, to reduce overlap. However, when reading these studies, it should be noted that, as is typical in fields early in their development, much of the dementia game research is exploratory in nature and has not yet reached the point where large-scale randomized and controlled trials have been conducted; these trials are needed to create sufficient confidence in the results to justify using them in the design and deploy of dementia games. Further, the field is lacking studies that assess the transferal of results to everyday tasks which must be completed by dementia patients. Nearly all studies that have shown positive effects of games on dementia require follow-up studies to confirm the results, especially studies that have large sample sizes, examine transfer or generalizability of results, and incorporate sufficient amounts of playtime to create change. In fact, a recent review of the literature found little evidence that brain training improves performance on everyday tasks and identified “major shortcomings in design or analysis” in the published studies (Simons et al., 2016, p. 103).

Sample Size

A large number of studies have not had a sufficient number of participants to maintain power and resist the influence of outliers. The smaller-scale pilot studies that have been conducted thus far are useful first steps for demonstrating feasibility and potential but must be expanded upon by future research. For instance, Weybright, Dattilo, and Rusch (2010) studied the effects of interactive video games versus television viewing on positive affect and engagement and found that video games promoted greater levels of affect and attention to task than television. Additionally, Fenney and Lee (2010) found that dementia participants who played Wii bowling were able to improve their bowling scores and memory for procedural components of game participation. Further, Tobiasson (2009) found that dementia patients who played Wii Sports enjoyed being more physically active within the game setting. Several other studies follow this path (e.g., Rosen, Sugiura, Kramer, Whitfield-Gabrieli, & Gabrieli, 2011; Yamaguchi, Maki, & Takahashi, 2011). These results seem encouraging, but they are not definitive. While these studies are useful first steps toward identifying the potential for games, they each include 12 or fewer participants, necessitating further study to confirm the findings. At these sample sizes (one as low as $n = 2$), power is low, and a single outlier can sway results.

Generalizability

In addition to sample size issues, few studies have examined how the results of experimentation transfer to everyday activities beyond the game, itself. Sometimes it is not feasible to conduct studies with the target population and on the target tasks at the outset of a field's investigation. Developing games is costly, and special populations are often difficult to access. As such, it can be worthwhile to see if the idea has any feasibility at all. Dementia game research has followed this path. While this may be the correct first step to see if the field is worth studying at all, it is not sufficient to provide strong evidence and support full-scale implementation; often, skills, abilities, and other capacities developed in one particular non-field setting do not transfer to other aspects of life. This can be problematic for the dementia patient; if a patient demonstrates increased memory within a game but cannot translate it to everyday tasks, the usefulness of the intervention is quite limited.

This phenomenon has been directly observed in dementia game experimentation – for example, Finn and McDonald's (2011) study on Lumosity, described earlier in this chapter. The problem of generalization means that studies must include an assessment of transfer to everyday activities. While these studies are a useful preliminary step before engaging in large-scale research, healthcare providers should use their results with care, as they may not manifest in useful ways during practice (e.g., memory increased in the game, but is the person better at remembering whether or not they took their medication today?). The study by Legouverneur et al. (2011) that showed dementia patients could learn to play Wii Sports is useful, but further study must investigate if learning to play Wii Sports transfers to learning to do other things, improving physical health, and engaging in more physical activity or other beneficial life changes.

Generalization or the transfer of results from the experimental session to everyday life has rarely been studied in dementia games. At the moment, there is little evidence that the dementia games that have shown positive results will create a positive benefit in a dementia patient's everyday tasks. Further study is needed.

Playtime

Ratner and Atkinson (2015) argue that the small amount of time playing dementia games in experimental conditions are likely insufficient to fulfill the requirements of one of the major theories for how these games might counteract dementia. The *scaffolding theory of aging and cognition* states that people may be able to build cognitive capacity reserves in the form of elevated neuronal connections that can serve as a fallback when others are deteriorated during cognitive decline (Reuter-Lorenz & Park, 2014). This fallback reserve theoretically allows for the brain to continue functioning efficiently for a longer period of time after onset, because it would open up new neuron routes for cognitive processes to take as others degraded.

This could be explained with the metaphor of a city and real-life roads. If a city builds one road and the road falls into disrepair, it will become very difficult to travel to your destination by car. However, if the city builds ten roads and one falls into disrepair, you can likely take an alternate route to arrive at your destination.

To this end, it may seem that training the brain to increase the number of connections is a useful task, and perhaps it is. However, when it comes to dementia games, the present research typically has participants play the games for a small number of hours. This is problematic. An individual spends decades building their cognitive capacity through school, work, hobbies, and other mentally taxing activities. 1, 10, or even 100 hours in a brain training game seems inconsequential in comparison. Thus, it is important for future research to include experimentation that examines the effects of both long-term engagement with games and large numbers of hours spent playing the game. Unfortunately, this research is difficult to conduct, as it is costly in terms of participant compensation and the researcher's time, a fact that is reflected in the rarity of longitudinal research in many fields. Further, as this research is conducted, it will be important that the game be sufficiently engaging to support such lengthy playtime. This is also problematic, as it will likely result in a substantial increase in development costs, ultimately reducing access to the game due to costs passed onto patients and caregivers to fund development.

While initial results of these studies, and others, show some promise, there is not enough confidence in the ability of dementia games to promote benefit, to justify the cost. Highly rigorous follow-up study is necessary to provide the evidence required to safely implement dementia games as part of standard dementia care.

Conclusion

Dementia remains one of the most critical healthcare problems of modern times, affecting millions of people worldwide. Treatment and diagnosis advancements are necessary, but games may not be the best solutions at this time. Games rarely succeed in replacing human judgment of complex phenomena, especially in the case of dementia diagnosis which has proven to be difficult even for dementia specialists. Moreover, much of the early research in games has not shown positive results, and the studies that have shown success with the experimental manipulation were smaller-scale or isolated studies; these require larger-scale follow-up studies that include a transfer assessment component to see how well the results transfer to daily tasks. The places where games have the most potential appear to be in the education of patients and caregivers on topics such as nutrition, hydration, and other productive health habits which are required to combat the frailty issues and other secondary risk factors that accompany dementia. Unfortunately, this side of dementia games has received little attention to date. Ultimately, the literature on games for dementia remains in its infancy. The field must engage in more research before video games can be used to treat dementia with confidence.

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For Better or Worse: Game Structure and Mechanics Driving Social Interactions and Isolation

Dmitri Williams

"Stay Aware of Your Surroundings"

In the game *Pokémon Go*, players are tasked with collecting virtual pets that are tied to real-world locations, inevitably resulting in millions of people going to places and doing things they hadn't done before. When the game first launched in the summer of 2016, the news media had a steady stream of human interest stories to keep them busy. Gamers were flooding public spaces, and counter to stereotype were going outside and being social.

Among the more colorful anecdotes were the two men who walked off a cliff in San Diego, trying to capture rare Pokémonsters. Authorities suspected alcohol was a factor (Kaur, 2016). In Toledo, Ohio, two players broke into the local zoo after hours to grab critters near the tiger cage (Victor & Mester, 2016). In Duvall, Washington, citizens chased creatures near the local police headquarters at night, prompting the police to post on Facebook "We have had some people playing the game behind the PD, in the dark, popping out of bushes, etc. This is high on our list of things that are not cool right now" (Batiot, 2016).

What these stories have in common, besides a slightly Darwinian flavor, is the immense power games can have over human social behaviors. For better or worse, the systems of games incentivize ordinary people to make choices and behave in ways they otherwise wouldn't. Sometimes the result is learning, fun, and community. Sometimes the result is danger and loneliness.

That's the heart of this chapter: good and bad social outcomes are the inevitable consequence of some designs, even when those consequences are unintended. To make this point, the chapter lays out a theoretical groundwork from

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computer-mediated communication and references a series of empirical research examples. I make the case that games have real community effects as the result of what we can call "social architecture."[1]

I'll start by making six assumptions and then go on to present a series of supporting examples.

Laying out the Groundwork

Assumption #1. Online communities are real.
There is now a long-standing and broad base of findings demonstrating that the interactions people have online result in real, tangible communities. Moving well past the original aspirational work that argued that an imagined community required only to share identity (Anderson, 1991), researchers in both the qualitative and quantitative traditions have demonstrated at length that game communities are vibrant and real. Ethnographic work has shown that relationships can become deep and be sites of meaning and identity (e.g., Nardi, 2010; Pearce, 2009). Groups form within the formal structures of games (Williams et al., 2006). Survey and experimental work has shown that vast numbers of players meet and form real social ties that move back and forth from the "real" world (Williams, 2006a; Yee, 2006).

Assumption #2. Online systems, including games, have code-based rules that enable and restrict behavior.
This is a deeply (sometimes literally) structuralist argument that may rankle some, especially those who study or focus on human agency. However, the supporting evidence is strong. As we will see throughout this chapter, aggregates of people react predictably to rules. Yes, people have choice and agency, but because of the way systems are created, the only means of exercising their voice (Hirschman, 1970) is often by quitting the system. This structure/agency tension exists in many fields, but in some places, it's more widely accepted that structures are where researchers should focus. For example, in urban planning and architecture, it's well understood that the placement of garages and porches and the spacing of sidewalks and parks have a profound impact on community interactions (Caragliu, Bo, & Nijkamp, 2011). It follows that you can take the same people and put them in different neighborhoods and get different levels of community.

In business research, Williamson's (1994) and Bain's (1986) industrial organization (IO) model posits that knowing the structure of a system will inevitably explain the conduct of the people in it. Rather than focus on agency, they focus on incentives

[1] Note that programmer Hintjens (2016) uses this term as well, but in a different way. He is referring to the best practices for building an online community independent of social science, as built up by anecdote. The use here is tied to SIDE (Postmes, Spears, & Lea, 2000) and SIP (Walther, 2006) theories, as well as to the experience of game-based practitioners like Kim (2000) and McGonigal (2011).

and rules. For example, when looking at tax evasion, their approach would examine the tax code and wealth distributions to predict how much cheating is likely to occur. This doesn't mean that cheating is good or acceptable in their world view—far from it. It simply means that focusing on the moral choices of the individuals misses the larger structural forces that encourage or discourage that particular behavior. Moreover, if we want the bad behavior to stop, we are better off focusing on the structural issues rather than the story of the individual wrongdoer. In this framework, while individuals may vary, in the aggregate peoples' behavior is predictable when we look at the system's laws and norms.

Lessig's foundational book *Code* (1999) makes the case that the code of a system effectively *is* its law. If a game developer has coded that you can fly, you can fly. If she wrote in that you can't talk to that group over there, you can't talk. According to Lessig, code "will present the greatest threat to both liberal and libertarian ideals, as well as their greatest promise. We can build, or architect, or code cyberspace to protect values that we believe are fundamental. Or we can build, or architect, or code cyberspace to allow those values to disappear. There is no middle ground. There is no choice that does not include some kind of building. Code is never found; it is only ever made, and only ever made by us" (p. 6).

Assumption #3. Developers control that code by virtue of their framing of the world through the lens of the mechanics, dynamics, and aesthetics (MDA) approach (Hunicke, LeBlanc, & Zubek, 2004; Sellers, 2006).

MDA is a design approach that suggests that game "mechanics" create a set of options for a player. Mechanics are the "various actions, behaviors and control mechanisms afforded to the player within a game context" (Hunicke et al., 2004, p. 3). Hunicke et al. give the example of shuffling or betting in card games. If we add or subtract shuffling, we can expect players to behave systematically differently. Another example is the common tank/damage dealer/support class structure found in RPGs. These mechanics create the dynamics within which players act. If the developer decides to change the rules, players will inevitably act differently. For example, if the developer makes support classes more valuable, more players may select them. Conversely, players in now-rarer classes may be more appreciated as they become scarcer.

There's a critical extra component to this assumption about MDA, and it's that developers are explicitly not social scientists. Their goals are usually to create a fun game and/or to make one compelling enough to incent players to spend money to play. Those goals are not particularly in line with or opposed to community outcomes. Community goals are rarely on developers' radar when conceiving, coding, and QA testing a game. Developers, therefore, will code their games with mechanics that may have subtle or massive social effects on the players and will frequently be unaware. Having attended the past 15 years of the Game Developers Conference, it's become clear to me that only a minority of developers are aware of, let alone focused on, the sociological implications of their MDA choices.

Assumption # 4. Some MDA and code choices lead to predictably good social outcomes and some to bad.
There are a handful of consultants and developers who focus on social mechanics. A leader in the space is Amy Jo Kim, who early on wrote the go-to manual for developing smart online communities (Kim, 2000). In her book *Community Building on the Web*, Kim lays out an exhaustive set of criteria for coding up compelling, healthy communities. She draws on dozens of real online community case studies in games and even in e-commerce. Without explicitly meaning to, she is often tapping the same thinking found in foundational work in political economy. For example, Ostrom's Nobel Prize-winning insights on the nature of trust in communities (Ostrom & Hess, 2007) may as well have been baked into Kim's advice to developers. After studying a lifetime of successful and failing communities around the world, Ostrom laid out a set of eight criteria found in every strong community. One of those criteria is that successful communities regularly have means of resolving conflict that are cheap and easy to access. When they don't, members suffer. Listing out all of Kim and Ostrom's suggestions is beyond the scope of this short chapter, but they are highly recommended for developers and for researchers looking for mechanics and criteria that will predict community levels.

Assumption #5. Computer-mediated communication theories and findings are consistent with structuralist frameworks.
Although there are dozens of theories that describe the behaviors of humans interacting in electronic environments, none have been so consistently supported as the social identity model of deindividuation effects (SIDE) theory (Postmes et al., 2000). This theory suggests that individuals entering a system are unsure of how to behave and readily take their cues from external sources. Arriving at a party, we look to others to see how we should behave. Is it a quiet, reserved affair or a loud dance rave? We will likely follow suit with the crowd rather than choose based on our own mood. According to SIDE, the fewer cues we have, the more we'll rely on what few we're given. And, according to Postmes et al., the online world is typically cue-scarce. Compared to the party, we are usually missing the cues of dress, body language, sound, and smell. This leads us to rely heavily on the system's cues to figure out how we should behave. One of the more extreme applications of this general idea is Yee and Bailenson's "Proteus effect," (2007) which suggests that in online games and virtual spaces, we will flow into the shape and identity we're given. If we are playing a tall character, we're more likely to act confidently, reflecting our impression of the social power of height in the real world. Consistent with this, others have found that color or group associations will shape players' behaviors (Pena, Hancock, & Merola, 2009).

Assumption #6. Individual-level social outcome measures are a good way to track these processes.
Evaluating any system requires a well-theorized set of metrics or variables. Evaluating the impact of mechanics on social outcomes means we should use measures that get at an individual's costs and benefits, but within a larger social context. In particular, when looking at the positive or negative impacts of game play, social

capital is an appropriate framework. Social capital (Coleman, 1988) is made up of the emotional and practical resources we draw from interactions with others. As extended by Putnam (2000) and codified into scales by Williams (2006b), it's broken into two related pieces: exposure to new ideas, people, and resources (bridging social capital) and deep social and emotional support (bonding social capital). Research on multiplayer gaming has tended to find that games are better at providing bridging social capital than bonding, though bonding can increase over time (Williams, 2006a).

Assumption #7. The combination of all of these building blocks is social architecture.

Collectively, the design and system code that shapes player behaviors—filtered through our human social psychology—can be thought of as "social architecture." "Architecture" conveys the potential for purposeful creation and construction. The architect builds a house and may or may not understand the full impact, but there is no question that there is a cause and effect. Obviously, architectures that generate higher levels of social capital, community, or positive well-being are normatively better than those that depress those things or even cause harm.

As an example, I was involved in an experimental project with MMO players to test the social impact of voice communications versus text-only chat (Williams, Caplan, & Xiong, 2007). In a controlled experiment of raiding guilds, we compared several text-only guilds to another set to whom we gave headset mics and free software to talk to each other. The text-only groups had drops in their social capital outcomes, whereas the voice-enabled players were insulated from the drops. The social architecture had a direct and large effect on the social outcomes.

The larger implication of architectures is that in the hands of highly aware developers, it is a tool of immense power and even control. In the hands of unaware developers, it's just as powerful, but rather than being a tool of control, it simply generates unintended consequences. Those consequences include social and financial outcomes for both players and developers (good and bad). The next step for researchers is to establish that this is happening regularly and then to gain an understanding of what kinds of architectures tend to lead to what kind of social outcomes.

Meta–Level Analysis

Analytics companies are now consuming and processing vast amounts of game telemetry data, typically to improve the marketing spend of developers, especially in the mobile and free-to-play sectors. One company, Ninja Metrics,[2] specializes in social data and has presented meta-level findings that speak directly to the question of whether game mechanics impact community outcomes. In a series of presentations at Game Developers Conferences (Williams, 2015, 2016), I have outlined the

[2] I am the lead data scientist and founder of the company.

measurement and results from an analytics system I designed to examine player networks. Data are ingested into a cloud-based system called Katana, which first assembles networks from log data. For example, if players A and B are in a group, or chat, a network edge can be drawn between them. With all such edges, the entire community graph can be drawn and then tracked over time. The Katana system generates a metric called "Social Value," which measures the impact of one player on her network neighbors (*Social Value: Finding the true influencers in social games and mobile apps*, 2013). By following behaviors over time, it tracks whether player A's actions are causing some of player B's actions. For example, when player A is present, player B may play longer than when she is not present. The metric of Social Value credits some of player B's behaviors to player A. Then, examining the entire roster of players, some can be seen to be more influential and some to be more followers. As I reported at GDC, the metric has been validated with nearly one billion player accounts and found to be 85% accurate across more than 20 game titles.[3]

The meta-level implication of this metric is that all of the Social Value can be aggregated for a title and compared to the Asocial Values of the same population. In other words, if we look at all of the individuals' playtime and compare the purely socially driven with the rest, we'll know how much play overall is the result of community rather than noncommunity forces. For example, if a game has 30% Social Value and 70% Asocial Value, it means that overall 30% of the play is driven by community and social forces, while 70% is driven by other forces—presumably the game play and marketing.

I have presented a compiled version of the meta-level results as broken down by four large comparative categories: mobile single player, mobile casual, PC hardcore multiplayer, and MMOs. These four categories range from low to high on their social architectures. For example, the single-player titles have no interactions within the game, and so any social element is relegated to out-of-game interactions such as personal conversations or Facebook posting. On the other end of the spectrum, MMOs are the most heavily socially architected with deep player group mechanics and interdependence; players progress faster with others compared to staying solo. The hypothesis was therefore that as we move from the asocial to the more social, we should see the percentage of social play increase, which is indeed what the data show (Table 1).

Given that this is the compilation of more than ten games, but not hundreds, it is a decent early meta-level indicator that game mechanics indeed have a direct and systematic impact on community and social outcomes. It also suggests that systems with more social architectures lead to higher levels of social play. And, those systems with lesser architectures lead to lower levels of social play. If we equate social

[3] Accuracy was measured by comparing the prediction of influence with the downstream actual influence. For example, if player A is forecasted to cause player B to play for an extra 10 min, player B's behavior can be checked. To address the lack of control condition, the more stringent test was applied: cases where player A quits the game were examined. In these cases, player B's play should be *reduced* by that same 10 min. Comparing those predictions versus actuals yielded the 85% accuracy rate.

Table 1 The percentage of social play across different genres and platforms

Category	Meta-level percentage of social play
Mobile single player	6
Mobile casual	28
PC hardcore multiplayer	30
MMO	60

play with positive outcomes, then we have a recipe for which kinds of games are potentially good and bad for social outcomes. Of course, this is not bulletproof causality; there is always the potential confound that perhaps more social players will self-select into more social titles. However, even in large-scale MMO research, the consistent finding is that the systems tend to amplify existing personality types, with extraverts faring well and introverts faring comparatively poorly (Caplan, Williams, & Yee, 2009). The as-yet unanswered question is whether those same introverts would fare *even worse* if placed in games lower on the social spectrum above. What's becoming increasingly clear, though, is that the systems drive behaviors, as the following example shows.

It's the Economy, Stupid

Game economists have taken the precepts of regular economics—markets, price indices, rational choice models, etc.—and applied them to game worlds (Lehdonvirta & Castronova, 2014). They find that players generally do the thing that is in their best interest, whether that's choosing the more fun choice, avoiding drudgery, or buying the less expensive version of two equal things. I was part of the first test of this idea in game research (Castronova et al., 2009), and it was foundational in driving me toward a structuralist approach.

In the study, we'd been given access to player logs of *EverQuest 2*. To my knowledge, this was the first time researchers were able to peer behind the curtain and get truly unobtrusive data directly from a developer. We had both survey data on the players and matching behavioral logs for 9 months of play. That means we saw every action, interaction, and transaction in that time period. Like many MMOs, *EverQuest 2* is "sharded," meaning that when one copy of the game world gets too populated, the developers simply create a copy and flow players into it. That sharding process happened to occur in our study window, allowing us to model a unique natural experiment. We'd started by measuring all of the macroeconomic indicators for our server, including market baskets, inflation rates, etc., and then suddenly, an entirely new and empty version of the game appeared. This is roughly the equivalent of studying the USA, and then suddenly a copy of the USA appears floating in the Pacific, with free instant teleportation to it for anyone who wants to relocate.

What this enabled was a natural experiment and a pure test of the structuralist approach. Were the players in our game server unique and local, or were their outcomes utterly predictable given the game's social architecture? Would players leaving our copy and combining with new players in the empty version establish their own unique patterns or perfectly copy the existing ones? We found the latter (Castronova et al., 2009). After an initial period of people joining, all of the indicators approached and then matched all of the first server's numbers. In other words, the structure leads directly to a predicted series of behaviors, which generated a predicted series of outcomes. As someone who likes human agency, I'll share that this was unsettling. I like to think of myself as a unique snowflake. And well, we all are, but we also gather into uniform snowbanks given a set of rules and an architecture. What's more unsettling is that these effects may be happening by accident.

Unintended Consequences

With a few notable exceptions, developers are—generally speaking—not aces at social science. At their most unaware, they create social systems with unintended outcomes. Two of the more celebrated misfires occurred in multiplayer games.

As detailed by a now-famous story by Dibbell (2001), the early MUD *LambdaMOO* was a pioneering game bringing together players from all over the world into a text-only "space." The code of *LambdaMOO* allowed immense player creativity and control, with the ability to change their surroundings, their abilities, and even some of the rules of interactions. It was extremely open social architecture, but like any text-only system, it was relatively low on social cues. One player known as Mr. Bungle used this open system to perpetrate the equivalent of a violent virtual rape of another player. This action caused widespread anger and anxiety across the community, in addition to the trauma inflicted on the victim. This was clearly not the intent of the system's designers, who struggled with their positions of authority. Bouncing back and forth between the extremes of total fascistic control or total anarchy, the developers were a microcosm of the challenges faced by all game makers. They just wanted to make a fun game, yet found themselves in the role of the state, with all of its responsibilities and consequences. I've often analogized game developers as wardens of a game park, just without any zoology training. It's simply not their area of interest. Ultimately, these developers chose the control route and unilaterally banished the offending player. It's one of the more blunt examples of Lessig's "code is law" statement—the player simply ceased to exist.

In the second instance, Blizzard Entertainment, creators of *World of Warcraft*, accidentally unleashed a killer plague on their population (Coppola, 2007). Players encountering a particular boss had to use its virus against it while staying alive and curing each other. However, the developers forgot to limit where this virus could function. As a result, players teleporting into the game's major cities discovered that they were fatally infecting the other players. Most were doing so gleefully, chasing others around. Although most players found the inconvenience minor and the incident funny, it certainly wasn't what the developers had in mind. It was a reminder of how powerful a game's code can be, even when the designer didn't intend it.

Last Thoughts

Architectures can be positive or negative and can be tools of control or liberating and socially enabling. On the positive side, we have designers like McGonigal, who see the immense potential for growth and happiness. "If we take everything game developers have learned about optimizing human experience and organizing collaborative communities and apply it to real life, I foresee games that make us wake up in the morning and feel thrilled to start our day. . .to be happy, resilient, creative—and empower us to change the world in meaningful ways" (McGonigal, 2011, p. 14). On the negative side, Lessig warns us of the kind of futures that are possible as dystopic science fiction becomes everyday fact: "Each new generation of system code would increase the power of government. Our digital selves—and increasingly, our physical selves—would live in a world of perfect regulation, and the architecture of this distributed computing—what we today call the Internet and its successors—would make that regulatory perfection possible" (Lessig, 1999, p. xiii). That's only one flavor of negative. Many others have written about the potential for addiction and loneliness in games where the designer certainly would have preferred positive outcomes (e.g., Elson & Breuer, 2014; Griffiths, 2014).

It's therefore up to us, those few nerds, students, researchers, and developers weird enough to read books and chapters like this. We need to build up an understanding of the implications of code and social architectures. We need to communicate them, translated from our researcher geek argot of p-values and Neomarxism into something every day, simple and direct. What we cannot do is simply sit back and assume that games are good for us, or bad for us. They are not natural or inevitable. They are the direct result of choices. Assuming they are "just there" is a path for talking heads and reactionary politicians. Our job as citizens, scientists, and players is to be honest and unmerciful as we analyze systems, laying out which enable and harm communities and individuals. It may be fun and games, but it's also critical media literacy with policy implications. Without solid research and advocacy, there will be only luck and the profit motive guiding the social outcomes of the literally billions of humans who are spending increasingly large parts of their lives in games.

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Video Games Are Not Socially Isolating

Rachel Kowert and Linda K. Kaye

Introduction

Since their popularization, video games have developed a reputation for being antisocial spaces. However, this is somewhat contrary to the wealth of social opportunities and functions which contemporary gaming offers, as well as what much of the research in the area suggests. For example, gaming can involve players congregating in arcades, or with groups of friends in front of a TV-based console, or networked with others through the Internet (i.e., online gaming). Regardless of this, gaming is often conceptualized as being an activity enjoyed only by "social recluses" and, in turn, has been suggested to result in these individuals experiencing further social isolation through spending time gaming. The stereotypes of various gaming groups support these anecdotal claims. Arcade gamers and online gamers in particular are perceived by many non-gamers as being socially inept, reclusive, and introverted (Kowert, Griffiths, & Oldmeadow, 2012; Kowert & Oldmeadow, 2012).

This chapter will outline the key claims and draw on research findings from the academic literature, in order to debunk much of these anecdotal and old-fashioned conceptualizations of what gaming is and who gamers are. First, we outline the various ways in which gaming can be experienced socially, to present a context for the subsequent discussions. What is important to note in any discussion pertaining to video game experiences or effects is that these differ considerably as a result of type of game or context of play. As such, conclusions surrounding what these social effects of games may only be addressed through exploring how these are relevant for particular types of games and the social context in which they are being played. Our discussion offers a degree of specificity in this regard.

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Social Contexts of Video Gaming

The development of video game technology and increased Internet connectivity means that video games can be played in many different ways. This includes being *physically co-located* with other players, for example, through *arcade gaming* or through *multiplayer games* with split-screen functionalities so players can play concurrently (either competitively or cooperatively). Players also now have the option to be *virtually co-located* with others through *online games* via the Internet or local area networks (LAN).

It is interesting to note that when exploring people's perceptions of different types of gamers, based on how they play, a number of differences are evident. For example, "offline" players (i.e., who are physically co-located) are perceived more positively than online players (Kowert & Oldmeadow, 2012), although even those who play offline are perceived to be some degree of socially inept (ibid). However, even though offline players are also perceived as obsessive and immature, they do not carry with them the same degree of social condemnation that has been ascribed to other gaming groups (Kowert & Oldmeadow, 2012). Compared to online gamers, they are perceived as fun-loving and determined, rather than online counterparts who are seen as introverted and awkward.

On the other hand, online gamers are consistently described as lonely and perceived as isolated, whereas arcade gamers are not. This is likely due to the differences in the environments in which these two activities take place. While both groups are engaging in a "virtual" space, arcade players are playing in a shared *physical space*, whereas online players typically gather in a shared *virtual space*, where their co-players are virtually, rather than physically, present. Thus, even if arcade players may not be engaging with those around them, they are perceived as less isolated.

These differences are perhaps why online games (and those who play them) tend to receive the most condemnation in terms of such gameplay promoting social isolation. For example, when a parent sees their child playing online games, they are *seeing* an isolated individual – someone alone in a room with a headset on interacting with their computer. As these kinds of games are being played "alone," insomuch as they are being played in a room often unoccupied by other individuals, it is not entirely unreasonable to assume that the games are isolating their players from their family and friends.

However, even if it is acknowledged that individuals are playing online games with others (albeit, virtual others), the friends one makes online are often discussed as being weaker than traditional "real-world" friendships, both in terms of the quality of the *contact* themselves and the *context* in which the friendships developed (Putnam, 2000). This makes the claims of online games being socially isolating threefold: the activity itself is isolating, playing video games takes time away from family and friends which is isolating, and the friends one makes through online games are socially "weaker" than face-to-face relationships and therefore isolate the player from more "valuable" face-to-face relationships.

While claims of the socially isolating nature of video games are often made, the research does not wholly support these contentions. In fact, in recent years online games in particular have been touted as uniquely social spaces and perhaps new "third places" (as opposed to home as the "first place" and work as the "second place"), where people can meet up, hang out, and play together much like people do in local bars and pubs (Steinkuehler & Williams, 2006). In fact, online games may be superior to more traditional "third places" (such as local clubs) as they can connect people regardless of their geographical location and provide a range of social affordances that can foster communication and friendship building, particularly for people who are shy, socially inept, or socially anxious (Kowert, 2015, 2016). To use an analogy put forth by Ducheneaut, Yee, Nickell, and Moore (2006), playing online games is like reading a book in a popular café. While one can choose to interact with the others around them, the sense of being in a social environment can be attractive enough for people to conduct independent activities there. For shy, socially self-conscious, or socially anxious individuals, this kind of space could be particularly attractive because they would have the sense of being engaged in a social space without necessarily having to directly interact with others (Kowert, 2015; Kowert & Oldmeadow, 2014).

In the rest of the chapter, we will identify the key claims that are made regarding video games being "socially isolating" and present a number of arguments that refute these assumptions. The majority of the claims discussed below will address claims related to online rather than offline gaming. This is because due to the nature of online gaming, claims of social isolation, reclusiveness, and "sup-par" social spaces have been wholly reserved – or at the very least magnified – when discussing online, rather than offline, gamers and gaming (Kowert & Oldmeadow, 2012). Our focus in this chapter will reflect this distinction and primarily center on addressing these claims.

Video Games and Social Isolation: The Claims

Claim: Video Games Are Socially Isolating

There is much evidence to refute the claim that video games are isolating. At face value, the most obvious evidence refuting these claim is the fact that 49% of the most frequent players play video games with others and about half of them "feel video games help them connect with friends" (Entertainment Software Association, 2015, p. 9). In this sense, playing video games is like any other group activity, such as team sports, organized clubs, friendship groups).

This evidence is specifically relevant in respect to the variety of types of games on the commercial market and the variety of contexts in which they may be played. That is, video gaming has been found to serve important social and interpersonal experiences and be key to positive, enjoyable experiences for players (Cairns, Cox, Day, Martin, & Perryman, 2013; Chappell, Eatough, Davies, & Griffiths, 2006; Gajadhar, de Kort, IJsselsteijn, & Poels, 2009; Griffiths, Davies, & Chappell, 2004;; Kaye & Bryce, 2014; van Looy, Courtois, & de Vocht, 2010; Vioda & Greenberg, 2011). Specifically, research has found players to experience higher positive mood when playing socially compared to solo (Kaye & Bryce, 2014), although players still often report positive experiences when playing alone (Kaye, 2016). This has even been found to be the case for when players report playing shooting games (Kaye, Monk, Wall, Hamlin, & Qureshi, 2017), which is arguably a genre of game that has received a substantive negative press. The assumption that video games are isolating therefore is flawed with this evidence in mind and should better acknowledge the diversity of game types and contexts which permit players to have a range of enjoyable, social experiences.

Claim: Online Video Games Are the Most Socially Isolating Type of Video Game

From the outside looking in, online gaming can seem like a more isolating activity than other forms of gaming. Players of online games are stereotypically characterized as being alone, in a darkened room, in front of a computer screen and, as such, seem isolated and reclusive (Kowert et al., 2012; Kowert & Oldmeadow, 2012). However, these assumptions are exaggerated and inaccurate as online gaming is far from a socially isolating activity.

Unlike offline video games, online games are designed to encourage and facilitate social interaction among co-players by posing players with in-game challenges that often require a complementary group to accomplish (Chen, 2009; Moore, Ducheneaut, & Nickell, 2007). Online games' unique integration of play within a social context creates a distinctive environment of social play. Thus, while any individual player in their own space may seem to be playing alone, they are connected to an environment which can be occupied by hundreds or thousands of other players and likely actively engaged with many of them.

At a minimum, socializing with one's co-players can be a means to an end in the context of accomplishing cooperative game tasks which require a team effort. However, many players seek more. For example, an analysis of the social interactions that take place in online games revealed that emotional communication predominates the task-oriented conversations (Pena & Hancock, 2006). It is perhaps unsurprising then that co-players are often described as close, trusted, and valued friends (Kowert, 2015; Pena & Hancock, 2006; Yee, 2006). Early research into online gaming friendships found that up to 75% of online game players report making "good friends" within their gaming communities (Cole & Griffiths, 2007) and, of these, between 40% (Cole & Griffiths, 2007) and 70% (D. Williams, Ducheneaut, Xiong, Yee, & Nickell, 2006) reported frequently discussing "offline" issues online, including those that they have not previously discussed with "offline" family and friends. Players have even been found to adjust their in-game location in relation to other players in an effort to sustain close proximity when engaged in social activities (think of it as a virtual "leaning in" toward someone you are speaking with), presumably to promote and/or maintain intimate social interactions (Lomanowska & Guitton, 2012).

Claims of social isolation also ignore the fact that many people report playing online games together with close family and pre-existing "offline" friends (Domahidi, Festl, & Quandt, 2014; Shen & Williams, 2010) as well as engage in what is referred to as "modality switching" (Ramirez & Zhang, 2007). "Modality switching" refers to when players transfer their offline friends online (i.e., begin playing online games with friends from school) as well as their online friends offline (i.e., meet their online gaming friends at local park). Modality switching has been thought to lead to stronger friendship ties by providing additional contexts where players can engage (Cole & Griffiths, 2007; Domahidi et al., 2014; Haythornthwaite, 2005; Trepte, Reinecke, & Juechems, 2012). It is unclear the rates at which players engage in modality switching, but it is clear that players do engage in this practice (Domahidi et al., 2014). There is also evidence that players use this practice to strengthen pre-existing friendships (Durkin & Barber, 2002; Kowert, Domahidi, & Quandt, 2014). Through modality switching processes, shy, socially anxious, and socially inhibited players are able to potentially strengthen their pre-existing friendships and generate additional levels of social support that might not have been possible without the social accommodations provided by online games themselves (such as visual anonymity) (Haythornthwaite, 2005; Kowert et al., 2014; Ramirez & Zhang, 2007).

Claim: People Who Play Online Games Are Lonely

Concerns of online video game players being lonely, and the game play itself contributing to feelings of loneliness, have likely been fueled by the stereotype of the online gamer (Kowert et al., 2012). The persistent belief that online game players are lonely (and become lonelier due to playing online games) seems to have been derived and generalized from the results of only a handful of studies.

For example, researchers have found online game players to exhibit higher rates of loneliness than less-involved game players (Caplan, Williams, & Yee, 2009; Shen & Williams, 2010). Over time, rates of loneliness have also found to worsen among problematic adolescent players (Lemmens, Valkenburg, & Peter, 2011). However, for the average online game player, claims of baseline loneliness, or loneliness worsening over time, are unfounded. For example, when following players over a 2-year period, no relationships between loneliness and online video game play have been found (Kowert, Vogelgesang, Festl, & Quandt, 2015).

When considering online games which are rich in social affordances, such as massively multiplayer online (MMO) games, evidence suggests that these engagements can have a positive impact upon players' sense of identity as well as the social value gained from relationships with other players (Kaye, Kowert, & Quinn, 2017). Additionally, these experiences are found to be positively associated with players' sense of self-esteem, perceptions of their social competence, as well as reduced loneliness (Kowert et al., 2015; Shen & Williams, 2010). Indeed, there is much to understand about the importance of virtual community as a key factor in the psychosocial well-being of players, in the same way that sense of community in a more general sense is important for facets such as well-being and life satisfaction (Haslam, Jetten, Postmes, & Haslam, 2009). In this way, virtual communities should not be overlooked as a powerful tool to promote inclusive social opportunities, as well as holding positive implications for player psychology. In particular, understanding gamer identity is one key functional means of garnering a better perspective of how online games may foster collectivity across players and how this in itself can be related to positive outcomes for players (Adachi, Hodson, & Hoffarth, 2015; Grooten & Kowert, 2015; Kaye, 2014; Kowert, 2015).

Claim: Online Gaming Spaces Are Sub-Par Contexts for Creating Friendships

The claim that friendships that are made online are *weaker* than friendships made in face-to-face contexts is typically supported by arguments that because online video games have lower social presence, they are somehow "weaker" social environments.

Social presence is the degree of awareness of the other person or "realness" in communication (Short, Williams, & Christie, 1976). This idea was developed from Mehrabian's (1969) concept of immediacy, which refers to the mutual exchange of "communication behaviours that enhance closeness to, and non-verbal interaction with, another" (p. 77). Typically, we convey immediacy through the exchange of various nonverbal cues, such as facial expressions, gestures, and eye contact. When these cues are present, our social interactions are more intense and affective (E. Williams, 1977). Social presence theory (Short et al., 1976) was not developed to explain differences in social interactions, however, but across social systems. Thus, the fewer immediacy cues that are available within a particular social system (e.g., face-to-face communication, telephone, computer-mediated communication, etc.), the less likely the other participants will be perceived as "real," social interactions will be less intimate, and the rate of social presence will decrease. The argument here is that because online gaming environments provide relatively few nonverbal cues,[1] they are believed to be relatively low in social presence (Rice & Love, 1987; Short et al., 1976; Slouka, 1995; Wellman & Gulia, 1999) and, therefore, generate more impersonal and less intimate communication than those supported by more immediacy cues (Slouka, 1995; Sproull & Kiesler, 1986; Wellman & Gulia, 1999).

[1] While some nonverbal cues, such as interpersonal distance (Lomanowska & Guitton, 2012; Yee & Bailenson, 2008) and those expressed through emoticons or emojis (Gunawardena & Zittle, 1997), have been integrated into online games, the nonverbal cue systems of online games create a world where verbal and nonverbal cues are disjointed (Moore et al., 2007).

However, in recent years researchers have begun to argue that the absence of immediacy cues may be more beneficial than harmful. For example, the lack of nonverbal cues can promote both dissociative anonymity (i.e., “You don’t know me”) and invisibility (i.e., “You can’t see me”). Together, this creates a unique combination of trust and anonymity, often referred to as the online disinhibition effect (Suler, 2004), which can stimulate open and intimate conversations because it removes the fear of any immediate social repercussions (Morahan-Martin & Schumacher, 2003; Suler, 2004; Walther, 1996). Consequently, individuals are more likely to speak freely and openly and disclose personal information at a quicker rate than is found in non-anonymous relationships (Joinson, 2001; McKenna & Bargh, 2000; Suler, 2004). Although this can serve a powerful positive social role, this can also have its downsides, including people disclosing too much personal information or, in some cases, being hostile to others based on their perception that they are less accountable for their actions (Suler, 2004).

Thus, while a lack of nonverbal cues is traditionally thought to limit the quality of communication, the lack of immediacy cues may actually be more socially beneficial than harmful. Due to the lack of nonverbal cues, online games are able to provide a sense of anonymity and invisibility that positively influences the social perceptions and behaviors of others, including greater self-disclosure than is found in offline communication (McKenna & Bargh, 2000).

Claim: Online Friends Are Less Socially Valuable than Offline Friends

It is often claimed that the relationships we establish online are less socially valuable than our “real-world” (offline) ones. This “weaker ties” preposition assumes that our online friends simply extend our networks, while our “real-world” friends are those which hold the strong, emotional ties (Valkenburg & Peter, 2007). Much of this is based on the notion that our networks provide two distinct types of social capital (Putnam, 2000). Social capital broadly refers to the particular resources that can be gained within any particular social relationship. This can include intellectual resources (e.g., new information) social and emotional resources (e.g., social and emotional support) and/or physical resources (e.g., tangible favors). The accumulation of social capital has been linked to a range of positive outcomes, such as career success and increased life satisfaction (Requena, 2003; Seibert, Kraimer, & Liden, 2001).

There are two types of social capital: bridging and bonding (Putnam, 2000). Specifically, “bridging” capital is theorized to consist relationships with those people who may be more peripheral to our core social network, to broaden perspectives or reach greater heterogeneity. “Bonding” capital, by contrast, is typically considered to consist the value we gain through the closer, intimate, or more meaningful relationships (Patulny & Svendsen, 2007). The concern is that online games may only promote opportunities for “bridging” social capital in which our friendships are weak extensions to other more "bonding" capitals that we develop through our "real-world" networks. However, this assumption may be refuted by evidence that suggests this is not always the case. That is, research has found that engagement in online gaming has the potential to heighten levels of social capital through players' experiences of connectedness (Collins & Freeman, 2013; Williams, 2006) and that bonding capital derived here can reduce players' perceptions of loneliness (Kaye, Kowert, & Quinn, 2017). In this sense, players can derive a sense of "togetherness" from being in gaming environments which foster social connections and interactions with others.

It is also important to note that one's "online" and "offline" friends are not always mutually exclusive. That is, often gamers will have "offline-extending" friendships in which they interact in the "real world" with friends they have met online (and vice versa) (Domahidi et al., 2014). In this way, it cannot be easily established on the extent to which these are distinct networks and thus how these function differentially, as proposed in the "weaker ties" hypothesis.

Concluding Thoughts

In this chapter we address several claims that have been made regarding the potentially isolating nature of video games, particularly in reference to online video games, which is stereotypically considered most problematic in this regard. Within this, we argue against these claims, as well as providing an evidence-base through which additional claims of online friends being "weaker" and "less valuable" than face-to-face relationships can be dispelled. Indeed, it is clear that the research in this area does not wholly support the claims of video games being attributed to social isolation.

While there may be some truth to the claims that online gamers can be lonely (Caplan et al., 2009; Shen & Williams, 2010), which may be why they seek out online games as a form of entertainment, there is no evidence to suggest that online games themselves solely contribute to loneliness or social isolation. In fact, video games have been found to be valuable activities for social connectivity and community, both in the "real world" and online. We recommend future research in this area to more carefully consider these conceptualizations, through adopting greater nuance in the approaches taken on these issues. Specifically, researchers should not assume homogeneity across all types and contexts of video games and thus be cautious in assuming that all games provide equivalent social affordances. Indeed, much of the "negative effects" perspective literature on video games presents somewhat outdated conceptualizations of what video games are and thus fails to acknowledge the dynamic and varied nature of what they may afford to players. As such, there is often gross overgeneralization in this literature on their psychological outcomes, with limited nuance on how these vary as a result of the different types of video games available and the varied social contexts in which they can be experienced. Scholars in this area should proffer greater specificity on these issues to inform a more critical account of how video games are associated with a range of psychological outcomes, including that of social isolation.

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