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Cite as: Sublette, V. A., & Mullan, B. (2012). Consequences of Play: A Systematic Review of the Effects of Online Gaming. *International Journal of Mental Health and Addiction*, 10(1), 3-23.

Consequences of Play: A Systematic Review of the Effects of Online Gaming

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Abstract

Massively Multiplayer Online Games (MMOGs) have received considerable attention in news headlines describing gamers who have died while engaging in excessive play. However, more common physical and psychosocial effects attributed to online video gaming are social isolation, increased aggression, and negative academic and occupational consequences. In consideration of the bias in reporting negative consequences of video gaming, a systematic review was conducted to evaluate the evidence of the effects of MMOGs on those who play them. In the sixteen studies that met the inclusion criteria, analysis revealed that only those players who were classified as “addicted” or engaged in “problematic game play” experienced significant negative consequences, with many gamers finding positive aspects to video gaming such as enjoyment, feelings of achievement, friendship, and a sense of community. However, significant limitations in the studies point to the need for further research so that appropriate treatments and interventions can be developed for problematic game play.

Key Words: “online gaming,” “online games,” “Internet gaming,” “Internet games,” “MMORG,” “MMORPG”

Introduction

Technological advances, such as increased speed, voice, and highly detailed, color-rich graphics have dramatically changed the video gaming world since arcade favorites like Donkey Kong and PacMan were popular. Today's gamer is more likely immersed in a virtual multiplayer world that offers sophisticated visual and auditory characteristics (Griffiths, Davies, & Chappell, 2004) through a constant stream of activity and engagement. A world that allows the player to maintain an evolving character with the ability to socialize and gather with players all over the world (Griffiths, et al., 2004; Williams, Caplan, & Xiong, 2007). These immersive environments are referred to as Massively Multiplayer Online Games (MMOGs), with the Massively Multiplayer Online Role-Playing Games (MMORPGs) being the most popular and pervasive (Woodcock, 2008).

Beyond casual entertainment, MMOG players report that these virtual worlds are positive and social environments that provide a sense of community (Williams, Yee, & Caplan, 2008), achievement, and connectedness (Ko, et al., 2005; Yee, 2006). Nevertheless, it has been suggested that excessive video gaming can destroy social lives, abate community involvement, and significantly affect the health of the player (Williams, Yee, & Caplan, 2008).

In the past, reports of the impact of video games on player health included: "Pac Man elbow," "video wrist" and "Nintendinitis" (Williams, Yee, & Caplan, 2008), while today, it is not uncommon to read news articles describing how obsessive video gaming can lead to death (Lee, 2004; Martirosyan, 2007; Spencer, 2007).

In the 2000s, headlines have depicted this lethal side of video gaming in cases such as the 26-year-old man from China who in 2007 collapsed and died of a heart attack after spending the entire lunar new year holiday playing computer games (Spencer, 2007), or the 28-year-old South Korean man who in 2005 played computer games in an internet cafe for 50 hours almost

non-stop and died of heart failure (Martirosyan, 2007). Although these deaths seem to be isolated cases, Lee (2004) indicates that the trend of sitting at the computer for long periods of time is becoming more common and can be fatal. In his 2004 case report, Lee describes in vivid detail the autopsy findings of a 24-year-old Korean man who collapsed and died after playing an online game constantly for 80 hours. The autopsy revealed the man died of a pulmonary thromboembolism caused by sitting at the computer too long. Lee warns heavy computer users – such as online gamers – of this new phenomenon he has termed “eThrombosis,” and cautions that online gamers are at risk (Lee, 2004).

Although these dramatic accounts of the dangers of video gaming seem to be pervasive (Chappell, 2006; Grüsser, 2007), there is a great need to evaluate the reliability of the evidence. More common reports of the effects of online video gaming include negative social, occupational, and academic consequences, rather than death (Chappell, 2006; Lo, Wang, & Fang, 2005; Williams, 2006). There has also been considerable attention given to the theory that violent video games increase aggression, especially in younger males (Eastin, 2006; Grüsser, 2007). Characteristics of addiction, such as conflict, tolerance, withdrawal symptoms, cravings and relapse, have also been reported as a consequence of obsessive video gaming (Chappell, 2006; Grüsser, 2007).

Who games and who is at risk?

The demographics of gamers have changed and players are getting older, and the stereotype of the video gaming world being dominated by teenagers no longer holds true. Today’s MMOG player is on average 25 years old, in a range that spans from 11 to 68 (Yee, 2008), and as of 2008, 40% of American adults were found to be regular players of online video games (Williams, Yee, & Caplan, 2008).

Although the most prolific online game players are still young males (Eastin & Griffiths 2006; Ko et al., 2009) who comprise approximately 85.4% of players, females tend to engage in online game play for the same duration as males (Yee, 2008). However, the uneven number of players does reflect the fact that fewer women play online video games. It is suggested that there are fewer female MMOG players for the reason that video games are not yet completely gender inclusive, with some video games depicting female characters with cartoonish breasts and behaviors that are irritating to female players (Yee, 2008).

Women's reluctance to fully join the ranks of gamers has resulted in video gaming companies increasing their marketing efforts to attract more women to video games, as online video gaming is a lucrative business. In 2006, video game sales reached \$7.4 billion in the United States alone (Williams, Yee, & Caplan, 2008). To increase that market share, companies such as Ubisoft, an international developer, publisher and distributor of online video games, is appealing to female players with their "Frag Dolls," a team of highly skilled female gamers recruited by Ubisoft to promote their video games and encourage an increase of women in the video gaming industry. The Frag Dolls promote women in video gaming through appearances at trade shows, television, web sites, and video gaming tournaments (Ubisoft, n.d.).

The types of video games that are consuming players' time and attention are dominated by the role-playing style of MMOGs, the MMORPGs. MMOGs were created around 1997, and due to the incredible growth and popularity of video games such as: *Ultima Online*, *EverQuest*, and *Asheron's Call*, the years 1997 to 2001 have been referred to as the "Golden Age of MMOGs." (Woodcock, 2008) In November 2004, the MMORPG, *World of Warcraft* was released to the burgeoning world of video gaming, and its incredible success changed the landscape of the video gaming world forever (Woodcock, 2008). *World of Warcraft* maintains its popularity and pervasive reach today, with over 11 million paying subscribers worldwide

(Simpson, 2009). As of 2008, these fantasy role-playing video games owned 94.2% of the market, while sci-fi role-playing video games (including superheroes) trailed at 3.7%. Combat simulation, or first-person shooter video games captured only 0.2% of the market, and less than 2% of video games played were in the social/other category (Woodcock, 2008).

The video gaming world has been established, but the actual physical and psychosocial effects of video gaming have not. As the MMOG world increases in popularity and acceptance, the need for evidence-based research becomes critical so that attention can be paid to prevention, education, and treatment of any negative consequences that MMOG play has on its playing population.

Therefore, the objectives of this report were to systematically review and analyze the current research to determine the physical and/or psychosocial effects of online video gaming on those who play Massively Multiplayer Online Games.

Materials and Methods

Search Strategy

The PsychInfo and Medline electronic databases from 2005 to 2009 were searched. These databases were chosen because of the psychological and medical focus that encompasses addiction and problematic physical and psychosocial behaviors.

Wide search terms were used in order to capture the maximum number of related studies. Search terms were “online gaming,” “online games,” “Internet gaming,” “Internet games,” “MMORPG” (common acronym for massively multiplayer online role-playing game), and “video games” plus “internet” or “online”.

PsychInfo produced 267 abstracts from the search criteria, while Medline produced 204, for a total of 471 abstracts. All studies were reviewed in accordance with the following inclusion and exclusion criteria that follow.

Inclusion criteria for studies

The inclusion criteria for the studies were:

- Publication was a study that examined a psychosocial and/or physical effect of online gaming.
- Publication was an academic and peer-reviewed study.
- The study used primary data.
- The study examined online gaming exclusively.

Exclusion criteria for studies

The exclusion criteria for the studies applied to:

- Online gambling.
- Studies involving sex: cybersex, pornography or topics that were sexual in nature.
- Studies that examined co-morbidity (schizophrenia, bipolar disorder, etc.).
- Studies in which the game was a tool for computer-based learning.
- Studies that used online games as a tool for the study of another topic.
- Studies that were only published in a language other than English.
- Dissertations or gray literature.
- Overall Internet addiction, or general problematic Internet use including studies of Internet-related activities, such as: email, chat, shopping or Internet surfing.

The exclusion process is described in Figure 1.

Review Method

The titles and abstracts of the identified records were screened for those that met the inclusion criteria.

Articles were rejected if it was determined from the title and abstract that the study failed to meet the inclusion criteria. When an article could not be rejected with certainty based on the title or abstract, the full study was retrieved for further evaluation. Any ambiguities regarding the application of the selection criteria to selected studies were resolved through discussion between the two researchers. The 16 studies chosen for analysis are detailed in Table I.

Study Characteristics

Of the 16 studies chosen for analysis, there were: 12 self-report questionnaires; one qualitative observational study, one randomized longitudinal study; one controlled brain-scan study; and one qualitative discourse analysis. Studies spanned the years from 2005 to 2009: there were three studies from 2005 (Ko et al., 2005; Lo, Wang, & Fang, 2005; Williams & Skoric, 2005); five studies from 2006 (Yee, 2006; Chappell, Eatough, Davies, & Griffiths, 2006; Williams, 2006; Eastin & Griffiths, 2006; Ang, Zaphiris, & Mahmood, 2006); three studies from 2007 (Grüsser, Thalemann, & Griffiths, 2007; Wei, 2007; Smyth, 2007); three studies from 2008 (Hussain & Griffiths, 2008; EJ Kim, Namkoong, Ku, & SJ Kim, 2008; Peters & Malesky Jr., 2008); and two from 2009 (Ko et al., 2009; Hart et al., 2009).

Age of Participants

Ages of participants were from 11 to 69 years old. Five studies focused solely on adolescents; with one study of gamers in their pre-teens to 20s (Wei, 2007); two studies of teenagers (Ko et al., 2005; Ang, Zaphiris, & Mahmood, 2006); and two of gamers in their teens to early twenties (Lo, Wang, & Fang, 2005; Smyth, 2007). One study involved participants in their twenties (Ko et al., 2009); while six studies included large age spans, including gamers from teenage to thirty years and over (Williams, 2006; Eastin & Griffiths, 2006; Hussain & Griffiths, 2008; Hart et al., 2009; Williams & Skoric, 2005; Peters & Malesky Jr., 2008). Two studies did not state the actual ages of participants, but indicated means of 21.11 and 21.30

years old (Grüsser, Thalemann, & Griffiths, 2007; EJ Kim, Namkoong, Ku, & SJ Kim, 2008). Two studies omitted participant age (Yee, 2006; Chappel, Eatough, Davies, & Griffiths, 2006).

Sample Sizes

Sample sizes ranged from three to 7,069.

Gender of Participants

Fifteen of the 16 studies had a significantly higher number of males as participants than females including two studies that recruited male participants exclusively. Eastin and Griffiths (2006), recruited males exclusively due to the increased likelihood of males playing violent games, and Ko and colleagues studied an exclusively male population for the higher potential of males to experience gaming addiction (Ko et al., 2009).

Only one study was conducted with more females than males in the study (Lo, Wang, & Fang, 2005), and the author did not indicate whether there was an intentional over-sampling of females to arrive at this ratio. However, the sample was derived from a single college in Northern Taiwan, so it is possible that the higher female ratio is representative of the demographics of that college (Lo, Wang, & Fang, 2005).

Country of Origin

The countries where the study was conducted or originated from were: the United States of America, the United Kingdom, Korea, China, Germany, and Taiwan, although the majority of studies involved participants belonging to an internet community that spanned the globe. A major limitation of the demographic information outlined above is that 50% of the studies reported here recruited participants from global Internet sites. In addition, the possibility of volunteer bias and the risk of participants falsifying their details needs to be considered, due to the unfeasibility of verifying the demographic information of a globally dispersed and anonymous sample.

Results

Twelve studies utilized surveys or self-report questionnaires for their outcome measures, risking social desirability and self-report bias. Two studies were qualitative, with a qualitative observational study focusing on the cognitive overloads of players (Ang, Zaphiris & Mahmood, 2006), and the other an analysis of players' accounts of their gaming experiences that they had posted to online forums (Chappel, Eatough, Davies, & Griffiths, 2006), both with very small sample sizes (n=3, n=14) and subjective analyses. Only one study involved a brain scan using cases and controls. An experiment by Ko et al. (2009), using fMRI brain scanning technology, demonstrated that brain activation patterns in addicted gamers were similar to those who suffered from substance addictions (Ko et al., 2009).

Online video gaming and gender

Research has shown that more males than females play MMOGs (Ko et al., 2005; Lo, Wang, & Fang, 2005; Eastin & Griffiths, 2006; Ko et al., 2009), and negative video gaming effects are more common in males than females (Ko et al., 2005; Ko et al., 2009). Two studies supported this research, with higher addiction scores, more pro-violent and aggressive attitudes, and less empathy in male than female gamers who were similarly engaged to game play (Ko et al., 2005; Wei, 2007). Rather than games causing pro-violent and aggressive attitudes, however, it is possible that people who are more aggressive engage in more violent entertainment, and that males may have lower empathy scores than females independent of video gaming.

Males also derived greater rewards from video gaming than females, suggesting that they play more because they perceive they benefit more from video gaming. Two studies established that males experienced feelings of achievement from video gaming (Ko et al., 2005; Yee,

2006), while one study found that males also engage in online video gaming to make friends (Ko et al., 2005).

Females as a group tended to be less passionate about video gaming, engaging in it as one study described as “a way to pass time” (Ko et al., 2005). In a study by Wei (2007), exposure to video game violence did not affect females’ attitudes or behaviors.

Conflicting studies on female participation in video gaming is evident, with one study by Yee (2008) finding that generally, women played for the same duration as males, and another by Ko et al., 2005) finding the converse, that males spent significantly longer online than females. The difference in results could be due to the three years between studies, suggesting that more women have become gamers and this may affect the validity of earlier research. Another possible explanation may be that female gamers are using online video gaming as an opportunity for socialization, and therefore, future research should investigate the actual activities that gamers engage in while video gaming; whether it is game play, social engagement, or other means of communication.

Impact of online video gaming on social lives

The effect of online video gaming on players’ social lives was a prevalent outcome that was included in nine studies, although no study focused on social impact exclusively.

A predominant theme in three studies (Williams, 2006; Smyth, 2007; Hussain & Griffiths, 2008) was the juxtaposition of the increase in online socialization coupled with a decrease in offline socialization. Although players reported their preferences were for offline friendships and their social lives had been adversely affected by video gaming, they also enjoyed the friends they made online, found conversations were easier to conduct in the video gaming world, and experienced feelings of connectedness and increased global awareness in the virtual environment (Williams, 2006; Smyth, 2007; Hussain & Griffiths, 2008).

Hart and colleagues found no relationship between video gaming addiction scores and social aspects of gamers' lives (Hart et al., 2009), while two other studies found positive social effects of video gaming (Ko et al., 2005; Yee, 2006). In these two studies, males reported their increased ability to make friends and ease of engaging in conversations in the online environment (Ko et al., 2005; Yee, 2006), while females in Yee's study reported the importance of their online relationships (Yee, 2006).

Three studies found that increased game play led to a decrease in the quality of interpersonal relationships (Chappel, Eatough, Davies, & Griffiths, 2006; Lo, Wang, & Fang, 2005; EJ Kim, Namkoong, Ku, & SJ Kim, 2008), including a qualitative discourse analysis where participants described how addictive video gaming resulted in social withdrawal and divorce (Chappel, Eatough, Davies, & Griffiths, 2006).

Impact of online video gaming on aggression

Aggression as a result of game play has been a controversial topic with conflicting findings. In this review, five studies included aggression as an outcome measure, with three studies finding a positive correlation with video gaming and aggression (Grüsser, Thalemann, & Griffiths, 2007; Wei, 2007; EJ Kim, Namkoong, Ku, & SJ Kim, 2008). Although these correlations were found, it is worth noting that correlation does not imply causation.

Of these three studies, however, two studies related aggressive behavior to online video gaming, and this was only in players who were considered addicted, whereas the third study found that only aggressive attitudes – not behavior – were related to violent video game exposure, and these attitudes were only found in males (Wei, 2007). Again, these attitudes were hypothesized to be as a result of the exposure, but confounding factors could have been present.

A study by Eastin and Griffiths (2006) found that hostile expectation ratings were highest in virtual reality (VR) games, although actual aggressive thoughts, feelings, and behavior were

not affected by the type of game played; while an earlier study found no significant correlations between playing violent video games and levels of aggression (Williams & Skoric, 2005). This finding needs to be treated with caution, however, as VR and FPS video games differ from the online collaborative and adventure-focused worlds of the MMOGs: FPS video games feature the point of view of the shooter (the player sees the online action through the eyes of their character) with the primary goal of the game to destroy multiple opponents by shooting, whereas VR video games normally include the addition of special clothing and devices that significantly enhance the sensory experience of the game, granting total immersion in the virtual world to the player. Therefore, the players of the FPS and VR video games in the Eastin and Griffiths studies could have been affected by the type of game they played and produced different results from all of the other studies in the review which studied players of MMOGs.

Therefore, a fruitful avenue of research would be to compare the impact of FPS and VR video games with MMOGs, such as *EverQuest* and *World of Warcraft*.

Impact of online video gaming on occupational and/or academic performance

Four of the studies compared academic and/or occupational performance with time spent video gaming. In two studies, there was no relationship found between hours of online game play and academic or occupational performance (Smyth, 2007; Hart et al., 2009). Although MMOG players in the study by Smyth (2007) reported that video gaming had interfered with their academic work, there was no evidence found by the researchers to support that video gaming had any effect on their academic performance.

Conversely, two additional studies found a negative relationship between online video gaming addiction scores and occupation, with problematic game play correlating with lack of employment and job loss (Chappel, Eatough, Davies, & Griffiths, 2006; EJ Kim, Namkoong, Ku, & SJ Kim, 2008).

The study by Smyth (2007) was the only one that used random sampling techniques, which may indicate a strong possibility of homogeneity in the other samples. The randomly-sampled study did not find any evidence of negative effects from game play on academic performance or quality of life, although it did find a positive relationship between hours played and worse overall health and sleep quality for the MMOG group (Smyth, 2007), suggesting that randomized control trials are needed to explore these relationships further.

Addictive video gaming behavior and personality

Two studies focused on the relationship between personality and video gaming addiction (as defined by hours played per week). Research by Kim and colleagues (2008) found positive correlations between ratings on addiction measures, and ratings on narcissistic personality trait measures, and Peters & Malesky Jr (2008) found that those individuals with problematic online game play had positive correlations with neuroticism, and negative correlations with agreeableness, extraversion, and conscientiousness.

Impact of video gaming on overall health and quality of life

Four studies mentioned quality of life issues, with two studies finding no relationship between level of life satisfaction, stressors, or overall quality of life ratings and video gaming hours played (Ko et al., 2005; Smyth, 2007). However, two studies of MMOG players reported that players experienced poorer overall health and sleep quality due to time spent playing during sleeping hours and sitting for extended periods of time while playing MMOGs, and withdrawal symptoms and cravings for video gaming when play was discontinued (Chappel, Eatough, Davies, & Griffiths, 2006; Smyth, 2007).

Discussion

Although the headlines of the effects of online video gaming have been sensational, there is inconclusive evidence to support that regular game play of MMOGs causes negative effects to the physical or psychosocial health of the player.

The evidence suggests that online game play involving MMOGs in itself appears to have few negative consequences. However, manifestations of addiction involving game playing have been shown to be detrimental, and more systematic research into video gaming addiction, treatments, and interventions is needed. The finding of similarities in the brains of addicted gamers and those with substance addictions by Ko et al. (2009), in addition to reports of problematic game playing possibly having a negative influence on the lives of gamers (Chappel, Eatough, Davies, & Griffiths, 2006; Grüsser, Thalemann, & Griffiths, 2007; Peters & Malesky Jr., 2008), indicate that some players are using online video games beyond entertainment, such as to hide from the real world. In fact, escapism was found in Yee's (2006) study to be the best predictor of problematic usage.

Female gamers are less affected by game play than males (Ko et al., 2005; Wei, 2007). There is no evidence to support increased aggression in females, and they are less likely to suffer addictive effects from playing (Ko et al., 2005; Wei, 2007). It is suggested that males are more likely to become addicted to online video gaming because they gain greater psychosocial benefits from playing, such as feelings of achievement, and the ability to socialize easier with online friends (Ko et al., 2005; Yee, 2006). In contrast, for many females, MMOGs are simply an entertaining pastime that allows them to increase their social network (Ko et al., 2005; Yee, 2006).

Contrary to previous assumptions that overall socialization suffers a decline for those who play MMOGs, it appears that socialization may just shift in focus: while real-world

relationships eroded for some players (Lo, Wang, & Fang, 2005; Williams & Skoric, 2005), others were found to have an active social life and engaged in meaningful interactions with other players in the game (Ko et al., 2005; Smyth, 2007; Hussain & Griffiths, 2008). This change in the way gamers socialize suggests a possible relationship between an increase of social activity in the virtual world and a decrease of real world friendships. It is also a possibility that some gamers gravitate to online games because they are unable to socialize offline. More research is required to determine if this relationship exists, and whether the benefits associated with socialization (Orth-Gomer, 2009) extend to friendships that are maintained in the virtual world, rather than face-to-face. Another issue to consider relates to the fact that all of the studies on socialization relies on self-report and this may have led to inaccuracies due to the weakness of retrospective reports and social desirability bias, which are a threat to the validity of the reports obtained in surveys and questionnaires (Bernard, Killworth, Kronenfeld, & Sailer, 1984; Fisher, 1993). This is an issue with twelve of the studies utilizing self-report as their main data collection tool (Fisher, 1993), and future research could consider alternative methods such as observation, or online diaries.

Of the evidence that supported a positive relationship between violent video games and aggression, only males in the studies demonstrated an increase in aggressive attitudes (Wei, 2007). In two studies, neither male nor female players' behavior was changed by any kind of game play, regardless of violent content (Wei, 2007; Williams & Skoric, 2005). The study by Ko et al. (2009) was one of only two studies (Ko et al., 2009; Williams & Skoric, 2005) that used a control group, suggesting that on balance, the evidence against a relationship between online video gaming and aggression is not supported. Future research using control groups is suggested.

Although there were two studies that described job loss and unemployment in those who were classified as addicted or problematic players (Chappel, Eatough, Davies, & Griffiths, 2006; EJ Kim, Namkoong, Ku, & SJ Kim, 2008), there was no support for negative effects of video gaming on academic performance in non-addicted gamers. In one study, students perceived that their academic work suffered, although empirical research did not support these perceptions (Smyth, 2007), suggesting that self-report questionnaires may lack construct validity, and to minimize their use in future research.

Positive correlations were found between video gaming addiction and negative personality traits such as narcissism and neuroticism, while negative correlations were found between problematic video game usage (as measured by amount of time spent playing) and a player's personality characteristics of agreeableness, extraversion and conscientiousness (EJ Kim, Namkoong, Ku, & SJ Kim, 2008; Peters & Malesky Jr., 2008). However, the direction of causality is unclear and a third variable may be involved such as those that have been found between personality and health, where the relationship appears to be mediated by an increase in health-risk behaviors (Caspi, Roberts, & Shiner, 2005). Future correlational research could explore this potential pathway and consider other factors such as hedonism and inhibition control.

There was no relationship between overall health and quality of life for those who engaged in regular MMOG play (Ko et al., 2005; Smyth, 2007; Hart et al., 2009). Only those participants who were classified as "addicted" or engaging in "problematic game play" suffered from negative effects such as: loss of sleep, conflict, tolerance, withdrawal symptoms, cravings and relapse (Chappel, Eatough, Davies, & Griffiths, 2006; Smyth, 2007), implying these peripheral effects correlate to addiction itself and are not inherent in the normal type of game play of non-addicted players. These findings suggest future research should be directed toward

studying the negative effects of video gaming addiction on those who engage in excessive online game play.

Conclusion

This review was limited to peer-reviewed studies published in academic journals. Gray literature and studies published in languages other than English were excluded, subjecting this review to the possibility of publication and English-language biases. However, this review has offered a valuable examination of the current research on the physical and psychosocial effects of online video gaming, which has not been previously conducted. The major limitation of the review relates to the generally poor quality research in the area, and emphasizes the importance of the need for well-designed studies in the future. Nonetheless, it must be acknowledged, as a new and burgeoning field of enquiry, a vast quantity of research has been conducted in a very short period of time, and without an understanding of the current state of research as is provided here, these issues of quality are unlikely to be addressed.

Recommendations for future research include consistency in operationalization when reporting studies and including all available demographic information, which is critical for performing analysis. Baseline measurements are essential to determine causation and not merely correlational effects. Other data collection methods are also recommended, such as online diaries, “think aloud” studies, and focus groups. In addition, consideration of demographic information, such as socio-economic status and living arrangements, for example, may provide better insight into factors involved in video gaming addiction.

There is ample scope for further longitudinal research into video gaming in order to establish whether the aggressive attitudes intensified from violent video games found in this review lead to a significant increase in aggressive behaviors over time, and it is worth investigating if physical presence is a factor in socialization; whether the psychosocial and

health benefits obtained from belonging to a social group (Orth-Gomer, 2009) apply to those relationships and friendships that are made and maintained online, or if beneficial effects are found exclusively in face-to-face interactions.

Finally, considering the evidence of negative effects that was found in this review was correlated with video gaming addiction rather than normal game play (Chappel, Eatough, Davies, & Griffiths, 2006; Grüsser, Thalemann, & Griffiths, 2007; Ko et al., 2009; EJ Kim, Namkoong, Ku, & SJ Kim, 2008; Peters & Malesky Jr., 2008), future research should be directed toward studying those who engage in problematic game play and exhibit the characteristics of addiction, rather than the casual gamer.

Author Disclosure Statement

The authors have no conflict of interest.

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FIGURE 1. THE EXCLUSION PROCESS FOR THE SYSTEMATIC REVIEW OF ONLINE GAMING

TABLE I. STUDIES INCLUDED IN THE SYSTEMATIC REVIEW OF ONLINE GAMING

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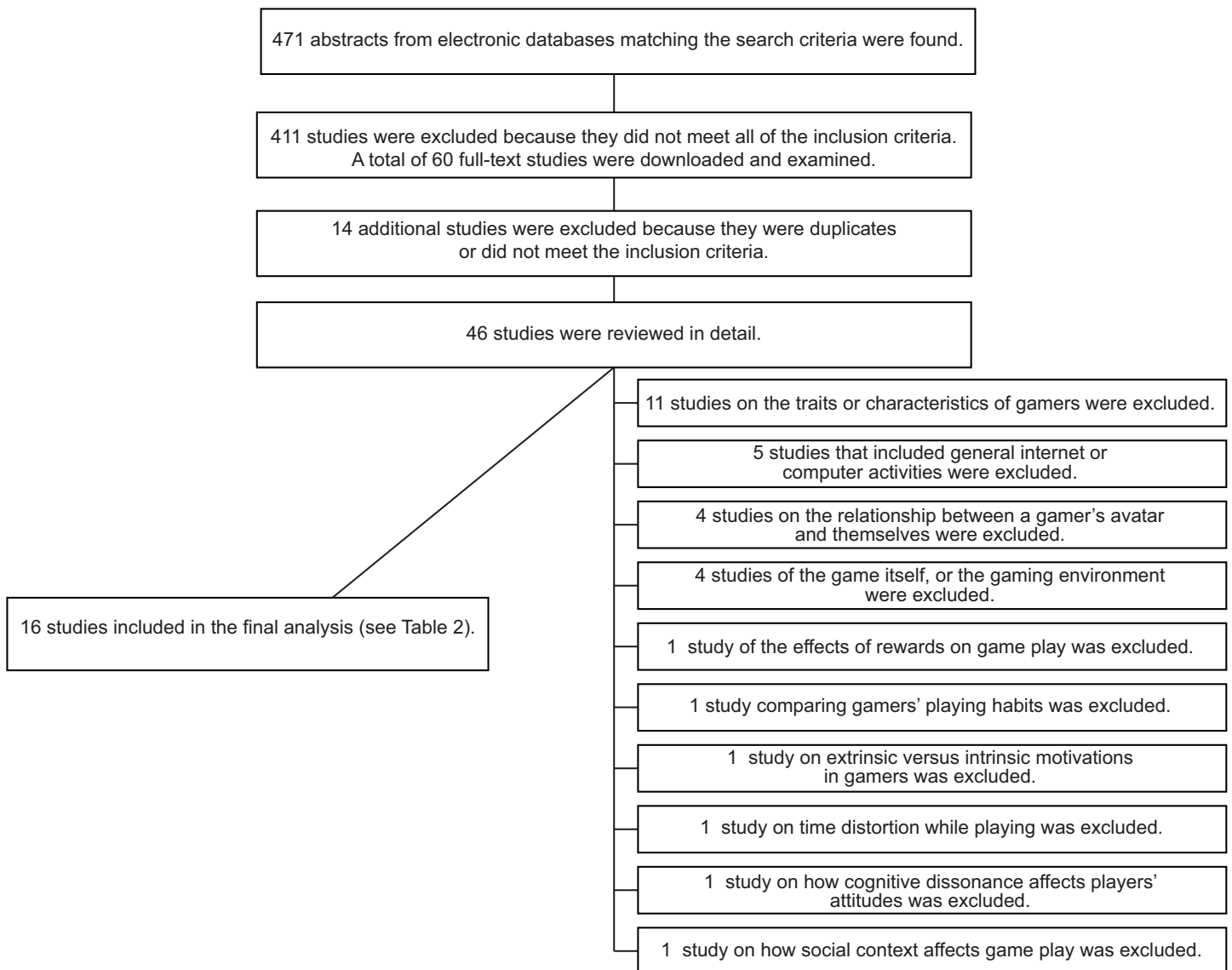


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Reference and country	Sample size and characteristics	Study Design	AIM and Purpose	Findings/Results	Limitations	Target Age
Ang CS, Zaphiris P, Mahmood S. (2006) United Kingdom	N = 3; 2 male and 1 female participant. One expert and two novice "Maple Story" MMORPG players.	Semi-controlled qualitative observation study.	To examine the types of cognitive overload experienced by players of MMORPGs.	<ul style="list-style-type: none"> Cognitive overload can make the game more enjoyable and challenging for the experienced user. Cognitive overload also makes the game difficult for new users because of multiple distractions. 	Extremely small sample size.	13, 16 and 18 years old
Chappell D, Eatough V, Davies MNO, Griffiths M. (2006) Participants' countries not stated; authors are from the United Kingdom.	N = 12. <i>Everquest</i> players who had given-up then resumed playing, those who had played for a long period of time and those who had given-up playing and had not resumed play.	Qualitative discourse analysis study. Self-reports of players describing their experiences with a popular MMORPG, <i>EverQuest</i> were collected from a range of public-domain online forums then analyzed.	To examine the perceptions and accounts of <i>Everquest</i> players who reported excessive play and addiction to the game.	<ul style="list-style-type: none"> Players reported varying levels of addiction to <i>Everquest</i> with consequences including loss of marriage, family and employment. Self-reports from gamers describe experiencing conflict, tolerance, withdrawal symptoms, cravings and relapse. 	Small sample size. Self-reports.	None reported.
Eastin MS, Griffiths RP. (2006) USA	N = 219 male university students. 85% Caucasian; 8% African-American; 3% Asian; 2% Latino, and 2% Native	2x3x2 experimental design. (game interface x game content x game context).	To examine how game interface, content and context affects hostile expectations (behaviors,	<ul style="list-style-type: none"> Overall hostile expectation ratings were highest in the virtual reality game-playing group. Aggressive behavior, thoughts and feelings did not 	Only males were recruited for this study. Possible selection bias, as participants were recruited from	18-31 years old

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	American or "Other."	A questionnaire was used to measure player "presence" experienced, while a story completion task was used to measure hostile expectation bias.	thoughts and feelings) and presence ("the subjective experience of being in one environment when one is physically in another") in male game players.	significantly differ between the virtual reality and standard console game players. <ul style="list-style-type: none"> The standard console game (shooter game) produced significantly greater levels of presence than the virtual reality game (fighting game). 	communication classes only.	
Grüsser SM, Thalemann R, Griffiths MD. (2007) Participants' countries not stated; author is from Germany.	N = 7069; 94% male and 6% female. Participants were active gamers and registered members of an online gaming magazine.	Survey design. Participants were recruited through on online gaming magazine, and completed two online questionnaires.	Investigating the addictive potential of online game playing and correlations between excessive game playing and aggression.	<ul style="list-style-type: none"> 840, or 12% of participants met at least three criteria of addiction behavior. Addicted or "pathological gamers" engaging in more hours of gaming, experienced withdrawal symptoms and higher cravings for play than non-pathological gamers. Pathological gamers rated significantly higher in aggressive behavior than non-pathological gamers, but had a small sample size. 	Self-report questionnaire. Social desirability factors. Cannot determine causation.	Mean age was 21.11 years old.
Hart GM, Johnson B, Stamm B, Angers N, Robinson A, Lally T, Fagley WH. (2009)	N = 790; 579 male and 146 female; 65 not stated. 3 samples: 1. High school	Survey design.	To determine if problems with social participation, academic performance, work, or daily	<ul style="list-style-type: none"> Participants' level of video game addiction was measured using the Problem Video Game Playing Survey. No relationship was found between addiction scores 	Volunteers, self-selected. Self-report questionnaires.	14-55 years old.

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USA	<p>students participating in classroom and online surveys.</p> <p>2: University students who stopped at a kiosk to play a game and volunteered for the survey.</p> <p>3. Adults who completed an online survey that was linked from a popular site (Craig’s List).</p> <p>A Computer/Video Game Behavior Inventory (CVGBI) was administered with the Problem Video Game Playing (PVP) embedded into it.</p>		functioning were related to excessive video game playing.	and problems in daily functioning, or social, educational and occupational areas of life.		

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Reference and country	Sample size and characteristics	Study Design	AIM and Purpose	Findings/Results	Limitations	Target Age
Hussain Z, Griffiths MD. (2008) Participants' countries not stated; authors are from the United Kingdom.	N = 119; 69% male and 26% female; 5% unspecified. (157 participants completed the questionnaire and 38 were excluded for being under 18 years old). 73% from the USA; 8% from the UK and 3% from Canada; 16% unspecified.	An online questionnaire was publicized and links to it were posted to several gaming forums.	To examine the impact of online gaming, the effect of online socializing, and reasons for gender swapping amongst MMORPG gamers.	<ul style="list-style-type: none"> • 67% of gamers reported that they preferred socializing offline to online. • Significantly more male than female gamers stated they would rather spend time with (offline) friends but that they found conversations easier to conduct online. • 59% reported they did not play games to escape from other activities. • 44% disagreed or strongly disagreed that they used gaming to change their mood. 	Volunteers self-selected. Self-report of gaming behavior.	18-69 years old.
Kim EJ, Namkoong K, Ku T, Kim SJ. (2008) Korea	N = 1471; 1216 males and 255 females. (Original sample size was 1713 before duplicates and incomplete questionnaires were excluded.)	Participants were recruited through advertising posted to online gaming sites for MMORPG players. A monetary reward was offered for completion of an online survey.	To determine if there are correlations between aggression, self-control, narcissistic personality traits and online gaming addiction.	<ul style="list-style-type: none"> • There was a highly significant positive relationship between online game addiction scores and narcissistic personality traits and aggression. • There was a highly significant negative relationship between online game addiction scores and self-control, interpersonal relationships, and employment. • 20% of variance in behavior predicted 	Self-report questionnaires. Social desirability factors.	Mean age = 21.30

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Reference and country	Sample size and characteristics	Study Design	AIM and Purpose	Findings/Results	Limitations	Target Age
Ko CH, Liu GC, Hsiao S, Yen JY, Yang MJ, Lin WC, Yen CF, Chen CS. (2009) Taiwan	N = 20; 10 cases and 10 controls. Males only. Chinese speaking; never had illegal substance use, and right-handed <i>World of Warcraft</i> players.	Psychiatric interview followed by completion of the Chen Internet Addiction Scale (CIAS), the Alcohol Use Disorder Identification Test (AUDIT), and the Test for Nicotine Dependence (FTND). On the day of fMRI scanning, the CIAS was administered again to record the duration of abstinence from gaming. Participants' brains were then scanned using an fMRI scanner.	To identify neural substrates of online gaming addiction using fMRI to determine if gaming addiction has the same neurobiological effect as substance addiction.	<ul style="list-style-type: none"> The study demonstrated that the brain activation patterns in gaming urge and craving for those experiencing online gaming addiction are similar to craving in those who suffer from substance dependence. 	<p>Only males were recruited for this study.</p> <p>There is a possible selection bias, as participants were recruited via advertising post on the Bulletin Board System on a single university campus.</p> <p>Only those who played the MMORPG <i>World of Warcraft</i> were recruited to participate.</p>	21-25 years old
Ko CH, Yen JY, Chen CC, Chen SH, Yen CF. (2005) Taiwan	N = 395; 170 males and 225 females. Junior high school students. 55.9% of participants had played online games.	Questionnaire design. Two self-report questionnaires were administered to participants: the Chinese Internet Addiction Scale	To determine if there is a relationship between gender, self-esteem, life satisfaction and online gaming addiction, and the risk factors that contribute to	<ul style="list-style-type: none"> Males spent significantly longer online and had significantly higher addiction scores than females. The benefits males gained from online gaming were feelings of achievement and the ability to make new 	<p>Self-report questionnaires.</p> <p>Social desirability factors.</p>	13-15 years old.

TABLE I. STUDIES INCLUDED IN THE SYSTEMATIC REVIEW OF ONLINE GAMING

Reference and country	Sample size and characteristics	Study Design	AIM and Purpose	Findings/Results	Limitations	Target Age
		(CIAS) to determine severity of gaming addiction and the Rosenberg Self-Esteem Scale (RSES) to assess participants' level of self-esteem.	online gaming addiction.	<p>friends.</p> <ul style="list-style-type: none"> Females engaged in online gaming more as a way to pass time. There were no significant gender differences in: the amount of money spent on gaming, age, total numbers of stressors in their lives, level of life satisfaction or RSES (self-esteem) scores. 		
Lo SK, Wang CC, Fang W. (2005) Taiwan	<p>N = 174; 85 male and 89 female.</p> <p>(Original sample size was 180; six questionnaires were excluded due to missing data.)</p> <p>College students in Taiwan.</p>	A three-part questionnaire was distributed to students.	To determine if there is a relationship between the amount of time playing online games and the quality of interpersonal relationships and levels of social anxiety.	<ul style="list-style-type: none"> The more time spent playing online games, the lower the quality of interpersonal relationships was rated, and the higher the amount of social anxiety. "Heavy online game players" reported lower quality of interpersonal relationships than "light online game players" and "light online game players" rated interpersonal relationships of lower quality than non-players. 	<p>Study does not indicate if questionnaire was completed privately or how it was collected from the students.</p> <p>Study is a self-report, retrospective analysis.</p>	17-24 years old
Peters CS, Malesky LA. (2008)	<p>N = 196; 173 males and 23 females.</p> <p>Players of World of Warcraft MMORPG</p>	Participants were recruited from the Internet where links from online message boards	To determine if number of hours playing World of Warcraft is correlated to	<ul style="list-style-type: none"> Those who rated highest on number of hours played per week rated higher on problematic usage. 	<p>Self-report questionnaire.</p> <p>Social desirability factors.</p>	18-43 years old.

TABLE I. STUDIES INCLUDED IN THE SYSTEMATIC REVIEW OF ONLINE GAMING

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<p>Participants' countries not stated; author is from the USA.</p>	<p>who belong to one of the top online guilds. (A guild member is a player who spends a minimum of 20 hours per week playing the game and works on gaming teams.)</p> <p>Original = 204; 8 players were excluded for being under 18.</p> <p>An additional 38 were excluded because they didn't complete the Problematic-Usage questionnaire and 13 more were excluded for not completing the M5 questionnaire.</p> <p>Total = 145, but does not state the final male/female breakdown.</p>	<p>directed them to the online survey.</p>	<p>personality characteristics such as agreeableness, neuroticism, extraversion and conscientiousness.</p>	<ul style="list-style-type: none"> Those with problematic usage had moderate positive correlations with neuroticism, and negative correlations with agreeableness, extraversion and conscientiousness. 	<p>Cannot determine causation.</p> <p>Personality could contribute to this correlation.</p>	

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Smyth JM. (2007) USA	N=100; 73 male and 27 female university student volunteers. Caucasian n= 68; African American n = 18; Asian n=13; Not specified n = 1. 2 participants dropped-out before completing the study, so 98 actually completed the study, but it was not specified how many male and how many female dropped-out.	Randomized longitudinal study. Participants were randomly assigned to play arcade, console, solo computer, or MMORPG games for one month. A self-report questionnaire was administered at the one-month completion date.	To compare the differences in impact from the type of game played on reported hours played gaming, overall health, quality of life, sleep, socializing and academic performance.	<ul style="list-style-type: none"> • The MMORPG group differed significantly from the arcade, console, or solo computer playing groups after one month, reporting more hours spent gaming, significantly worse overall health and sleep quality. • The MMORPG group reported greater enjoyment from the game and greater interest in continued play. • Paradoxically, MMORPG players reported more new online friendships, but also that the game had interfered in their social life. • MMORPG players said that the gaming interfered with their academic work, although the researchers found no significant differences in reported academic performance, overall ratings of social life or quality of life between the four gaming groups. 	Short duration of study (one month). Self-selection of participants.	18-20 years old
Wei R. (2007) China	N=312; 65.1% male and 34.9% female.	Questionnaire design.	To determine if there is a correlation between exposure to online video	<ul style="list-style-type: none"> • There was no relationship between exposure to video game violence and aggressive <i>behavior</i> for females or 	Voluntary self-administered questionnaire.	11-22 years old

TABLE I. STUDIES INCLUDED IN THE SYSTEMATIC REVIEW OF ONLINE GAMING

Reference and country	Sample size and characteristics	Study Design	AIM and Purpose	Findings/Results	Limitations	Target Age
			game violence and adolescents' attitudes toward violence, empathy and aggressive behavior.	<p>males.</p> <ul style="list-style-type: none"> Exposure to video game violence was significantly related to pro-violent attitudes, less empathy, and more aggressive attitudes in male gamers. No significant effects from exposure to video game violence were found in females. 		
Williams D, Skoric M. (2005) Participants' countries not stated; author is from the USA.	<p>N = 213; 167 male, 45 female, and 1 unspecified.</p> <p>Those who had never played an MMORPG.</p> <p>(Original sample size was 232; 11 were excluded because they didn't play as instructed, and 8 more were excluded because of minor data errors.)</p>	<p>Participants were randomly assigned to either a control group or a treatment group that received a copy of <i>Asheron's Call 2</i>, a popular MMORPG and a diary to record playing time for one month.</p> <p>Participants completed a pre-test and post-test online survey to measure their aggression scores.</p> <p>A monetary reward was offered for</p>	To determine if there is a correlation between playing violent video games and aggressive thoughts and behaviors.	<ul style="list-style-type: none"> No significant correlations were found between playing a violent video game and the players' subsequent levels of aggression. 	<p>Analysis method was unable to detect small effects.</p> <p>Short duration of study (one month).</p>	14 to 68 years old

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		completion of an online survey.				
Williams D. (2006) Participants' countries not stated; author is from the USA.	N = 347; 85% male and 15% female or unspecified. 85% of participants were Caucasian. (Original sample size was 378; 31 did not complete the study.)	Participants were solicited from online gaming message boards and general interest websites. 378 were selected and mailed a copy of <i>Asheron's Call 2</i> , a MMORPG to play for at least 5 hours per week for a month. Participants completed a pre-test and post-test online survey.	Examining the social and civic impact on players of the <i>Asheron's Call 2</i> , MMORPG.	<ul style="list-style-type: none"> • This study found no effects on civic attitudes, i.e., participants' sense of community. • Overall measures of socialization decreased, although measures of connectedness and global outlook increased for some participants. • Playing <i>Asheron's Call 2</i> did not affect family relationships, although players experienced sharp declines in extended friendship networks, and face-to-face interactions with friends. 	Self-report questionnaire. Lack of control group. Short duration of study (one month).	14-68 years old, with a mean age of 27.7 years.
Yee N. (2006) Country not stated	N = 3,200; 2,769 male, 431 female MMORPG players.	Participants were recruited through advertising posted to online gaming sites catering to MMORPG players. Respondents were directed from the ads to the online survey.	To determine the reasons for playing and the benefits MMORPG players receive from playing these particular types of online games.	<ul style="list-style-type: none"> • Males were motivated significantly more than females by feelings of achievement produced by playing. • Females found that online relationships more important. • Age, gender and hours played were significantly 	Self-report questionnaires. Social desirability factors.	Age not stated.

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Reference and country	Sample size and characteristics	Study Design	AIM and Purpose	Findings/Results	Limitations	Target Age
				related to motivation to play MMORPGs. <ul style="list-style-type: none"> • Escapism was found to be the best predictor of problematic usage. 		