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**How Gender Moderates Internet Gaming Disorder**

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## **Abstract**

Although Internet Gaming Disorder (IGD) was only included in the DSM-5 as an area for further research, there is growing concern about compulsive online video game playing amongst parents. This literature review investigates the neuropsychosocial risk factors in IGD through the lens of gender. Prevalence of IGD is higher amongst boys than girls, but the reasons for this have not been established. Explanatory evidence is presented regarding gender differences in goal-orientation, cognitive control and developmental needs that contribute to the current gender bias. Evidence suggests that if games companies start to target female gamers explicitly, then the gender gap in IGD could become narrower. Recommendations are made for future policy direction and further research.

## **How Gender Moderates Internet Gaming Disorder**

The internet video game Fortnite became an overnight teenage cultural phenomenon. In April 2018, Fortnite related Youtube views reached five billion, twice those of the next most popular video game having doubled over the prior two months (Aksile Media, 2018). A survey by Common Sense Media in October 2018 found that 24% of parents were concerned about the amount of time their kids play Fortnite, with 75% of teenage boys and 47% of teenage girls reporting having played it. However, when it came to regular play, 22% of boys reported playing every day compared to 9% of girls. These gender differences reflect overall differences in the prevalence of problematic gaming and this literature review will explore the reasons why males are twice as likely to meet the criteria for Internet Gaming Disorder (IGD) than females are (Lemmens & Hendriks, 2016).

While IGD was not officially recognised in the DSM-5 (American Psychiatric Association, 2013), criteria for its diagnosis were proposed to encourage further research. The criteria for IGD is similar to that used for substance disorders, including a preoccupation with gaming, loss of control, negative social/educational consequences, and deceiving family members about the amount of time playing. Since the DSM-5 was published in 2013, internet video games have continued to evolve rapidly, as have the economic models for monetising them. The tactics being used to generate more hours of play on games such as Fortnite include several mechanics that are strikingly similar to those found in Electronic Gaming Machines, which have been shown to cause addiction three times faster than any other form of gambling (Murch & Clark, 2016). Virtual worlds like Roblox and Minecraft have presented invaluable

testing platforms for video game producers to test and iterate game concepts and reward salience. It was a Minecraft “mod” that spawned the Battle Royale genre of which Fortnite has been the most successful to date (Hornshaw, 2019).

While IGD is not an official recognised diagnosis, parents of children who play games such as Roblox, Minecraft and Fortnite are recognising many of the symptoms proposed in the DSM-5 for IGD. While most video games are harmless and casual gaming can have positive benefits for wellbeing (Russoniello, O’Brien, & Parks, 2009), it seems that only a handful of games account for the vast majority of time spent gaming. Fearing a modern-day Pied Piper, parents need better information regarding risk factors for IGD, so that they can identify problematic gaming early and intervene appropriately.

Given the speed at which new games become popular, it has become impossible for IGD researchers to keep up. For example, a search for “Fortnite addiction” on Google Scholar does not return a single study. Research has shown that behavioural addictions like Gambling Disorder (GD) and IGD have similar addictive mechanisms to stimulant abuse (Kuss & Griffiths, 2012). A better understanding of how video gaming causes addiction is required to protect gamers in general and adolescents in particular. Given that the progression of addiction tends to be faster for women than for men (Bobzean, DeNobrega, & Perrotti, 2014), it is also of scientific importance to identify why boys are more susceptible to computer addiction than girls so as to understand the etiology of IGD better.

The common factor thought to underlie all addiction is dysregulation of the brain reward pathways, known as the mesolimbic system (Schmitz, 2005). According to Marc Lewis (2018),

addiction is a maladaptive form of deep learning that is so pleasurable that it develops into an obsession and compulsion to use, leading to dysfunctional goal-seeking behaviour. According to evolutionary developmental psychology (Bjorkland & Kip, 1996 as cited in Hosseini-Kamkar & Morton, 2014), goals differ between genders with men seeking dominance and women seeking affiliation (Luxen, 2005). One theory of play regards it as practice for adulthood (Groos, 1901), and from that, it follows that boys would be more interested in competitive games while girls would be interested in games that foster better social connections. Another finding that could influence video gaming is sensation seeking, which is more prevalent amongst men, especially regarding thrill and adventure seeking (Cross, Cyrenne, & Brown, 2013). Addiction is associated with impulsivity, where there are also gender differences. Women are less prone to impulsivity, which could act as a protective factor for the development of addictions (Hosseini-Kamkar & Morton, 2014).

The main hypothesis for this literature review is that gender differences in IGD occur due to differences in interests, enjoyment and inhibition. This topic will be explored in three sections. The first section will investigate how gender moderates desire to play video games, with the sub-hypothesis that girls are less interested than boys in games associated with IGD, because of a reduced need to compete. The second subsection will investigate how gender moderates arousal from video game play, with the sub-hypothesis that girls are less aroused by video games than boys because they are less sensation-seeking. The final subsection will explore how gender moderates the compulsion to play video games, with the sub-hypothesis that girls experience less craving than boys, due to superior impulse control.

## **How Gender Moderates Desire to Play Video Games**

This literature review is exploring how gender moderates IGD. This section will investigate how gender moderates desire to play video games. Previous research has shown that girls are less likely to play video games than boys and do not feel that gaming helps them develop socially (Lucas & Sherry, 2004). Research also shows that genre is a significant moderator of IGD with players of first-person-shooters (FPS) and role-playing games (RPG) at significantly higher risk (Lemmens & Hendriks, 2016). One of the reasons for gender differences in IGD could be explained by genre, which leads to the sub-hypothesis that girls are less interested than boys in video games associated with IGD

Phan, Jardina, Hoyle, and Chaparro (2012) investigated gender differences in video game related attitudes, genre preferences, and playing frequency. The online survey covered existing gaming habits, supplemented by a range of attitude and behavioural items that were measured on a five-point Likert scale. The video games reported were categorised into twelve genres, whilst playing frequency was quantified as the number of hours of gameplay per week on computer, console or mobile device. The research was cross-sectional, with participants completing it once only. Results showed a significant difference in game genre preference between genders. Men (85%) were more than twice as likely to play violent games than women (36%). It was also found that the increased amount of hours men spend gaming compared to women was reflected in primary platform preference, with PC gaming prevalent amongst males and mobile/handheld gaming more popular with females. Attitudinally, they found that men were more likely to identify gaming as their main hobby, while women would prefer to watch television. The

conclusion was that there are opposing gender preferences in device, genre and attitudes towards playing video games.

While the above study shows significant gender differences in gaming attitudes, preferences and behaviour, it does not explain how they relate to underlying psychological needs. Understanding how video games meet psychological needs is required to explain how the motivation to play video games differs between genders. The next study addresses this by measuring gender differences in brain activity between social and material rewards.

Spreckelmeyer et al. (2009) researched gender differences in neurocognitive responses for social and monetary rewards. Half of the adults who participated in the study were female. Participants brain activity was recorded using fMRI while they performed an incentive delay task, which required them to press a button while a white square appeared for 160-260ms. At the commencement of each trial, a cue informed the participant as to the level of size of reward available (low/medium/high) for the proceeding trial, followed by a fixation cross before the target rectangle appeared. For higher rewards, the response window was shorter. There were two incentive type conditions. In the monetary condition, participants could win €0.20 for an easy trial, €1 for a medium trial and €3 for a hard trial. For the social incentive condition, rewards consisted of seeing faces expressing increasing positive emotion with trial difficulty. Neurocognitive responses were measured in two ways. Firstly, the reaction times (RTs) in each condition for each level of reward were recorded. The second measure of neurocognitive response was the blood-oxygenation-level-dependent (BOLD) response in the striatum. A mixed repeated-measures design was used with each participant taking part in four sessions, half of

which were SI trials and the other MI ones. The results showed a significant interaction effect for RTs between gender, incentive type, and reward size. While female RTs did not change significantly by either reward level or incentive type, males reacted faster to cues in the high-reward money condition but not in the high-reward social condition. A gender difference was also found in the location of BOLD-responses in the striatum. High rewards in the monetary condition were associated with increased activity in the left putamen but only for men, while high rewards in the social condition caused activity in the right caudate nucleus for women but not for men. The researchers concluded that there are gender differences in how rewards are perceived. Men are more motivated by financial rewards and less motivated by social feedback; women appear to respond to financial and social rewards equally.

This section investigates how gender moderates desire to play video games from a social evolutionary perspective. It shows gender differences in goal-orientation that are reflected in video gaming habits, with men preferring more violent action games and women preferring games that provide social rewards. Therefore, the sub-hypothesis that girls are less interested than boys in video games associated with IGD is supported. However, curiosity is only one step towards addiction and the degree to which it becomes habit-forming depends on the level of experiential-enjoyment. The following subsection explores the next stage in addiction by exploring gender differences in arousal during gameplay.

### **How Gender Moderates Arousal during Video Gameplay**

This literature review is exploring how gender moderates IGD. The previous section shows differences in video gaming interests with boys showing a preference towards competitive

games that are associated with IGD. Previous research indicates that dopamine levels in the striatum increase during video gameplay (Weinstein, 2010), which indicates the arousal of the brain reward pathway. Research has also shown that disordered gamers are four times more likely to play online (Lemmens & Hendriks, 2016) and that violent game exposure increases stress for girls but not for boys (Ferguson et al., 2015). Positive emotional arousal could lead to an obsession to repeat the behaviour. Therefore, this section will investigate how gender moderates arousal for video game play, with the sub-hypothesis that girls are less aroused than boys by video gaming.

Kätsyri, Hari, Ravaja, and Nummenmaa (2013) investigated how the type of opponent moderates brain reward activation from competitive gaming, amongst experienced male video game players. The game used was a modified version of BZFlag, an open-source 3D tank game. Brain reward activation was measured using fMRI to capture BOLD-response in the limbic and frontal areas. While the opponent was always computer controlled, participants were put into computer and human conditions based on the type of opponent they were told they were playing against by the research assistant. In order to increase the manipulation, participants were told they would win .33 euros for each time they destroyed an opponent's tank and lose .33 euros each time their tank was destroyed. Results showed significant increases in BOLD signal within the striatum and frontal areas for a win in both the human and computer conditions. An additional increase in BOLD-response was observed in the dorsal-ventral striatum and ventromedial prefrontal cortex for the human condition only. The conclusion was that brain reward activation from video gameplay was higher for winning than for losing and that it was moderated by social context.

While the above study shows that competitive video gameplay activates brain reward areas, the study only included men. As gender differences have been established regarding different types of reward, the results cannot be generalised to women. The next study addresses this by comparing brain reward activation during video gaming between genders.

Hoefl, Watson, Kesler, Bettinger, and Reiss (2008) investigated gender differences in the activation of the mesocorticolimbic system during computer gameplay. Participants were required to play a simple, bespoke game that required them to click on balls to increase their amount of screen-space. The play occurred in an fMRI scanner, with activity in the mesocorticolimbic system measured using fMRI BOLD-responses in the nucleus accumbens (NAc), amygdala (AMYG) and orbitofrontal cortex (OFC). No instructions were given regarding the objectives and mechanics of the game, and participants had to work out the rules of the game as part of the task. A control condition was used where the screen-space reward was disabled, but otherwise, the game was the same. Both genders showed increased BOLD-response in the NAc, AMYG and OFC, when the gameplay condition was compared to the control condition. Men learned the goal of the game faster than women, and this corresponded with increased activity in the right AMYG in comparison to women. There was also a significant increase in functional connectivity (FC) between the NAc and the OFC, during gameplay. The researchers concluded that the mesocorticolimbic system responds to abstract virtual rewards in the same way that it does for stimuli that can lead to addiction. Furthermore, the degree of activation in the mesocorticolimbic system differs between genders, with men showing more activation, which suggests increased arousal during gameplay.

This section investigates how gender moderates arousal during video gameplay from a neurobiological perspective. It shows gender differences in reward motivation that are reflected in video gaming habits. This supports the sub-hypothesis that girls are less aroused by video gameplay than boys. While desire and arousal may be habit-forming, they do not necessarily lead to a loss of control. Therefore, the following subsection explores the next stage in addiction by exploring gender differences in the compulsion for video gameplay.

### **How Gender Moderates Compulsion to Play Video Games**

This literature review is exploring how gender moderates IGD. The first section shows that boys are more inclined towards exciting, competitive games than girls and the previous section highlights that boys find video gameplay more stimulating, especially when their opponent is human. Previous research has shown that Buprion, a medication used for alleviating craving in cocaine and nicotine addiction, is also effective for reducing video game cravings (Han et al., 2011). Research has also shown a sizeable behavioural advantage for females compared to males with regards to social inhibition, and a moderate advantage for females regarding inhibition generally (Bjorkland & Kip, 1996 as cited in Hosseini-Kamkar & Morton, 2014). This section will investigate how gender moderates compulsion to play video games by investigating how gender moderates craving for gameplay, which can become compulsive. The sub-hypothesis for this section is that girls experience less video game craving than boys.

Dong, Wang, Wang, Du, and Potenza (2019) studied how gender moderates craving during video gameplay and abstinence. The subject of the study was League of Legends (LoL), a leading multiplayer online battle arena (MOBA) game, that is not an FPS. LoL players were

recruited and placed into IGD and regular-gamer (RG) groups. Participants were classified as in the IGD group based on their Young's Internet Addiction Test score in addition to meeting the DSM-5 criteria. In order to facilitate a 2x2 design, half of the sample were women, and half of each gender group met the criteria specified for IGD. Brain activity was recorded using fMRI to evaluate FC between the dorsolateral prefrontal cortex, striatum, and insular (mesolimbic activity), as well as DLPFC and SFG areas (inhibitory pathway activity). Each participant completed one session in which they were required to play LoL in the scanner. Once they were fully engaged in battle, fMRI activity was recorded for four minutes (gameplay condition). After this came a forced-break condition, where the internet was disconnected by a research assistant. Results showed that during the gameplay condition, men showed higher mesolimbic activity than women. In the forced-break condition, inhibitory pathway activity correlated negatively with self-reported craving for both genders, with men showing less inhibitory pathway activity and reporting greater craving accordingly. Furthermore, the forced-break condition increased mesolimbic activity for both genders in the IGD group, but there was a gender difference in the RG group where men showed mesolimbic activity, but females did not. The researchers concluded that men crave video gameplay more than women because they have inferior inhibitory control and find gameplay more rewarding. Furthermore, female gamers who meet the criteria for IGD have similar reward pathway activity to male gamers, which could be a cause of, or effect from, IGD.

While the above study shows gender differences in reported craving that correlated with differences in mesolimbic activity, it did not investigate whether gameplay craving is compulsive. It is possible that the nature of video game craving will not lead to compulsive

consumption, which occurs in substance addiction. The next study addresses this by comparing craving from gameplay cues in IGD with those of drug cues in substance addiction.

Han et al. (2011) investigated the effect of video game cues on activity in brain areas associated with addictive craving. The video game chosen was “War Rock”, a first player shooter (FPS), which is played online against others, simultaneously. All of the participants were male, none of whom had a history of substance addiction, or met the criteria for internet addiction according to Young’s Internet Addiction Scale. A gameplay cue condition consisted of clips of “War Rock”, while a control condition used clips of animated war scenes. A neutral condition was also used, which consisted of presenting a white cross on a black background. Brain activity was monitored using an fMRI scanner to evaluate BOLD signals in the prefrontal cortex (PFC), OFC, AMYG, hippocampus and thalamus. A partially counterbalanced, repeated-measures design was used with each subject exposed to the three conditions, in five different orders. Results showed that, compared to the neutral condition, the video game cue condition causes a significant increase in BOLD signal within the PFC, OFC, parahippocampal gyrus and thalamus. The researchers concluded that internet video game cues cause craving that is neurologically equivalent to drug cues for addicted substance users.

This section investigates how gender moderates the compulsion to play video games from a neurocognitive perspective. It shows that females have superior functional connectivity in brain areas associated with impulse control than males have, both during gameplay and abstinence. Men experience more craving to play video games, showing a pattern of brain activity similar to substance addiction. It follows that video game cues could lead to compulsive gaming, regardless

of negative consequences, the sub-hypothesis that girls experience less craving to play video games than boys do is supported.

### **Conclusion and Discussion**

This literature review explores how gender moderates Internet Gaming Disorder from a neuropsychosocial perspective. The first section investigates how gender moderates desire to play video games and finds that girls prefer less violent games to boys and are more motivated by social rewards than competition. The second subsection explores how gender moderates arousal for video gameplay and finds that girls are less aroused during video gameplay than boys. The final subsection addresses how gender moderates the compulsion to play video games and shows that girls experience less craving than boys during periods of abstinence. The main hypothesis that gender differences in Internet Gaming Disorder occur due to differences in interests, enjoyment and inhibition is supported.

While this literature review supports neuropsychosocial factors in the etiology of IGD, it is limited in several regards. Firstly, the definition of Internet Gaming Disorder is open to subjective interpretation, which may affect reliability. Secondly, the samples used could have been skewed by selection bias by recruiting participants who responded to advertisements for a video gaming experiment. Thirdly, many of the experiments lacked a control condition, which raises the possibility of confounding factors. However, the tightly regulated environment inside an fMRI scanner mitigates this internal validity threat to some degree. Finally, given the findings regarding genre differences, most of the studies only included a single game, and many studies failed to recruit females. The generalisability of future research would be enhanced by adding

trials using an additional game from a different genre, as well as including sufficient female participants for gender differences to be accounted for.

However, all of the studies used have strong face-validity, and the neuropsychosocial factors proposed seem well supported. While girls may have some protection from IGD due to greater impulse control, a large part of the gender difference could be the lack of social rewards in the games that are popular currently. Until fifteen years ago, gaming was an almost exclusively male pastime, but since the rise of smartphones and social networks, casual gaming has become the norm for girls also. Further evidence that supports the desire for social rewards as a driver for female gaming can be found in the popularity of social games on Facebook. Farmville became a worldwide phenomenon, particularly amongst women who outnumbered men three to one as players (DataGenetics, 2011). This led the CEO of Zynga, Farmville's developers, to proclaim that "the forty-year-old mom is the new hardcore gamer" (Tom's Guide, 2011). More recently, the South China Post (2018) reported that 54% of MOBA game "King of Glory" players were female players, which they speculated to be due to shorter sessions, lower skill barriers to entry and social media.

Games developers appear to be using increasingly elaborate operant conditioning schemes to reinforce gameplay habits. These include virtual money, positive reinforcement, unexpected rewards, near misses, limited addition outfits and shorter game lengths. Research is required into how these techniques impact on the brain reward system to understand how these specific aspects of modern games affect desire and craving for video gameplay.

To establish the direction of causality, further research is required into the development of problematic gaming and impulsive behaviour. Schools could be approached to support longitudinal studies that track the development of Executive Functions, intelligence and gaming habits during childhood. What is more, should the video game industry share its usage data, in the same way that the gambling industry does, then it would enable quantitative studies into between genre differences in gaming behaviour.

This literature review has shown that a large part of the gender difference in Internet Gaming Disorder can be explained by the desire for competitive gaming online. Competitive gaming is more appealing to males than females because of the need for dominance (Luxen, 2005). Given the evidence that IGD, like gambling disorder, is a behavioural addiction caused by maladaptive learning (Lewis, 2018), it is suggested that warnings should be displayed before gameplay commences and that in the absence of adequate parental controls, age-restrictions be considered for competitive gaming online.

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