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Is experience in multi-genre video game playing accompanied by impulsivity?

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ABSTRACT

Developing impulsivity has been one of the main concerns thought to arise from the increasing popularity of video gaming. Most of the relevant literature has treated gamers as pure-genre players (i.e. those who play only a specific genre of game). However, it is not clear how impulsivity is associated with different genres of games in multi-genre gamers, given that there is increasing diversity in the games played by individuals. In this study, we compared 33 gamers to 23 non-gamers in a go/no-go task: the Continuous Performance Test (CPT). To evaluate whether or not impulsivity occurs as a trade-off between speed and accuracy, we emphasised fast performance to all participants. Then, to examine the ability to predict impulsivity from game genre-hours, we fitted separate multiple regression models to several dependent variables. As an additional measure, we also compared groups in an antisaccade task. In the CPT, gamers showed a trend towards significantly faster reaction time (RT), accompanied by higher false alarm rate (FAR) and more risk-taking response bias (β), suggesting impulsive responses. Interestingly, there was a significant negative correlation between RT and FAR across all participants, suggesting an overall speed-accuracy trade-off strategy, perhaps driven by the emphasis on speed during task instruction. Moreover, time spent on role playing games (RPG) and real-time strategy (RTS) games better predicted FAR and β than did time spent on action and puzzle games. In the antisaccade task; however, gamers showed a shorter antisaccade latency but a comparable error rate in comparison with non-gamers. There was no specific game genre which could predict performance in the antisaccade task. Altogether, there was no evidence of oculomotor impulsivity in gamers; however, the CPT results suggested the presence of impulsive responses in gamers, which might be the result of a speed-accuracy trade-off. Furthermore, there was a difference in game genres, with time spent on RPG and RTS games being accompanied by greater probability of impulsive responses. Training studies are required to investigate the causality of different video game genres on the development of impulsivity.

1. Introduction

Playing video games has become one of the major forms of entertainment around the world. In United States, 65% of American families are home to at least one person who plays video games 3 hours or more per week and 67% of households own a device that is used to play video games (Entertainment Software Association, 2017). The increasing popularity of video games has drawn researchers' attention to the consequences of extensive playing on users. One of the concerns in this regard has been the development of impulsivity in video gamers.

Impulsivity refers to a predisposition for unplanned actions with little or no forethought to consequences (Daruna & Barnes, 1993). Impulsivity is a multidimensional concept that incorporates personality, behavioural and biological components. With regards to behavioural component (what we are examining here), it refers to deficits in response inhibition (Littel et al., 2012). While playing a video game, one is required to rapidly press various buttons (this is particularly the case for fast-paced games, including action and driving games) to shoot or move, and also to be able to inhibit erroneous actions at the right time, to avoid things such as losing lives or shooting at friends by mistake. How does gaming affect our lives outside of the game? We could argue that such a cognitive task might lead to either a disability at inhibiting inappropriate responses (Decker & Gay, 2011; Deleuze, Christiaens, Nuyens, & Billieux, 2017) or an enhancement in executive function and decision making abilities (Metcalf & Pammer, 2014; Strobach, Frensch, & Schubert, 2012). There is evidence that playing video games decreases reaction time in tasks beyond video games, such as perceptual decision making (Green, Pouget, & Bavelier, 2010),

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switching between tasks (Cain, Landau, & Shimamura, 2012; Colzato, van Leeuwen, van den Wildenberg, & Hommel, 2010), visual search (Castel, Pratt, & Drummond, 2005; Hubert-Wallander, Green, Sugarman, & Bavelier, 2011; Wu & Spence, 2013) and information processing (Dye, Green, & Bavelier, 2009b). Therefore, the question arises whether this faster reaction time occurs at the cost of less accuracy and thus is associated with impulsivity or alternately with modified executive function.

Impulsivity in video gamers has been investigated in studies using a variety of behavioural techniques. Colzato, van den Wildenberg, Zmigrod, and Hommel (2013) compared action video gamers with non-gamers in a stop signal task and observed comparable performance between groups on their stop signal reaction time and percentage of errors. In line with this study, Metcalf and Pammer (2014) found no evidence of impulsivity in first person shooter gamers (FPS) in comparison with non-gamers in either error rate or reaction time (RT) in both a go/no-go and a continuous performance test (CPT). In the first half of the CPT, participants were asked to press the button when the letter "X" appeared on the screen and in the second half whenever the letter "X" appeared following the letter "A". The authors also showed evidence of better decision-making abilities in the Iowa gambling task in a FPS gamer group. Dye et al. (2009b) also compared action gamers and non-gamers in the Test of Variables of Attention (TOVA). The test requires the participant to make a quick response to a stimulus appearing in one location (targets), while suppressing a response if it appears at another location (non-targets). In different parts of the test the target can appear either often or very rarely. Examining RT and response sensitivity or d′ (which measures the rate of deterioration in performance over time, obtained by calculating the ratio of hit rate to false alarm rate) in the impulsivity condition of the TOVA, they found faster responses in action gamers, who still maintained comparable levels of response sensitivity. Moreover, they conducted a meta-analysis on nine previously published experiments comparing action gamers and non-gamers on speeded choice tasks. They found that action gamers were 11% faster than non-gamers, although the accuracy level was not different between groups. Altogether, they concluded that there was no evidence of impulsivity in action gamers, in spite of them being faster. Another piece of evidence came from Mack and Ilg (2014), who used an antisaccade task (Hallett, 1978), to test impulsivity between gamers and non-gamers (they did not recruit a specific genre). They showed a faster saccadic reaction time in gamers while the antisaccade error rate was not different between groups, attributing this to there being no difference in impulsivity between gamers and non-gamers (Mack & Ilg, 2014).

On the other hand, there is contrasting evidence for impulsivity in video gamers (Decker & Gay, 2011; Deleuze et al., 2017; Gentile, Swing, Lim, & Khoo, 2012). Deleuze et al. (2017) examined 81 gamers in three groups: 1) players of online FPS games, 2) multiplayer online battle arena and 3) multiplayer online role playing games, in a behavioural task which served to measure two distinct components of inhibition: cancellation and restraint. They observed a faster reaction time in FPS gamers as well as reduced inhibition abilities in the cancellation task, although not in the restraint task, in comparison to the participants in the other groups. Decker and Gay (2011) also compared twelve World of Warcraft players with thirty non-gamers in two versions of a computer-based go/no-go task. The gaming group had faster reaction times and better ability to discriminate between target and distractor (high d′), but showed lower response bias (C index, measured by using a signal detection analysis of hit rate and false alarm rate, representing the tendency to respond to both targets and distractors) in both versions of the task. The authors explained this as a pattern of enhanced cognitive function which led to more accurate and faster performance, in spite of being more impulsive. A reduced ability to inhibit a response (i.e., impulsivity) might result in a tendency to respond to all stimuli (i.e., a low C index).

Excessive video gaming (4.67 hours per day for an average of 5 days a week) has also been accompanied by higher levels of self-reported impulsivity (measured by the Eysenck Impulsiveness Questionnaire) as well as lesser inhibition ability, as reflected in a go/no-go task (responding to any letter that appeared on the screen except the one that was similar to the previous one) in comparison to non-gamers. Excessive gamers showed a faster RT in go trials, higher false alarm rate, less sensitivity to detect go and no-go trials and a more risk-taking response bias, indicating their tendency to respond to both go and no-go trials (Littel et al., 2012).

The results obtained are rather ambiguous, with some studies indicating no evidence of impulsivity in gamers, whereas the others showed impulsivity in game players. One potential issue with these studies might be composition of the gamer groups. Gamer groups have mostly been composed of single-genre gamers (those who play a specific genre, with most evidence being available from action games) for at least 4–5 hours a week for a period of time. This classification is somewhat arbitrary, as nowadays most regular gamers tend to play multiple genres rather than playing only a specific one. Recently, Dale and Green (2017) showed that of 5008 individuals who played at least 1.5 hours a week, only 6% were pure genre gamers (i.e., they played one genre for > 5 hours/week, but did not play any other genre for > 3 hours/week), whereas 48% were multi-genre gamers (i.e., they played > 5 hours/week, playing > 3 hours/week of more than one genre) and 47% were casual gamers (who played between 1.5 and 5 hours/week). This finding warrants careful consideration of multi-genre playing in video game research if one is to obtain a real view of changes attributed to video gaming. This is an issue with the above-mentioned studies which has rarely been acknowledged (but see Dale & Green, 2017 for mentioning multi-genre gamers; and Eichenbaum, Kattner, Bradford, Gentile, & Green, 2015 for including such a classification). Moreover, most of these studies have only investigated action video games and there is scarce data on the other genres in this regard. One possible solution would be looking at game-genre-specific hours that each player allocated to playing a specific genre of game during a week, instead of treating gamers as pure genre gamers. In this way, we would include both multi-genre gamers and single-genre gamers and have a real view of the association between video gaming and impulsivity.

In this study, we aimed to first compare impulsivity between regular video gamers (those who played any video game at least 5 hours a week) and non-gamers, using a go/no-go task: the continuous performance test (CPT). The CPT was initially designed to measure the ability to sustain attention over time (Rosvold, Mirsky, Sarason, Bransome Jr, & Beck, 1956); however, it also has been used as a measure of impulsivity in the form of motor response inhibition (Riccio, Reynolds, Lowe, & Moore, 2002). The CPT is a go no-go paradigm where the participant is required to respond with a fast motor response to a frequent go stimulus (target), but to withhold the response when an infrequent no-go stimulus (non-target) is presented. The key variable in this test is the rate of false alarms (i.e. failure to suppress the response to the no-go stimulus). Moreover, to investigate whether or not impulsivity occurs as a result of a trade-off between speed and accuracy, we emphasised to all participants the need for fast performance while performing the CPT task. We then sought to predict impulsivity in gamers from game genre hours via multiple regression analysis.

As an additional measure of impulsivity, we also compared groups in an antisaccade paradigm after they completed the CPT. Antisaccade is considered as a measure of oculomotor impulsivity, although it can account for psychometric trait impulsivity to a limited extent (see Aichert et al., 2012). In this task, participant fixates a central stimulus which will be replaced by a sudden-onset peripheral stimulus. However, the participant is asked to refrain from looking at the peripheral target and instead make a saccade towards the mirror position in the opposite direction (Hallett, 1978). Therefore, it measures the ability to withhold a reflexive prosaccade response to the target, although it is sometimes inefficient when the prosaccade error has already been