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Research Report

Acute exposure to difficult (but not violent) video games dysregulates cognitive control

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ABSTRACT

Recent research has suggested that acute exposure to violent video games inhibits the capacity for self-control across neurological, cognitive, and behavioral domains. However, the games used in previous research to reach these conclusions often confound violence with other game features, such as game difficulty. Here, participants were randomly assigned to play one of four versions of a video game, wherein content (violent or not) and difficulty (easy or difficult) were orthogonally manipulated, prior to completing a cognitive control task. Results showed that playing a difficult video game produced decrements in cognitive control, but only if the game was perceived to be difficult, and that perceptions of game difficulty may mediate this relationship. Game content, by comparison, had no effect on cognitive control. Findings are discussed in terms of understanding effects of difficult games on cognitive processes that have important implications for social behavior.

1. Introduction

One of the most fascinating human abilities is self-control, or the ability to effectively override one's automatic and habitual responses in the service of goal-directed or socially appropriate behavior. This unique skill is often vital for intrapersonal salubrity and interpersonal harmony. Indeed, numerous problems and negative social interactions seem to be caused by a relative lack of self-control: impulsivity, addictive behaviors, criminality, aggression toward others, and many more. Thus, understanding factors that affect self-control has far-reaching implications for understanding numerous social and behavioral phenomena.

Some research has suggested that the use of violent video games can cause short-term (Gabbiadini, Riva, Andrighetto, Volpato, & Bushman, 2013) or long-term (Hummer et al., 2010; Wang et al., 2009) impairments in the strength of self-control. However, these studies have often confounded other game features with game violence, leaving it unclear as to what specific game feature is responsible for the observed changes. The present research attempts to identify the game features (if any) that cause short-term changes in attention control.

1.1. Attention control and self-control

The control of attention might be one of the most fundamental forms of self-control (Gailliot & Baumeister, 2007). After all, it is difficult to imagine how someone could respond appropriately to diverse situations without first attending to the contextually relevant stimuli within them. This is perhaps why previous research has suggested that *attention control* can be thought of as the first line of defense against numerous deleterious behaviors, and that a relative lack of this control can lead to self-control failure across many behavioral domains (Baumeister, Heatherton, & Tice, 1994). Because numerous stimuli are often present in our environment at any one point in time, it is the job of attention to determine which ones are important for subsequent information processing and which ones can be safely ignored. In other words, controlling attention requires self-control because attention can automatically orient to extraneous, non-relevant objects in the environment (see Schneider & Shiffrin, 1977).

Much of the research on attention control has involved tasks in which participants are asked to differentiate between concomitant information or ignore conflicting signals (Rueda, Posner, & Rothbart, 2004). A classic example of such a task is the Stroop task (Stroop, 1935). A typical Stroop task requires participants to name the color of ink in which a color word is printed. This rule is simple to follow when the ink color and color word are congruent (e.g., when the word blue is written in blue ink), but is difficult to follow

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when these two sources of information are incongruent (e.g., when the word blue is written in red ink). Overriding the prepotent response to read the color word on incongruent trials requires attention control, as attention must be oriented to the color of the ink in which a word is written rather than to the color word itself in order to perform well at the task (for similar findings, see Fairclough & Houston, 2004; Gailliot et al., 2007).

According to the strength model of self-control, volitional acts of self-regulation exhaust a global psychological resource pool, thereby leaving individuals with fewer available resources for subsequent attempts at self-control (i.e., 'depletion effects'; see Baumeister, Bratslavsky, Muraven, & Tice, 1998; Baumeister, Vohs, & Tice, 2007). In other words, much like an intense physical challenge can diminish the ability to demonstrate prowess in other physical domains, the ability to implement attention control is theorized to be reduced following initial acts of self-control. Demonstrations of this effect date back several decades and are abound in current research. For example, participants who endured unpredictable, rather than predictable, electric shocks performed worse on a subsequent Stroop task, presumably due to the greater strain on mental endurance (Glass & Singer, 1972). Similar effects also have been shown in several recent laboratory experiments (e.g., Baumeister et al., 1998, 2007; Job, Dweck, & Walton, 2010; Vohs & Heatherton, 2000; Vohs et al., 2008). For example, Job et al. (2010) reported that participants who performed a depleting task requiring cognitive control committed more errors on incongruent trials during a subsequent color-word Stroop task (Stroop, 1935). Findings such as these have led some researchers to speculate that attention control and self-control draw from the same limited resource pool (see Gailliot & Baumeister, 2007). In other words, exercising self-control (attention control) on one task should reduce the amount of attention control (self-control) that could be recruited for a subsequent, demanding task, an idea that has received considerable empirical support (e.g., Gailliot, Schmeichel, & Baumeister, 2006; Vohs, Baumeister, & Ciarocco, 2005; Vohs & Faber, 2004).

More recent research on depletion effects suggests considerable inter-individual variability in the experience of self-control depletion manipulations and related outcomes. Indeed, one recent meta-analysis provides evidence of heterogeneity across depletion studies (Hagger, Wood, Stiff, & Chatzisarantis, 2010). Hagger and colleagues reported that this heterogeneity can in part be explained by how difficult the task is perceived to be, which often varies according to levels of previous experience with the task. In other words, degree of impairment in task performance is moderated by perceptions of task difficulty.

However, the estimated population effect size of the depletion effect reported by Hagger et al. (2010), $d = 0.62$ (95% confidence interval [0.57, 0.67]), has been the subject of recent skepticism. Specifically, based on a re-analysis of the data used by Hagger and colleagues, Carter and McCullough (2013, 2014) argued that the effect size reported in the initial meta-analysis is overstated and posit that the extant evidence on depletion effects could largely be an artifact of publication bias. They reported a pattern of excess significance (that is, more significant results in studies than those studies' power would indicate as likely) in studies of cognitive depletion. Most importantly, when attempting to correct for this publication bias, the depletion effect size was estimated to be indistinguishable from zero. Carter and McCullough concluded by suggesting that researchers should re-examine the magnitude of depletion effects in future studies. That is, further research on depletion – whether it exists, how it can be manipulated, and how it influences subsequent outcomes and behavior – is needed. Previous research suggests that exposure to violent video games can cause increases in deleterious behaviors that require self-control. It is this possibility that we explore in more detail in the sections that follow.

1.2. Violent video games and self-control

Whereas decades of research have been conducted on the relationship between exposure to violent video games and aggressive behavior (see Anderson et al., 2010; Ferguson & Kilburn, 2010; Greitemeyer & Mügge, 2014), comparatively few studies have examined the acute effects of violent games on laboratory analogues of self-control. Because increased aggression can, in part, stem from decreased self-control (DeWall, Baumeister, Stillman, & Gailliot, 2007), the extent to which violent games contribute to self-control failures also might have implications for aggression-related outcomes.

Only one study to date has examined the acute effect of violent game exposure on a behavioral measure of self-control (see Gabbiadini et al., 2013). In this study, Gabbiadini and colleagues predicted that, in line with moral disengagement theory, individuals high in moral disengagement should interpret immoral behaviors in a video game as justifiable, thereby increasing the likelihood of self-control failures following game play. To test this idea, participants were assigned to play one of two violent games (*Grand Theft Auto [GTA] III* or *GTA: San Andreas*) or one of two nonviolent games (*Pinball 3D* or *Mini Golf 3D*). During game play, a 100-g bowl of M&M's was positioned next to the participant's computer. The experimenter instructed participants that they could consume the M&M's at their leisure, but that high amounts of candy consumption within brief periods of time is unhealthy. Participants who played a violent game consumed more M&Ms. than did participants who played a nonviolent game, a finding interpreted as evidence that violent games can lead to lapses in self-control. The estimated magnitude of this effect was large, $d = 1.29$, and similar results were found on measures of cheating and aggression. Gabbiadini and colleagues speculated that engaging in unconstrained, morally reprehensible behaviors in a violent video game can undermine subsequent efforts at self-control.

Similar effects of violent games have been observed on attentional cognitive control, rather than general self-control. For example, experimental research has shown that acute exposure to violent games can undermine the neural correlates of cognitive control. Wang et al. (2009) reported that, compared to participants who played a nonviolent game (*Need for Speed*), participants who played a violent game (*Medal of Honor*) for a period of 30 min showed decreased activation in areas of the prefrontal cortex during a subsequent cognitive control task, an effect consistent with reduced implementation of cognitive control (see also Hummer et al., 2010).

1.3. Disentangling violence from other in-game dimensions

A common methodological problem shared by most studies investigating these questions is that game 'violence' is almost always confounded with specific game contexts and contents. For example, *GTA* differs from *Mini Golf 3D* and *Pinball 3D* on a host of dimensions other than violence and criminal behavior. *GTA* requires the player to successfully navigate a dynamic, challenging game environment in which the player must manage *direct* competition and conflict in order to play the game effectively. By comparison, *Mini Golf 3D* and *Pinball* 3D require the player to interact with a confined, simplistic game environment in which the player might experience, at the most, minimal levels of *indirect* conflict. These between-game differences are confounds which may be responsible for the negative effects on self-control.

At least one piece of evidence points to game difficulty as being an important factor to consider in self-control related outcomes. This evidence stems from emerging research suggesting that thwarted in-game competence predicts increased post-game aggressiveness (see Przybylski, Deci, Rigby, & Ryan, 2014; study