Computers in Human Behavior 27 (2011) 1942–1947

Contents lists available at ScienceDirect

Computers in Human Behavior

journal homepage: www.elsevier.com/locate/comphumbeh

Attentional bias in excessive massively multiplayer online role-playing gamers using a modified Stroop task

Olivia Metcalf*, Kristen Pammer

Department of Psychology (Building 39), The Australian National University, Canberra ACT 0200, Australia

ARTICLE INFO

Article history:
Available online 24 May 2011

Keywords:
MMORPG
Attentional bias
Stroop
High engagement
Online gaming addiction

ABSTRACT

There is considerable dispute regarding the nature of excessive or problematic Internet-related behaviour and whether it constitutes a clinical addiction. Classification of excessive gaming is hindered by a lack of experimental research investigating behavioural responses from gamers and comparing these patterns to those found in established addictions. We investigated whether an attentional bias for gaming-related words existed for addicted Massively Multiplayer Online Role-Playing Gamers (MMORPGers) identified using the Addiction–Engagement Questionnaire.

Forty frequent MMORPGers (15 female) and 19 non-MMORPGers (eight female) completed a computerised modified Stroop task comprised of game-related, negative and neutral word lists, Addiction–Engagement Questionnaire, Depression, Anxiety and Stress Scale 21, gaming-related variables. The results indicated that addicted MMORPGers had significantly longer reaction times to negative and MMORPG words compared to neutral words, whereas highly engaged and non-MMORPG participants showed no such bias. The presence of an attentional bias in addicted MMORPGers is comparable with research investigating this behavioural response in established addictions.

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1. Introduction

1.1. Overview

Current research in cyberpsychology has found evidence indicating a small but significant proportion of gamers are exhibiting signs of addiction to online games (Charlton & Danforth, 2007; Gentile, 2009; Griffiths, 2010; Grüsser, Thalemann, & Griffiths, 2007; Ko, Liu, Hsiao, et al., 2009; Lemmens, Valkenburg, & Peter, 2009; Smahel, Blinka, & Ledabyl, 2009; Thalemann, Wolfling, & Grusser, 2007; Yee, 2006; Young, 1996). Online gaming addiction is typically defined as excessive use of games that results in a range of psychosocial problems for the gamer. However, despite the mounting consequences of excessive gaming these gamers are unable to cut back on the activity (Lemmens et al., 2009). The negative effects of overuse of online games include significant impacts on health such as sleep-related problems, poor diet and even gaming-induced seizures, in addition to serious consequences for work or school commitments and negative interpersonal repercussions (Chuang, 2006; Kim, Han, Park, et al., 2010; Lee, Ko, Song, et al., 2007; Lo, Wang, & Fang, 2005).

Although there is little doubt that excessive online gaming can become problematic for an individual, there remains debate as to whether such behaviour constitutes a psychiatric disorder (Ng & Wiemer-Hastings, 2005; Petry, Rooij, et al., 2011; Widyanto & Griffiths, 2006) either as a distinct type of addiction (Kim et al., 2010) or a subtype of Internet addiction (Young, 1996). Furthermore, although the majority of research investigating online gaming addiction has treated online games as a homogenous group, recent evidence indicates that there may be great diversity amongst online gamers and the aetiology of any putative online gaming addiction (Gentile, 2009). While the workforce for the next edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-V) has outlined a proposal considering online gaming addiction as a subtype of Internet addiction, uncertainty remains surrounding the relationship between general problematic Internet use and more specific Internet-based activities (Pies, 2009).

A significant limitation facing classification of excessive online gaming is that various psychometric measures used to identify addiction have not been systematically validated (Petry et al., 2011). A great deal of research has compared the psychometric properties of excessive online gamers to those found in other addictions (Widyanto & Griffiths, 2006). There is general consensus by researchers that excessive online gaming most closely resembles a behavioural addiction such as pathological gambling. Behavioural addictions share most of the features and symptoms of substance addictions but without the ingestion of a psychoactive substance (Griffiths, 1996). Features include behavioural and cognitive salience, mood modification, tolerance, withdrawal, conflict and relapse (Griffiths, 2005). Nearly all tools developed to measure

* Corresponding author. Tel.: +61 2 612 54106; fax: +61 2 612 50499.
E-mail addresses: Olivia.Metcalf@anu.edu.au (O. Metcalf), Kristen.Pammer@anu.edu.au (K. Pammer).

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doi:10.1016/j.chb.2011.05.001

online gaming addiction have used items tapping these criteria; however, relying on endorsement of a certain number of these features may result in an overestimation of prevalence of addiction (Charlton & Danforth, 2007). This may be due to some of the proposed criteria for online gaming addiction being less indicative of a clinical addiction and more indicative of those who game frequently but do not suffer any of the negative consequences that are classically associated with addiction (Charlton & Danforth, 2007; Griffiths, 2010). Charlton and Danforth (2007, 2010) termed the latter behaviour *high engagement* and developed the Addiction–Engagement Questionnaire (AEQ) to distinguish between the two types of gaming behaviour. Charlton and Danforth (2007, 2010) have speculated that some highly engaged gamers may be in a developmental stage preceding addiction although empirical evidence is still needed to assess this.

1.2. Measuring attentional bias in addictions

In addition to poorly established psychometric scales, a major limitation facing the classification of excessive online gaming is the lack of evidence indicating that excessive online gamers share behavioural features consistent with those found in established addictions. A central tenet to theories of the development and maintenance of addictive behaviour and subsequently, a phenomenon that has been extensively explored in addiction research is the *attentional bias*. It is believed that over time, addiction–associated cues acquire the ability to capture an addict's attention, and this process is thought to occur both automatically and implicitly (Field & Cox, 2008; Ryan, 2002). Research has established the presence of attentional biases in all substance abuse disorders and in pathological gambling. Recently, some research treating addiction as a continuous variable has shown that degree of dependency or frequency of substance use co-varies with attentional bias (Field et al., 2008; Franken, Stam, Hendriks, & van den Brink, 2003; Ryan et al., 2002).

The task most commonly used to measure attentional bias is the modified Stroop task (Stroop, 1935). Addicts and controls are presented with addiction related and non-addiction related words, matched on qualities known to affect semantic processing such as frequency of use and length. The words are presented in different colours and participants are required to ignore the semantic meaning of the word and indicate as quickly and accurately as possible the colour. Longer reaction times to addiction–related words compared to neutral words are typically observed for addicts. The effect is attributed to interference from an attentional bias towards addiction–related words, interrupting the ability to complete the task efficiently. Although the exact mechanisms by which the effect operates remain debated, it has been replicated in a large number of studies confirming that performance on a modified Stroop is a robust indicator of attentional bias in addiction (Cox, Fadardi, & Pothos, 2006).

1.3. Study objectives

The aim of this study was to investigate the presence of an attentional bias using the modified Stroop task in addicted gamers as identified using the AEQ. We selected Massively Multiplayer Online Role-Playing Games (MMORPGs) as the genre of online games to investigate as they are the most popular online games and consequently, the focus of the majority of research into online gaming addiction. The presence of an attentional bias in gamers can then be used to critique the AEQ method of identifying addiction. An additional aim was to investigate attentional bias in highly engaged gamers and the speculation that at least some highly engaged gamers may be in a stage of developing addiction (Charlton & Danforth, 2007, 2010). Additionally, we assessed psychosocial variables as measured by the Depression, Anxiety and Stress Scale 21 (DASS) to evaluate their relationship with addiction and engagement.

2. Material and methods

2.1. Experimental procedure

Participants were recruited through flyers located around a university campus and in gaming-related venues. MMORPG participants were required to have played any MMORPG at least once per month for the preceding 3 month period. Non-MMORPG participants had never played any MMORPGs. Participants were tested individually and completed the Stroop task, provided demographic information and completed the AEQ and DASS21. The experiment took approximately 45 min and participants were reimbursed AUS$20.

2.2. Participants

Forty (15 female) MMORPGers and 20 non-MMORPGers (eight female) participated in the study. All participants had normal or corrected-to-normal vision and were fluent in English. One non-MMORPGer was excluded for self-reported colour blindness. All participants gave informed written consent and all completed the experiment in full.

2.3. Materials

Stimuli were generated and responses recorded using the Inquisit software package (Software, 2009). Tasks were displayed on a Sony Trinitron 22-in. monitor operating at a refresh rate of 100 Hz with a spatial resolution of 1024 × 768 pixels. The monitor was presented at eye level and participants were seated approximately 50 cm away. Participant responses were recorded using a keyboard and four button response pad (Cedrus Cedrus Corporation & CA, 2010). Fifty gaming words were sourced from the *Daedalus Lexicon* (Yee, 2006) and from various popular MMORPG-related websites and were independently rated by MMORPGers not used in the current study ($N = 5$). Twenty words that were rated most highly for frequency and familiarity in MMORPG gameplay were selected. Negative words were selected from previous modified Stroop studies [e.g. 29] and words potentially related to gaming were excluded (e.g., lose, die, kill). Three final word lists comprising 20 negatively valenced (e.g., "lie", "angry", "hate"), 20 neutral, semantically-related household (e.g., "book", "lamp", "vase") and 20 MMORPG (e.g., "raid", "loot", "mobs") words were matched for length, frequency and orthographic neighbourhood (ANOVA; all p's < .05) using the English Lexicon Project (Balota & Hutchison, 2002).

2.3.1. Stroop task

Participants completed three trial blocks, one for each word type. The order of words within each word type was randomized and the order of blocks was counterbalanced among participants. Each word was presented once in each colour (red, blue, green and yellow), resulting in 80 trials per block (240 total). No word or colour was presented more than two times consecutively. Each block was separated by a 30 s break and the next block was initiated by participants. Stimuli were presented in Arial, font size 30, on a black background. Each trial began with a white fixation cross for 1000 ms, followed immediately by a word presented in colour on a black background. The word remained onscreen until the participant responded or 3000 ms had elapsed. No feedback was given during experiment trials. Participants were given 20 practice trials of random 5-letter strings (e.g. WIYFJ) presented in one of the four

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