Failure to utilize feedback causes decision-making deficits among excessive Internet gamers

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ABSTRACT

Internet gaming addiction (IGA) is an increasing mental health issue worldwide. Previous studies have revealed decision-making impairments in excessive Internet gamers (EIGs) with high symptoms of IGA. However, the role of feedback processing in decision-making deficits among EIGs remains unknown. The present study aimed to investigate the effect of feedback processing on decision-making deficits under risk among EIGs, using the Game of Dice Task (GDT) and a modified version of the GDT in which no feedback was provided. Twenty-six EIGs and 26 matched occasional Internet gamers (OIGs) were recruited. The results showed: (a) OIGs performed better on the original GDT than on the modified GDT (no feedback condition); however, EIGs performed similarly on both tasks; (b) EIGs and OIGs performed equally on the modified GDT; however, EIGs chose more disadvantageous options than OIGs on the original GDT; (c) EIGs utilized feedback less frequently on the original GDT relative to OIGs. These results suggest that EIGs are not able to utilize feedback to optimize their decisions, which could underlie their poor decision-making under risk.

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1. Introduction

As the population of Internet users rapidly surges, Internet addiction has become an increasing mental health issue worldwide, raising public concerns (Young, 1998; Block, 2008). Some researchers even regard Internet addiction as the most rapidly growing addiction (Dong et al., 2012). Internet gaming addiction (IGA) is the most prevalent subtype of Internet addiction in many countries (Kuss and Griffiths, 2012), especially in China (Dong et al., 2013a), where over 330 million people play Internet games (China Internet Network Information Center, 2014). Excessive Internet gaming can result in severe consequences, such as a loss of interest in other activities, reduced academic performance, jeopardized interpersonal relationships, and poor health (Petry et al., 2014). As IGA demonstrates behavioral and neural similarities with drug addictions, it is classified as a behavioral addiction (van Holst et al., 2010). Moreover, the American Psychiatric Association included IGA in the DSM system as a topic requiring additional research (American Psychiatric Association, 2013).

The criteria for IGA, such as excessively gaming online at the cost of other important life activities or playing longer than intended, provide several direct and indirect references to maladaptive decision-making in daily life (Dong et al., 2013b; Petry et al., 2014). However, only a few studies have experimentally examined decision-making abilities among individuals with symptoms of IGA or Internet addiction in general, and the findings from these studies are mixed. For example, Pawlikowski and Brand

(2011) observed that excessive Internet gamers (EIGs) showed impaired decision-making abilities on the Game of Dice Task (GDT; Brand et al., 2005). Moreover, using the modified version of Iowa Gambling task (IGT; Bechara et al., 1994), Sun et al. (2009) observed that excessive Internet users generally made more disadvantageous decisions and performed worse than healthy controls. This result is consistent with a study showing that individuals with Internet addiction had deficits in decision making as measured by the IGT (Xu, 2012). However, Ko et al. (2010) reported that college students with Internet addiction performed better on the IGT than healthy controls.

A remaining question is why many people who play Internet games for recreation do not develop IGA, whereas a subset of individuals become addicted to Internet games and persist in playing online even when they have experienced negative consequences of excessive Internet gaming (e.g., impaired academic performance, problems with interpersonal relationships). One possible cause might be a reduced ability to process feedback. Feedback processing is one of the core components of decision-making (Paulus, 2007). Since decision-making is an adaptive process in which individuals have to update and integrate information of potential options, feedback processing and regulation are crucial for optimal decision-making (Weber and Johnson, 2009). Brand (2008) found that healthy volunteers utilize feedback processing to significantly improve their decision-making performance, whereas reduced ability to utilize feedback to optimize decisions has been found in methadone-maintained opiate users (Ersche et al., 2005), patients with opiate dependence (Brand et al., 2008), young adults at risk for stimulant dependence (Stewart et al., 2013) and women with binge eating disorder (Svaldi et al., 2010). However, the role of feedback processing in decision making among EIG with high symptoms of IGA has not been investigated previously.

In the current study, our purpose was to expand upon previous studies and clarify the role of feedback in decision-making among EIGs with high symptoms of IGA. For this purpose, all participants were administered the original GDT (Brand et al., 2005) and a modified version of the GDT (Brand et al., 2008) for which no feedback was provided. We chose the GDT rather than the widely used IGT in this study for two reasons: first, explicit possibilities for gains and losses are not provided in the IGT. Research suggests that EIGs with high symptoms of IGA generally know the consequences of excessive Internet gaming in real life (Pawlikowski and Brand, 2011). For this reason, a decision-making task with explicit winning probabilities and an explicit number of gains and losses, such as the GDT, may be a more sensitive instrument to assess decision-making in this population. Second, the IGT is a relatively complex task that involves many cognitive processes, such as working memory, response inhibition, and rule detection (Dunn et al., 2006), which might make it difficult to pinpoint

the specific mechanism contributing to decision-making deficits among EIGs.

Based on previous findings of a reduced ability to utilize feedback to guide decision-making among individuals with other types of addiction (Ersche et al., 2005; Brand et al., 2008) as well as findings of impaired decision-making performance on the original GDT among EIGs (Pawlikowski and Brand, 2011), we hypothesized that: (1) EIGs would perform worse on the original GDT than occasional Internet gamers (OIGs); and (2) EIGs would fail to utilize feedback from previous phrases to optimize their decision-making performance.

2. Methods

2.1. Participants

Fifty-two college students (26 EIGs and 26 OIGs) were recruited from universities by online advertisement. All participants were right-handed adults. Given the higher prevalence rates of IGA among men (Yen et al., 2012; Ko et al., 2014), in addition to the possibility of gender-related differences that might add additional statistical within-group variance, only males were included in this study. Participants who reported a history of neurological or psychiatric disease as well as any other type of addiction, or current use of any psychotropic medication were excluded. After complete explanation of the study procedure, participants gave informed consent to the experimental procedure, which was approved by the Beijing Normal University institutional review board. Demographic characteristics for all participants are presented in Table 1.

Participants were selected based on their scores on the Chen Internet Addiction Scale (CIAS; Chen et al., 2003) and the amount of time that they spent on Internet gaming each week. Participants were classified as EIGs if they: (1) scored higher than 67 on the CIAS (Ko et al., 2009); (2) played Internet games for at least 14 h a week; and (3) spent the majority of their time (i.e. > 50%) of Internet use on Internet games and kept this intensive use over one year. OIGs played Internet games less than 5 h per week and did not meet CIAS requirements for IA within one year. Thus, EIGs spent significantly more time on Internet gaming weekly relative to OIGs (Table 1). The Internet games that participants played include Defense of the Ancients (12 EIGs and 11 OIGs), League of Legends (5 EIGs and 4 OIGs), World of Warcraft (2 EIGs and 4 OIGs), and Cross Fire (3 EIGs and 5 OIGs). In addition, two EIGs and 2 OIGs played both Defense of the Ancients and League of legends, and 2 EIGs played both Defense of the Ancients and World of Warcraft.

All participants were paid 30 yuan ($\approx$ \$5) for their participation. In addition, to motivate participants to try their best on the tasks, they were informed before the tasks that the 10 best-performing participants would be rewarded with an additional 10 yuan.

2.2. Instruments

2.2.1. The Chen Internet addiction scale

The CIAS consists of 26 items, assessing 5 dimensions of IA symptoms: compulsive use, withdrawal, tolerance, problems of interpersonal relationships, and time management. For each item, a graded response is selected from 1="Rarely" to 4="Always", so that the total score ranges between 26 and 104. The reliability and validity of the CIAS among college students has been demonstrated previously (Chen et al., 2003).

Table 1
Demographic, Internet use lifetime, the CIAS scores and time spent on Internet gaming for EIGs and OIGs.

	EIGs ($n=26$) mean $\pm$ S.D.	OIGs ($n=26$) mean $\pm$ S.D.	t value
Age	22.54 $\pm$ 2.10	22.00 $\pm$ 2.15	0.91
Years of education	15.85 $\pm$ 1.78	15.31 $\pm$ 1.74	1.10
Internet use lifetime (in years)	9.27 $\pm$ 2.84	9.58 $\pm$ 2.75	$-$0.40
CIAS scores	77.96 $\pm$ 7.34	50.46 $\pm$ 10.04	11.28[**]
Time spent on Internet gaming per week (in hours)	17.02 $\pm$ 4.82	0.87 $\pm$ 0.47	17.01[**]

[*]$P < 0.05$; [**]$P < 0.01$.
S.D.=standard deviation; EIGs=excessive Internet gamers; OIGs=occasional Internet gamers; GDT=Game of Dice Task.