Research Paper

Online Attentional Bias Modification Training for Adolescents With Internet Gaming Disorder

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Abstract

Objective: Previous research has shown that attentional bias toward game-related stimuli is a significant factor in the etiology, maintenance, and severity of internet gaming disorder (IGD). Therefore, interventions targeting attentional bias toward game-related stimuli can potentially ameliorate this disorder. The present research aims to examine the effectiveness of online Attentional Bias Modification (ABM) training in reducing game-related attentional bias and the severity of IGD in adolescents.

Methods: In this quasi-experimental study, 33 adolescents with a DSM-5 diagnosis of IGD were sampled and randomly assigned to an experimental group (n=17) and a control group (n=16). The experimental group received online ABM, while no intervention was delivered to the control group. Attentional bias and IGD severity in these two groups were measured at pretest and posttest phases and then at 2 months follow-up via a modified Stroop test and internet gaming disorder-20 (IGD-20) questionnaire. Two-way repeated measures analysis of variance and Fisher’s Least Significant Difference (LSD) were implemented to analyze the data using SPSS software, version 26.

Results: Game-related attentional bias and the severity of IGD were significantly decreased in the participants of the experimental group (P<0.05). The reductions were also maintained at the 2-month follow-up, whereas such reductions were not evident in the control group at any stage (P>0.05).

Conclusion: Given our findings, it can be concluded that online ABM can be an auxiliary or standalone treatment for adolescents with IGD; further research is necessary to understand its mechanisms of effect.

Keywords:
Attentional bias modification, Internet gaming disorder, Modified Stroop test, Online intervention, Adolescents

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1. Introduction

Playing internet games is regarded as one of the most favorite activities for children, adolescents, and young adults, and as long as it is done in a reasonable and controlled amount, it is considered to be an innocuous or even beneficial activity (Wilms, Peterson, & Vangkilde, 2013). Nearly 1.7 billion individuals worldwide play online games routinely (Jeromin, Rief, & Barke, 2016). This behavior goes out of control for 0.2% to 8.7% of this population (Gentile, 2009), which leads to Internet Gaming Disorder (IGD). This disorder is defined as a regular and persistent preoccupation with playing internet games, causing clinical levels of mental distress and functional impairment (Argyriou, Davison, & Lee, 2017). The disorder has temporarily been introduced in the third section of DSM-5 with diagnostic criteria similar to those of gambling and substance use disorder (Jeromin, Nyenhuis, & Barke, 2016). Meanwhile, it requires more study before being recognized as a definite psychological disorder (Pontes & Griffiths, 2015). Also, in the 11th edition of the International Classification of Diseases (ICD-11), published in 2018 by the World Health Organization, gaming disorder is added to the list of mental disorders (Kim et al., 2019).

Earlier studies have shown numerous adverse physical and psychological outcomes arising from IGD. For instance, this disorder causes increased obesity, sleep abnormalities, decreased occupational function or job loss, decreased educational achievements, interpersonal issues, loneliness, heightened stress, lowered well-being, neglecting other entertainments and relationships, depression, and anxiety (Kuss & Griffiths, 2012; Lam, 2014; Sublette & Mullan, 2012). In DSM-5, the main characteristics of IGD are continuous and repetitive playing of internet games and significant distress and dysfunction due to concerns about these games (Association, 2013).

Aside from the diagnostic criteria of IGD, its symptomatology, comorbidity, genetic origins, prognosis, underlying cognitive processes, and neurobiological mechanisms are comparable to gambling and substance use disorders (Yau & Potenza, 2015; Zhang et al., 2016). One of the cognitive processes prominent in the literature regarding the causation and sustenance of addiction symptoms is the selective allocation of attention in processing information. According to previous theories, the attention of individuals with addictive behaviors is focused more on the stimuli associated with their objects of addiction, which is called attentional bias (Metcalf & Pammer, 2011). Extensive empirical evidence supports
this assumption that people with addictive behaviors, including younger adults and adolescents diagnosed with IGD, process addiction-related stimuli with attentional bias (Azarmehr & Ahmadi, 2020; Chia & Zhang, 2020; van Holst et al., 2012).

One of the common methods of evaluating attentional bias is the modified Stroop test (Metcalf & Pammer, 2011). In this test, addiction-related and neutral words, which are leveled in terms of semantic processing characteristics (e.g., number of letters or usage frequency in the language), are presented to people with and without addictions. Similar to the classic Stroop test (Stroop, 1935), these words are displayed in four different colors, and participants should correctly point out every word’s color as fast as possible while ignoring their meanings. Usually, people with addictive disorders indicate the colors of the addiction-related words with more delay compared to normal participants. This delay is because their attention is initially focused on the meaning of the words; therefore, the bias in attention delays the recognition of the colors of the words (Metcalf & Pammer, 2011). Research shows the modified Stroop test as a valid instrument for measuring attentional bias in addictive disorders (Cox, Fadardi, & Pothos, 2006). Studies using the modified Stroop test and similar instruments have shown that game-related attentional bias is evident in both adolescents and adults suffering from IGD (Decker & Gay, 2011; Dong & Potenza, 2014; Kim et al., 2018; van Holst et al., 2012; Zhou, Yuan, & Yao, 2012).

Researchers have altered the methods used to assess attentional bias to develop training through which attentional bias can be manipulated (Mathews & MacLeod, 2002). For example, the aforementioned modified Stroop test can be adjusted in a way that addiction-related stimuli and neutral ones are presented in pairs (an addiction-related one next to a neutral one, placed randomly), while the participants are asked to only point out the colors of neutral stimuli. This measure acts as training, and through repetition, participants learn not to focus their attention on addiction-related stimuli; therefore, their attentional bias would be reduced. Studies have demonstrated that such attentional bias modification (ABM) methods are effective in a variety of mental health problems, including depression, anxiety, gambling, and substance use disorder (Browning, Holmes, & Harmer, 2010; Heitmann, et al., 2018; MacLeod & Clarke, 2015; Witekand et al., 2019).

As the association between IGD and attentional bias has been observed in previous research, investigating the effects of ABM interventions on IGD could be the next step in understanding the mechanism and treatment of this disorder. So far, only one study has been conducted for this purpose. Although its results indicate significant effects of ABM on IGD, their research had several limitations (Rabinovitz & Nagar, 2015); namely, only adult males were recruited as participants, only one session of ABM was carried out, and the permanency of the intervention effects was not examined through follow-up assessments. Moreover, similar to most studies that examine attentional bias in people with IGD, the research was also conducted in an experimental setting, thus decreasing the generalizability of the results. Online studies benefit from higher external validity and can be accessible to a wider variety of participants as they contribute to the study from home (Denissen, Neumann, & Van Zalk, 2010).

Considering the need for more research about IGD as a newly introduced disorder in the field of psychopathology, this study aims to evaluate the outcomes of internet-delivered ABM training on game-related attentional bias and IGD severity in adolescents suffering from this mental health problem. In light of the research background, this study hypothesizes that delivering online ABM to adolescents with IGD would decrease their game-related attentional bias and ameliorate their disorder.

2. Participants and Methods

Study participants

In this quasi-experimental study, the target population was all the adolescents in the city of Tehran, Iran, according to the following inclusion criteria:

a) being diagnosed with IGD according to DSM-5;

b) being in the age range of 12 to 17;

c) having the informed consent to contribute to the study.

Meanwhile, the exclusion criteria were defined as follows:

a) suffering from serious medical conditions that necessitated prompt treatment;

b) comparability of other DSM-5 disorders;

c) engaging in any type of psychotherapy;

d) leaving the study before the completion of the participation.
The convenience method of sampling was used by visiting multiple schools in different locations in Tehran and asking their staff to inform their students about the website of the study. There, they could familiarize themselves with the research and participate in it. Social media platforms and online forums related to gaming were also used to recruit participants. A total of 1217 adolescents filled the Internet Gaming Disorder-20 (IGD-20) questionnaire, from which 67 participants scored 72 or higher. They were called via telephone to be interviewed for the diagnosis of psychological disorders. The required sample size was calculated using power analysis with the G*Power software while considering the participants’ dropout. Thirty-eight participants diagnosed with IGD, without comorbidities, and under no psychotherapy were recruited and randomly assigned (using a computer random number generator) to experimental and control groups. Five participants terminated their participation before the completion of the study; therefore, their data were excluded from the analysis. Ultimately, the data gathered from 33 adolescents (9 females, 16 controls) were used for the analysis.

**Study measures**

**Modified Stroop Test**

Game-related attentional bias was evaluated using the modified Stroop test. For the current study, the development of this test was based on the theoretical guidelines and methodological recommendations of Cox et al. (2006). Accordingly, the two series of game-related words and neutral words were selected in equal amounts, and none of them were representative of a color. Also, the words were leveled in terms of the number of letters. However, because no reference is available for the usage frequency of Persian words, the authors had to consider this criterion based on their judgments. Brown et al. (2014) have demonstrated that the English version of this test has good test-retest reliability (with the correlation coefficient ranging from 0.65 to 0.74) and internal consistency (with the split-half correlation ranging from 0.83 to 0.89). Khodadadi et al., (2014) and Rasti and Taghavi (2006) evaluated and verified the psychometric properties of the IGD’s Persian version, with its Cronbach α ranging from 0.83 to 0.94, and its test-retest correlation coefficient ranging from 0.80 to 0.91.

**Internet Gaming Disorder-20 (IGD-20)**

The severity of IGD symptoms in participants was assessed using IGD-20, developed by Pontes, et al., (2014). This questionnaire includes 20 items divided into 6 sub-scales, named salience (SA), Mood Modification (MM), tolerance (TO), withdrawal (WI), conflict (CO), and relapse (RE). A 5-point Likert scale is used for scoring the questionnaire’s items, and the total score is from 20 to 100. The structural validity of the questionnaire was confirmed via confirmatory factor analysis. Additionally, the correlations of its scores with weekly hours of gameplay and the diagnostic criteria of IGD confirmed its criterion validity. Also, the Cronbach α of 0.88 demonstrated good internal consistency (Pontes et al., 2014). Studies recruiting non-adult samples have shown that this instrument can be implemented for adolescents (Fuster, et al., 2016; Shu et al., 2019). In their study of the psychometric properties of the Persian version of IGD-20, Vahidi, et al., (2019) demonstrated good criterion and structural validity, test-retest reliability (r=0.95), and internal consistency (Cronbach α=0.91).

**Attentional Bias Modification (ABM)**

ABM was first developed and successfully implemented in 2002 to reduce threat-related attentional bias (MacLeod, et al., 2002). Since then, ABM has extensively been used for reducing attentional bias in various mental health problems (Browning et al., 2010; Heitmann et al., 2018; Wittekind et al., 2019). In the present study, the design of the ABM was adapted from a training developed by Ziaeefadardi, Cox, and Yazdi (2016) for modifying drug-related attentional bias, using the structure of a modified Stroop test. Four sets of stimuli (game-related words and pictures, and neutral words and pictures) were presented to the participants, and their task was to correctly point out each stimulus’ background color or border color as fast as possible.

A sample of 69 unbiased individuals was asked to rate the potential stimuli for the training (64 words and 64 pictures; half were related to gaming, e.g., joysticks, consoles, popular games, and their characters, and half were neutral, e.g., doors, windows and other parts of buildings) from 0 to 100 based on their relevance to gaming. A total of 16 lexical and 16 pictorial stimuli that received the highest and lowest ratings were selected for the game-related and neutral stimuli sets, respectively. In the first half of the training, each stimulus was separately and randomly shown to the participants, and they were asked to indicate the color of the backgrounds or the borders of the stimuli without considering their contents. In the second half of the training, the stimuli were displayed in pairs (a game-related stimulus along with a neutral stimulus, with random placements), and the participant’s task was directing their attention away from the game-related stimulus and indicating the neu-
The successful completion of each session depended on the total number of each participant’s errors and the response time for all of the stimuli in that session. The details of each training session are presented in Table 1.

### Study procedure

The experimental group received ABM, while the control group received no interventions. Before the intervention, all participants completed the modified Stroop test (IGD-20 was filled during sampling). Eight sessions of online ABM were conducted every two days, and reassessments with modified Stroop test and IGD-20 were carried out once after the last session of intervention (or after 16 days for the participants who did not receive any intervention) and once again after 2 months.

The study was conducted according to all ethical standards. The research protocol was developed in compliance with the ethical guidelines defined in the Declaration of Helsinki in 1975 (as revised in 2000). All participants and their mothers were informed about the subject, purpose, and procedure of the research prior to their formal declaration of consent to participate. Also, it was clarified to all participants that their information remains anonymous, and they have the option to discontinue their participation at any time. In the end, the participants and their mothers were thanked for contributing to the study, and a simplified explanation of the results and their meanings were delivered to them.

### Statistical analysis

Two-way repeated measures analysis of variance (ANOVA) was used in combination with Fisher’s least significant difference to analyze the data gathered from the evaluations. A comparison of the two groups at baseline was carried out for the quantitative and the qualitative data using independent samples t-test and chi-squared test, respectively. These analyses were done using SPSS software v. 26.

### 3. Results

The analysis of the participants’ demographic information (gender, age, and educational level) and the data regarding their weekly hours of gameplay and the age of first gameplay revealed no significant differences between the participants in the experimental and control groups (all P’s>0.05). The details of these comparisons are provided in Table 2.

To test the hypotheses of the research regarding the effectiveness of ABM on game-related attentional bias and IGD severity, the experimental and control groups’ differences in their scores on the modified Stroop test and IGD-20 at three measurements were evaluated via 2-way repeated measures analysis of variance (with assumed sphericity). Group was defined as an inter-subject factor in the analysis, with time as an intra-subject factor and the scores in the modified Stroop test and IGD-20 questionnaire (Table 3) as dependent variables. As demonstrated in Table 4, the analysis results confirmed the statistical significance of time, group, and time*group interaction.

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**Table 1. Details of each session of attentional bias modification training**

| Sessions | Stimuli | Criteria of Passing |
|----------|---------|---------------------|
|          | Type    | Appearance | Color | Location | Response Time (s) | Number of Errors |
| 1        | Picture | Single     | Background | <1 | <4 |
| 2        | Word    | Single     | Background | <1 | <4 |
| 3        | Picture | Single     | Border   | <1 | <3 |
| 4        | Word    | Single     | Border   | <1 | <3 |
| 5        | Picture | Paired    | Background | <1 | <3 |
| 6        | Word    | Paired     | Background | <1 | <3 |
| 7        | Picture | Paired    | Border   | <1 | <2 |
| 8        | Word    | Paired     | Border   | <1 | <2 |

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effects on both dependent variables (all \( P < 0.05 \)), i.e., the experimental and control groups’ scores in the modified Stroop test and IGD-20 have been significantly different at three stages of measurements.

After the significance of time, group, and time*group effects on attentional bias and IGD severity was confirmed. Pairwise comparisons using Fisher’s LSD were conducted to detect the areas in which significant changes had occurred. The post hoc test results revealed that only the experimental group had experienced significant change, as their scores in the modified Stroop test had significantly been reduced from the pretest stage to the posttest assessment and from the pretest to 2 months follow-up evaluation (Table 5). The IGD-20 scores of the experimental group were also reduced from the pretest stage to the posttest assessment and from the pretest to 2 months follow-up evaluation (all \( P < 0.05 \)). Meanwhile, the control group’s scores on the modified Stroop test and IGD-20 did not change significantly between measurements at multiple stages (all \( P > 0.05 \)).

4. Discussion

The present study was the first research initiative for evaluating the effects of ABM on game-related attentional bias and IGD severity in adolescents suffering from such disorder. In this study, online ABM was delivered to an experimental group, and its effects were examined via the comparison of attentional bias and IGD severity in the participants of the experimental and control groups.

The findings demonstrated that ABM was successful at reducing the game-related attentional bias of adolescents diagnosed with IGD, and this was evidenced

### Table 2. Participants’ baseline demographic information and clinical characteristics

| Variables                  | Experimental | Control | Statistics | \( P \)  |
|----------------------------|--------------|---------|------------|---------|
| Age (y)                    | 14.38±1.76   | 14.79±1.05 | t=0.80     | 0.42    |
| Gender (male - female)     | 11 - 6       | 13 - 3   | \( \chi^2=1.13 \) | 0.28    |
| Education (middle school - high school) | 7 - 10       | 8 - 8    | \( \chi^2=0.25 \) | 0.65    |
| First gameplay (age in years) | 9.13±2.41  | 8.46±1.92 | t=0.87     | 0.38    |
| Weekly gameplay (h)        | 23.69±11.30  | 21.28±9.84 | t=0.65     | 0.51    |

### Table 3. Participants’ Mean±SD scores in the studied variables

| Variables                  | Measures                              | Pretest   | Posttest  | Follow-up | Pretest  | Posttest  | Follow-up |
|----------------------------|---------------------------------------|-----------|-----------|-----------|----------|-----------|-----------|
| Attention bias             | Modified Stroop test                  | 3257.63±539.11 | 1184.37±314.61 | 1375.19±296.86 | 3104.77±467.14 | 3354.31±570.35 | 3013.84±541.08 |
| Internet Gaming Disorder (IGD) severity | IGD-20                             | 80.68±16.22 | 56.82±14.81 | 55.36±14.17 | 79.21±17.31 | 76.89±16.63 | 78.31±16.74 |
|                            | Salience Mood modification             | 4.48±1.03 | 3.11±0.82 | 3.04±0.93 | 4.54±1.15 | 4.50±1.01 | 4.67±0.98 |
|                            | Tolerance                             | 4.01±0.93 | 3.39±0.95 | 3.07±0.90 | 3.88±0.98 | 4.09±1.06 | 3.76±0.89 |
|                            | Withdrawal                            | 3.69±0.93 | 2.66±0.76 | 2.48±0.79 | 3.75±0.90 | 3.88±0.92 | 3.81±0.83 |
|                            | Conflict                              | 4.21±0.99 | 2.85±0.78 | 2.94±0.82 | 4.10±0.97 | 4.16±1.02 | 4.02±0.91 |
|                            | Relapse                               | 3.94±0.86 | 2.41±0.71 | 2.35±0.69 | 3.97±0.98 | 3.62±0.79 | 3.49±0.81 |
in the significant decrease of the modified Stroop test scores of the experimental group. This significant change was observed while comparing the pretest stage and the posttest assessment, and it was maintained at the 2-month follow-up, indicating the relative stability of the intervention effects. These results are consistent with the research background demonstrating the effective manipulation of attentional bias via ABM training (Arsanjani, et al., 2020; Heitmann et al., 2018; Wittekind et al., 2019) and its compatibility with internet-based implementation (Denissen et al., 2010). Contrary to this study’s findings, Wen et al. (2020) concluded that online ABM may not effectively reduce attentional bias in people with addictive behaviors. In explaining these contrary results, it could be said that the insignificant results of the study by Wen et al. (2020) could be the result of a large number of participants dropping out and the use of very few training sessions. In this study, the stimuli used for the development of the modified Stroop test and the ABM training were different; therefore, the

| Table 4. Results of 2-way repeated measures analysis of variance for the study’s variables |
|-----------------------------------------------|----------------|----------------|----------------|----------------|----------------|
| Variables                                     | Measures       | Source       | F       | df  | P Value | η²  |
| Attentional bias                              | Modified Stroop test | Group       | 89.53  | 1, 31 | < 0.001 | 0.66 |
|                                               | Time           | Group*Time   | 118.96 | 2, 62 | < 0.001 | 0.78 |
|                                               | Time           | Time         | 64.32  | 2, 62 | < 0.001 | 0.59 |
| Internet Gaming Disorder (IGD) severity       | Group          | Group        | 7.61   | 1, 31 | < 0.01  | 0.37 |
|                                               | Time           | Group*Time   | 10.89  | 2, 62 | < 0.001 | 0.54 |
|                                               | Time           | Group        | 7.96   | 1, 31 | < 0.01  | 0.38 |
|                                               | Time           | Group*Time   | 5.84   | 2, 62 | < 0.01  | 0.24 |
|                                               | Time           | Group        | 9.57   | 2, 62 | < 0.001 | 0.46 |
|                                               | Time           | Group*Time   | 7.44   | 1, 31 | 0.01   | 0.33 |
| Internet Gaming Disorder (IGD) severity       | Group          | Group        | 10.11  | 1, 31 | < 0.01  | 0.39 |
|                                               | Time           | Group*Time   | 4.91   | 2, 62 | 0.01   | 0.17 |
|                                               | Time           | Group        | 9.02   | 2, 62 | < 0.001 | 0.42 |
|                                               | Time           | Group*Time   | 7.71   | 1, 31 | < 0.01  | 0.36 |
|                                               | Time           | Group        | 5.53   | 2, 62 | < 0.01  | 0.21 |
|                                               | Time           | Group*Time   | 9.29   | 2, 62 | < 0.001 | 0.43 |
|                                               | Time           | Group        | 7.88   | 1, 31 | < 0.01  | 0.36 |
|                                               | Time           | Group        | 5.02   | 2, 62 | < 0.01  | 0.19 |
|                                               | Time           | Group*Time   | 8.98   | 2, 62 | < 0.001 | 0.41 |
|                                               | Time           | Group        | 7.40   | 1, 31 | 0.1    | 0.32 |
|                                               | Time           | Group*Time   | 5.67   | 2, 62 | < 0.01  | 0.22 |
|                                               | Time           | Group        | 8.91   | 2, 62 | < 0.001 | 0.40 |
effects of the intervention were generalized to new and untrained stimuli. In other words, the observed results were not due to response bias.

Another finding of the study was that, in addition to reducing game-related attentional bias, ABM was also successful at ameliorating IGD severity in adolescents suffering from this disorder. This was observed by the significant decrease in the experimental group’s scores on the IGD-20 questionnaire at the posttest stage compared to the pretest. ABM effects on IGD severity were maintained at a 2-month follow-up, which confirmed the relative reliability of these effects. These results suggest that deficits in the cognitive process of selective attention are crucial in IGD’s etiology, sustenance, and exacerbation. Meanwhile, the treatments that target such deficits may have therapeutic effects on this psychological disorder. Confirming the study’s hypothesis, these findings add to the growing research suggesting that IGD is essentially similar to other addictive disorders like substance use disorder and gambling disorder (Yau & Potenza, 2015; Zhang et al., 2016), and ABM can be suitable as an auxiliary or standalone treatment for this disorder (Rabinovitz & Nagar, 2015). Nevertheless, this was only one of the first attempts at studying the potential benefits of this novel treatment on adolescents with IGD. Examining its replicability and mechanisms of effect is necessary for future research.

Certain limitations should be noted while conducting this study. First, this research was an online study, and in addition to the ABM intervention, the process of clinical assessment of the participants was conducted online (except for the DSM-5 diagnostic interview via telephone) and indirectly. Therefore, only self-report measurement of the severity of IGD was possible, whereas evaluation through behavioral assessment and clinical examination might provide a more thorough evaluation. Accordingly, it is recommended to use additional assessment measures in future studies. Another limitation was the short-term follow-up of two months, which, although it confirms the relative reliability of the observed results,

### Table 5. Results of fisher’s least significant difference as mean differences between different measurements

| Variables   | Measures        | Groups   | Pretest with posttest | Pretest with follow-up | Posttest with Follow-up |
|-------------|-----------------|---------|-----------------------|------------------------|-------------------------|
| Attentional bias | Modified Stroop test | Experimental | 2073.26* | 1882.44* | -190.82 |
|             |                 | Control   | -249.54 | 90.93 | 340.14 |
| IGD severity | IGD-20          | Experimental | 23.86* | 25.32* | 1.46 |
|             |                 | Control   | 0.52 | 0.90 | 0.38 |
| Salience    |                 | Experimental | 1.37* | 1.44* | 0.07 |
|             |                 | Control   | 0.04 | -0.13 | -0.17 |
| Mood modification |             | Experimental | 0.62 | 0.94* | 0.32 |
|             |                 | Control   | -0.21 | 0.12 | 0.33 |
| Tolerance   |                 | Experimental | 1.03* | 1.21 | 0.18 |
|             |                 | Control   | -0.13 | -0.06 | 0.07 |
| Withdrawal  |                 | Experimental | 1.36* | 1.27* | -0.09 |
|             |                 | Control   | -0.06 | 0.08 | -0.14 |
| Conflict    |                 | Experimental | 1.22* | 1.13* | -0.09 |
|             |                 | Control   | 0.17 | -0.20 | -0.37 |
| Relapse     |                 | Experimental | 1.53* | 1.59* | 0.06 |
|             |                 | Control   | 0.35 | 0.48 | 0.13 |

* Significant mean difference (P<0.05).
does not guarantee long-term stability. Therefore, we suggest longer periods of follow-up in future studies. It is noteworthy to mention that the control group received no placebo interventions in this study; therefore, the effect of the time spent by the experimental group in front of the computer for doing the training was not controlled. We recommend that in future studies, placebo training similar to ABM be developed and delivered to the control group to evaluate the replicability of these results after controlling the effect of the aforementioned variable.

5. Conclusion

Notwithstanding the aforementioned limitations, it could be concluded that the present study provided initial evidence demonstrating that online ABM can effectively reduce the attentional bias of adolescents with IGD toward game-related stimuli and successfully ameliorate the severity of their disorder. The clinical and practical implication of this study is that ABM can be considered a potential auxiliary or standalone treatment for IGD. Considering that IGD is a newly introduced disorder in the field of psychopathology, and a deeper understanding of its etiology and treatment requires more research, it is recommended that interventions targeting attentional bias, like ABM, be the subject of more research and evaluation.

Ethical Considerations

Compliance with ethical guidelines

This study was conducted in compliance with all ethical standards. The study’s protocol was designed according to all the ethical guidelines defined in the Declaration of Helsinki in the year 1975 (as revised in the year 2000). Moreover, all participants were informed that the data obtained from their participation in the study stays anonymous and confidential, and they have the option to terminate their participation at any point during the study.

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Authors’ contributions

All authors equally contributed in preparing this article.

Conflicts of interest

The authors declared no conflicts of interest.

References

Argyriou, E., Davison, C. B., & Lee, T. (2017). Response inhibition and Internet Gaming Disorder: A meta-analysis. Addictive behaviors, 71, 54-60. [DOI:10.1016/j.addbeh.2017.02.026] [PMID]

Arsanjani, M., Zargham Hajebi, M., & Mirzohosseini, H. (2020). The effectiveness of cognitive bias Modification intervention on reducing attention bias of students with test anxiety. Education Strategies in Medical Sciences, 13(4), 325-334. [Link]

American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (DSM-5®). Virginia: American Psychiatric Association. [Link]

Azarmehr, R., & Ahmadi, E. (2020). [The role of anxiety sensitivity and attentional control in predicting the tendency toward addiction in youth (Persian)]. Iranian Journal of Health Psychology, 2(2), 45-50. [Link]

Brown, H. M., Eley, T. C., Broeran, S., Macleod, C., Rineck, M., & Hadwin, J. A., et al. (2014). Psychometric properties of reaction time based experimental paradigms measuring anxiety-related information-processing biases in children. Journal of Anxiety Disorders, 28(1), 97-107. [DOI:10.1016/j.janxdis.2013.11.004] [PMID]

Browning, M., Holmes, E. A., & Harmer, C. J. (2010). The modification of attentional bias to emotional information: A review of the techniques, mechanisms, and relevance to emotional disorders. Cognitive, Affective, & Behavioral Neuroscience, 10(1), 8-20. [DOI:10.3758/CABN.10.1.8] [PMID]

Chia, D. X., & Zhang, M. W. (2020). A scoping review of cognitive bias in internet addiction and Internet Gaming Disorders. International Journal of Environmental Research and Public Health, 17(1), 373. [DOI:10.3390/ijerph17010373] [PMID]

Cox, W. M., Fadardi, J. S., & Pothis, E. M. (2006). The addiction-stroop test: Theoretical considerations and procedural recommendations. Psychological bulletin, 132(3), 443–476. [DOI:10.1037/0033-2909.132.3.443] [PMID]

Decker, S. A., & Gay, J. N. (2011). Cognitive-bias toward gambling-related words and disinhibition in World of Warcraft gamers. Computers in Human Behavior, 27(2), 798-810. [DOI:10.1016/j.chb.2010.11.005]

Denissen, J. J., Neumann, L., & Van Zalk, M. (2010). How the internet is changing the implementation of traditional research methods, people’s daily lives, and the way in which developmental scientists conduct research. International Journal of Behavioral Development, 34(6), 564-575. [DOI:10.1177/016502541038746]

Dong, G., & Potenza, M. N. (2014). A cognitive-behavioral model of Internet Gaming Disorder: Theoretical underpinnings and clinical implications. Journal of Psychiatric Research, 58, 7–11. [PMID]

Fuster, H., Carbonell, X., Pontes, H. M., & Griffiths, M. D. (2016). Spanish validation of the Internet Gaming Disorder-20 (IGD-20) test. Computers in Human Behavior, 56, 215-224. [DOI:10.1016/j.chb.2015.11.050]

Gentile, D. (2009). Pathological video-game use among youth ages 8 to 18: A national study. Psychological Science, 20(5), 594-602. [PMID]

Heitmann, J., Bennik, E. C., van Hemel-Ruiter, M. E., & de Jong, P. J. (2018). The effectiveness of attentional bias modification for substance use disorder symptoms in adults: A systematic review. Systematic Reviews, 7(1), 160. [DOI:10.1186/s13643-018-0822-6] [PMID] [PMCID]
Kuss, D. J., Griffiths, M. D., Karila, L., & Billieux, J. (2014). Internet addiction: A systematic review of epidemiological research for the last decade. *Current Pharmaceutical Design, 20*(25), 4026-4052. [DOI:10.2174/1381612813199900617] [PMID]

Jeromin, F., Nyenhuis, N., & Barke, A. (2016). Attentional bias in excessive Internet gamers: Experimental investigations using an addiction Stroop and a visual probe. *Journal of Behavioral Addictions, 5*(1), 52-40. [PMID] [PMCID]

Jeromin, F., Rief, W., & Barke, A. (2016). Using two web-based addiction Stroops to measure the attentional bias in adults with Internet Gaming Disorder. *Journal of Behavioral Addictions, 5*(4), 666-673. [PMID] [PMCID]

Faizy Derakhshi, M. R., Kodadad, M., Movahedi, Y., & Ahmadi, A. (2014). Assessment of attention bias in the cognitive processing of neutral and emotional words Using semantic Stroop test. *Shenali Journal of Psychology and Psychiatry, 1*(1), 23-30. [Link]

Kim, M., Lee, T. H., Choi, J. S., Kwak, Y. B., Hwang, W. J., & Kim, T., et al. (2019). Dysfunctional attentional bias and inhibitory control during anti-saccade task in patients with Internet Gaming Disorder: An eye tracking study. *Progress in Neuro-Psychopharmacology and Biological Psychiatry, 35*, 109717. [PMID]

Kim, S. N., Kim, M., Lee, T. H., Lee, J. Y., Park, S., & Park, M., et al. (2018). Increased attentional bias toward visual cues in Internet Gaming Disorder and obsessive-compulsive disorder: An event-related potential study. *Frontiers in Psychiatry, 9*, 315. [PMID] [PMCID]

Kuss, D. J., & Griffiths, M. D. (2012). Internet gaming addiction: A systematic review of empirical research. *International Journal of Mental Health and Addiction, 10*(2), 278-296. [DOI:10.1007/s11469-011-9318-5]

Lam, L. T. (2014). Internet gaming addiction, problematic use of the internet, and sleep problems: A systematic review. *Current Psychiatry Reports, 16*(4), 444. [PMID]

MacLeod, C., & Clarke, P. J. F. (2015). The attentional bias modification approach to anxiety intervention. *Clinical Psychological Science, 3*(1), 58-78. [DOI:10.1177/2167702614560749]

MacLeod, C., Rutherford, E., Campbell, L., Ebbsworth, G., & Holker, L. (2002). Selective attention and emotional vulnerability: Assessing the causal basis of their association through the experimental manipulation of attentional bias. *Journal of Abnormal Psychology, 111*(1), 107-123. [DOI:10.1037/0021-843X.111.1.107] [PMID]

Mathews, A., & MacLeod, C. (2002). Induced processing biases can have causal effects on anxiety. *Cognition & Emotion, 16*(3), 331-354. [DOI:10.1080/02699930143000518]

Metcalfe, O., & Pumper, K. (2011). Attentional bias in excessive massively multiplayer online role-playing gamers using a modified Stroop task. *Computers in Human Behavior, 27*(5), 1942-1947. [DOI:10.1016/j.chb.2011.05.001]

Pontes, H. M., & Griffiths, M. D. (2015). Internet Gaming Disorder and its associated cognitions and cognitive-related impairments: A systematic review using PRISMA guidelines. *Revista Argentina de Ciencias del Comportamiento, 7*(3), 102-118. [Link]

Pontes, H. M., Kiraly, O., Demetrovics, Z., & Griffiths, M. D. (2014). The conceptualisation and measurement of DSM-5 Internet Gaming Disorder: The development of the IGD-20 Test. *PloS One, 9*(10), e110137. [PMID]

Rabinovitz, S., & Nagar, M. (2015). Possible end to an endless quest? Cognitive bias modification for excessive multiplayer online gamers. *Cyberpsychology, Behavior, and Social Networking, 18*(10), 581-587. [DOI:10.1089/cyber.2015.0173] [PMID]

Rasti, A., & Taghavi, M. R. (2006). Implicit memory bias for negative information in patients with generalized anxiety disorder and major depressive disorder and normal individuals (Persian). *Advances in Cognitive Sciences, 8*(5), 25-32. [Link]

Shu M, Y., Ivan Jacob, A. P., Meng Xuan, Z., & Anise M S, W. (2019). Psychometric validation of the Internet Gaming Disorder-20 Test among Chinese middle school and university students. *Journal of Behavioral Addictions, 8*(2), 295-305. [PMID] [PMCID]

Stroop, J. R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology, 18*(6), 643-662. [DOI:10.1037/h0054651]

Sublette, V. A., & Mullan, R. (2012). Consequences of play: A systematic review of the effects of online gaming. *International Journal of Mental Health and Addiction, 10*(1), 3-23. [DOI:10.1007/s11469-010-9304-3]

Vahidi, M., Zamanzadeh, V., Musavi, S., Janani, R., & Namdar, A. H. (2019). Validation of the Persian version of the Internet Gaming Disorder-20 Test among the students of Tabriz University of Medical Sciences (Persian). *Journal of Torbat Heydariyeh University of Medical Sciences, 7*(1), 15-26. [Link]

van Holst, R. J., Lemmens, J. S., Valkenburg, P. M., Peter, J., Veltnam, D. J., & Goudriaan, A. E. (2012). Attentional bias and disinhibition toward gaming cues are related to problem gaming in male adolescents. *The Journal of Adolescent Health: Official Publication of the Society for Adolescent Medicine, 50*(6), 541-546. [PMID]

Wen, S., Larsen, H., Boffo, M., Grasman, R., Prontk, T., & van Wijngaarden, J., et al. (2020). Combining web-based attentional bias modification and approach bias modification as a self-help smoking intervention for adult smokers seeking online help: Double-Blind randomized controlled trial. *JMIR Ment Health, 7*(5), e16342. [PMID]

Wilms, I. L., Petersen, A., & Angvikilde, S. (2013). Intensive video gaming improves encoding speed to visual short-term memory in young male adults. *Acta Psychologica, 142*(1), 108-118. [DOI:10.1016/j.actpsy.2012.11.003] [PMID]

Wittekind, C. E., Bierbrodt, J., Lüdecke, D., Feist, A., Hand, I., & Moritz, S. (2019). Cognitive bias modification in problem and pathological gambling using a web-based avoidance task: A pilot trial. *Psychiatry Research, 272*, 171-181. [DOI:10.1016/j.psychres.2018.12.075] [PMID]

Yau, Y. H., & Potenza, M. N. (2015). Gambling disorder and other behavioral addictions: Recognition and treatment. *Harvard Review of Psychiatry, 23*(2), 134–146. [PMID] [PMCID]

Zhang, Y., Ndasauka, Y., Hou, J., Chen, J., Yang, L. Z., & Wang, Y., et al. (2016). Cue-induced behavioral and neural changes among excessive internet gamers and possible application of cue exposure therapy to Internet Gaming Disorder. *Frontiers in Psychology, 7*, 675. [PMID] [PMCID]

Zhou, Z., Yuan, G., & Yao, J. (2012). Cognitive biases toward Internet game-related pictures and executive deficits in individuals with an Internet game addiction. *PloS One, 7*(11), e49861. [PMID]

Ziaee, S. S., Fadardi, J. S., Cox, W. M., & Yazdi, S. A. (2016). Effects of attention control training on drug abusers’ attentional bias and treatment outcome. *Journal of Consulting and Clinical Psychology, 84*(10), 861-873. [PMID]
Nasiry, S., & Noori, M. (2022). Online ABM for Adolescents with IGD. JCP, 10(2), 79-90
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