

Adolescent Online Gaming Disorder, Comorbidity, Neural Mechanism and Psychotherapy of Internet Gaming Disorder

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Abstract: Due to the sharp increase in the number of online game addicts, this paper systematically reviewed the neural mechanism, comorbidity, and psychotherapy of adolescent online game addicts. Online gaming disorder (IGD) is a new concept, which has been studied in many aspects in different literature. The analysis of existing research results shows that inhibition control and risk behaviors of adolescents with online gaming addiction are increased, and depression and dissociative experience is a common comorbidity of Internet game disorder. Single psychotherapy cannot effectively treat adolescents with online gaming addiction. Comprehensive psychological intervention based on cognitive behavior therapy is more effective for adolescent participants. This paper aims to analyze the existing literature, systematically review the neural mechanism, comorbidity, and psychotherapy of adolescent online game disorder, and provide guidance for future research in this emerging field. At the end of this paper, these suggestions will help scholars find problems and gaps that have not been fully explored, and these problems and gaps can become the basis for further research.

Keywords: Internet gaming disorder, Inhibition control, Reward-seeking mechanism, Comorbidity, PIPATIC psychotherapy program

1. Introduction

Online games have become popular leisure activities around the world, but excessive use of video games has negative impacts on personal life.

In addition to the time and energy spent by individuals playing video games, the physical and mental health of individuals who overuse online games has also been seriously affected. Patients with online game disorder (IGD) usually feel irritable and depressed due to excessive use of online games, which may lead to psychological diseases.

The structural characteristics of the game, the motivation of online game players, the ability to deal with negative emotions, social interaction and immersion, and the sense of achievement obtained in the game are generally considered the main factors of online gaming disorder [1]. In addition, personality characteristics are also considered to be the decisive factor in determining internet gaming disorder or excessive use of online games [2]. Compared with extroverts, introverts are more likely to become addicted, mainly because introverts are used to using online virtual worlds to establish

social relationships. Introverts often use virtual environments to create new lifestyles, and these activities may make individuals more dependent on the use of the Internet. In addition, since the unstructured program of the virtual environment, individuals with a low sense of responsibility showed more Internet use time. The previous meta-analysis studied the relationship between five personality types and internet gaming disorder, indicating that online gaming addiction is negatively related to extraversion, responsibility, pleasure, and openness to new things [3]. Many previous studies have focused on the personal factors and five personality factors of Internet game disorder. However, few literatures discuss the neural mechanism and comorbidity of online gaming addiction, as well as its psychotherapy. Therefore, this paper attempts to explore the neural mechanism, comorbidity, and effective treatment of the online game disorder.

There are five sections to this article: 1. the introduction mainly introduces the research background, content, and significance. 2. Risk factors and comorbidity of internet addiction. 3. Treatment of online game addiction. 4. Research limitations and future directions. 5. The conclusion part will reaffirm the research results and look forward to the future.

2. Neurological Mechanism and Comorbidity Factors of Internet Gaming Disorder

2.1. IGD (internet gaming disorder) Neural Mechanism: Inhibition Control and Reward-Seeking Mechanism

It is necessary to discuss the potential neural mechanism of IGD (internet gaming disorder) based on its comorbidity and clinical importance.

Research shows that the dual system theory of adolescent brain development believes that the imbalance between the decline of cognitive control ability and the increase of reward-seeking is the neural mechanism of online game disorder [4]. Neuroscience research shows that online game disorder is related to poor inhibition and control ability [5]. Poor self-control may increase the risk of individual addiction to online games. The color Stroop task for adolescents with Internet gaming disorder (IGD) showed a longer reaction time to game-related words and made more errors in the Stroop task [6]. Some functional magnetic resonance imaging studies found that the activation of the anterior cingulate cortex was activated during color Stroop tasks in patients with Internet game disorder, and the anterior cingulate cortex (ACC) was responsible for the inhibition and control of the brain. Previous studies have shown that the executive function of IGD patients is impaired. In addition, diffusion tensor imaging, and magnetic resonance imaging showed that the decrease in the volume of left Anterior cingulate cortex gray matter in adolescents with online gaming addiction may lead to the interruption of executive function and the researchers observed an increase in glucose metabolism in the orbitofrontal cortex (impulse control) in adolescents with online gaming addiction [7].

A recent research report on adolescent internet addiction and response inhibition and reward-seeking recruited 34 adolescents with IGD (internet gaming disorder) for go/no go tasks and questionnaires, and the statistical results of the experimental group were compared with 32 healthy participants of age, sex, and education level. The difference in scores between IGD adolescents and the control group showed significantly different response inhibition and reward-seeking patterns. In addition, the questionnaire results show that adolescents with IGD symptoms are more sensitive to new things, more impulsive, and have weak inhibition control of negative consequences. The correlation analysis of the results of go/no go tasks also showed that the decrease of IGD symptom accuracy in go/no go tasks was related to the increase of risk decision-making tendency [8]. The above results indicate that it is difficult for adolescents with IGD to avoid obtaining rapid and achievable stimulation and high-risk behaviors, and the dysfunction of inhibition control and reward pathway system are risk factors for IGD.

2.2. Comorbidity of Internet Gaming Disorder

Adolescents with Internet gaming disorder have emotional regulation defects due to their special period of psychological development.

Previous studies have shown that 9.2% of IGD adolescents have nonpsychotic anxiety, 15.1% have depression and 10.9% have impulsive symptoms [9]. For clinical diagnosis and psychological intervention of online gaming addiction, depression is a key factor in predicting the symptom score of Internet game disorder. Internet game disorder is considered an addictive behavior, which is related to ADHD (attention deficit disorder), substance abuse, generalized anxiety disorder, and depression [10]. In a recent study, researchers investigated the related factors of comorbidity depression in patients with the online game disorder.

The study conducted an Internet-based observational study in South Korea, which recruited 500 participants aged 14-39. The researchers used the severity of anxiety disorder, and alcohol and nicotine dependence. The experiment used GAD-7, AUDIT-10, FTND-6, and PHQ-9 to test the comorbidities of problematic use of online games [11]. In the experiment, information about the use pattern and severity of online games was obtained. The researchers collected the number of days they played online games on their mobile phones every week and conducted the online gaming addiction test. Internet addiction screening tool (LAT) consists of 20 questions and its effectiveness and reliability are proven to be effective by psychological clinicians [12]. The researchers developed a self-reported scale (IGD-9), which is composed of nine projects, with internet gaming disorder (IGD) symptoms as the standard. In the experiment, respondents were required to answer each question. The investigators used five thresholds to screen for IGD positivity.

The study found that the number of people diagnosed with online gaming disorder (10.8%) was higher than that of other researchers' research reports (2.95%) and showed that the number of people diagnosed with IGD in Asian countries was significantly higher than that in Western countries [11]. Psychotherapy of problematic drinking, anxiety disorder, and online game addiction has been proven to be important predictors of the comorbidity of depression and online game disorder [11]. As far as gender differences are concerned, men are the predictors of online game barriers, mainly because men participate in online games more frequently than women. In the previous experiment (n=7200), although the prevalence of the online game disorder in men (14.3%) was significantly higher than that in women (7.9%), the prevalence of depression in women with the online game disorder was higher than that in IGD group [11]. Although Internet addiction is more common in men, women are at greater risk of depression [11]. The comorbidity of online game disorder and depression is associated with more severe mental symptoms and poorer clinical outcomes.

2.3. Internet Gaming Disorder (IGD) and Dissociative Experience

Online game addiction should be considered from the same perspective as substance abuse, gambling addiction, and other addictive substances.

Research showed that the brains of patients with Internet game disorder and drug addicts have similar characteristics [12]. The neurobiological basis of Internet disorder patients' addiction is similar to that of chemical addiction. The same neural mechanism has been found in online game addicts and drug addicts. Compared with the healthy control group, online game addicts and drug addicts found higher levels of dopamine, endorphin, and norepinephrine. In addition, patients with the pathological online game disorder and cocaine addicts have similar degrees of brain damage. The study found that compared with healthy people, the white matter in the orbital frontal lobe of patients with Internet game disorder and those with cocaine causes decreased significantly [13].

DSM-5[14] puts forward nine criteria for diagnosing IGD: (1) When online games become the dominant activity in daily life, individuals will think deeply about the past or expect to play the next

game; (2) Withdrawal symptoms when not playing games. Withdrawal reaction usually shows irritability, sadness, or anxiety. (3) Tolerance of internet addiction: like other addictive behaviors, individuals need to spend more time and energy to get satisfaction from online games. (4) Excessive use of online games has made people lose interest in their previous hobbies and entertainment. (5) Although individuals know that online games can cause psychological problems, they still overuse online games. (6) Use online games to escape or relieve negative emotions, including helplessness, guilt and anxiety. (7) Excessive use of online games will lead to crises or loss of important jobs and education opportunities. (8) Cannot control not participating in excessive use of online games. (9) Conceal the time and amount of excessive use of online games by family members, consultants, and others.

A recent study emphasized the relationship between mental disorders and online games, showing the correlation between IGD and dissociative disorder. In this study, 221 college students were collected from the University of Catania (Italy) to test the relationship between IGD and dissociative disorder. The experiment was conducted in two stages. In the first stage, participants were asked about their favorite online games and learned about their clinical distress level through a symptoms list (SCL-90R). In the second stage, the researchers conducted diagnostic interviews with the participants according to DSM-5 IGD diagnostic criteria and distributed the Online Game Disorder Scale and the Italian adolescents' dissociative experience scale to participants.

IGD9-SF assessed the severity of the participant's disease by summarizing the participants' answers, with scores ranging from the lowest (9) to the highest (45). The higher the score represents the more symptoms of problematic use of online games. A-DES (Italian version of the dissociative disorder scale), which consists of 30 questions about daily life experience. Participants were asked to describe how often they experienced a particular situation (0-10). The dissociative experience of the adolescent with internet gaming disorder in the experiment was divided into four parts, (1) passive influence, (2) depersonalization and derealization, (3) absorption and imaginative involvement (ABII), and (4) Dissociative amnesia (DA). The characteristic of dissociative amnesia (DA) is that it cannot be explained by common amnesia and individuals cannot form a memory of important information. The symptom of absorption and imaginative involvement (ABII) is that individuals often neglect their surroundings. The symptoms of depersonalization and derealization are that individuals feel that they are incorporeal observers or lose confidence in the real environment around them. Passive influence (PI) is defined as the deprivation of personal emotions, thoughts, and behaviors by external sources. Research data shows that 33 of 221 subjects reported more than 5 IDG symptoms, which is equivalent to 14.9% of the whole sample [15]. In addition, the research results show that internet gaming disorder is significantly related to derealization and depersonalization [15]. When participants try to reduce overuse of the game, attention absorption and imagination participation are related to irritability and emotional vulnerability. Specifically, adolescents with internet gaming disorder use excessive online games to escape from the negative emotions brought by the real world, which is related to dissociative experience.

3. Psychotherapy of Online Gaming Disorder

In recent years, the research on online game disorder has increased significantly, but there is still little evaluation of the feasibility of psychotherapy for online game addiction.

Research shows that cognitive behavioral therapy seems to be the practical and efficient way to treat Internet addiction, and other potential treatments include drug intervention and psychological counseling [16]. Most treatment methods for online game addiction are based on drug abuse treatment, including learning appropriate coping measures, solving problems related to addiction, self-monitoring strategies, and exposed withdrawal adjustment measures. At present, there are many limitations in the clinical treatment of online game addiction, the most important of which is that

psychologists did not consider the comorbidities related to online addiction [17]. Therefore, in view of the increase in counseling for teenagers who have problems using the Internet and the inherent multiple psychological vulnerabilities of teenagers in their specific life stages, it is necessary to provide a comprehensive treatment method in the clinical aspect of treating online game addiction, considering the comorbidity characteristics related to IGD.

The PIPATIC program ("personalized psychotherapy program for information and communication technology addiction") is developed by clinical psychologists in recent years to specifically treat adolescent internet addiction. PIPATIC is composed of 6 modules and special sub-modules. For adolescents with internet addiction and high-risk comorbidity, in addition to common cross-psychotherapy, interventions focus on comprehensive psychotherapy. The program includes 22 times 45-minute personal and family meetings per week for six months. The PIPATIC intervention experiment was conducted by a qualified clinical psychologist for person-to-person treatment. The module group of the PIPATIC project includes 1. Psychological education and motivation; 2. Usually, adapt to the addiction treatment of IGD; 3. Intrapersonal. 4. Interpersonal communication, 5. Family therapy. 6. Assist adolescents to create new lifestyles [18]. In addition, all modules include specific treatment tasks and methods needed to strengthen and help change daily behaviors. Research shows that in the treatment plan of PIPATIC, family factors are very important to help young people get rid of Internet addiction. This is mainly because young people lack effective self-discipline and self-management to reduce the problematic use of online games. It is usually the families of young people who ask psychologists to give psychological treatment to young people.

In the clinical experiment on adolescent internet addiction, the study collected data from 17 patients who received the treatment. In addition, the PIPATIC plan shows that the efficacy of this treatment method shows a good prospect [19]. The application results of the PIPATIC project show that, after 6 months of treatment, the time for teenagers to play online games is reduced, IGD-related symptoms and comorbidity are reduced, and the interpersonal relationship, family relationships and academic performance of teenagers are improved.

The above research proves that adolescence is regarded as an important period for the development of adolescents' mental health, characterized by the high risk of addictive behavior and other comorbidities. PIPATIC adjusted the vulnerable characteristics of adolescents at this stage. Therefore, PIPATIC is a comprehensive psychotherapy intervention, focusing on multiple areas of personal development.

4. Limitation and Future Direction

In the research discussed earlier in this article, several limitations should be considered.

First, psychological consultants should be more conservative and consider the changes in Internet technology when classifying and diagnosing online game addiction. Great changes have taken place in the use of the Internet, Internet games, and access platforms. Media, TikTok, and applications are not included in the list of Internet gaming disorders. Secondly, the two independent tasks mentioned in the research of inhibition control and reward-seeking mechanisms cannot be used for the dynamic regulation of the two systems. In future experiments, an effective method is needed to study the dynamic regulation of inhibition control and reward system mechanism.

Some limitations have also been found in the study of Internet game disorders and comorbidities. First, in the Internet gaming disorder (IGD) and comorbidity study, researchers used the IGD-9 scale to test the severity of participants' online game disorder. Since there was no face-to-face diagnosis of psychiatric students in the survey. Therefore, the research cannot determine the effectiveness of participants in reporting their online gaming disorder. The third part of DSM-5 introduced online game disorder, and research on disease prevalence has been published. However, most of the diagnoses of Internet gaming disorder come from the participants' self-report scale, not from

professional psychotherapists or clinical psychologists. The second limitation is the need to further study the effectiveness of online gaming addiction according to DSM-5 diagnosing standards. Considering that many studies on the prevalence of online gaming disorder need large-scale investigation, the DSM-5-based scale can be effectively managed online in the future. The third limitation is that the research samples of Internet and comorbidity are data collected through online surveys. Therefore, the data cannot be used as representative samples. In addition, participants who are active on the Internet are more likely to participate in the study of Internet gaming addiction and comorbidities. Compared with other adolescents, the sample data obtained in the study may lead to an overestimation of the prevalence of online game barriers. The fourth limitation is that the study on online game disorder and comorbidity is a cross-sectional observational study. Therefore, the study cannot determine the causal relationship between online game disorder and depression.

Although PIPATIC is a CBT-based comprehensive treatment of adolescent Internet gaming disorder. The project design is based on the combination of various psychotherapy viewpoints and psychological treatment strategies, which are effective in the psychological intervention of adolescent online game disorder. However, this study also has many limitations. First, this project is designed for the adolescent with online gaming addiction. Due to the rigidity of the intervention, it must be allowed to sell specific methods for other applications and evaluations. Since the specific rigid evaluation methods and standards, it is difficult to adapt to the special needs of young people with online game disorders. In the future, to solve the specific problem of rigidity, this program module can be independently developed by professional clinical psychologists and adapted to the treatment of juvenile online game disorder programs (PIPATIC) in a different order.

5. Conclusion

Firstly, the research mentioned in this paper found that inhibition control and reward pathway activities of adolescents with the online game disorder were abnormal, which would help psychologists and other researchers understand the basic characteristics and clinical applications of online game disorder.

Secondly, the research mentioned in this paper found that depression is an important predictor of adolescent online game disorder (IGD). The comorbidities of problematic use of online games and major depressive disorder are statistically significantly related to substance abuse, generalized anxiety disorder, excessive drinking, and increased utilization of psychiatric services among females. Finally, the comprehensive psychotherapy of adolescent online game disorder (PIPATIC) provides a new treatment direction for professionals in this field. In the future, the project can analyze various cases of different age groups, game types, and backgrounds, as well as clinical characteristics, to confirm the effectiveness of the research results in other populations and environments.

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