

# Clinical and Neurobiological Features of Gambling Disorders and Internet-Gaming Disorders

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## Abstract

*In the presented work the acutance and relevance of the growth in behavioral addictions problem associated with gaming activities, such as gambling disorder (GD) and Internet gaming disorder (IGD) is demonstrated on the materials of numerous studies. These studies address both the prevalence and negative clinical and social consequences of these addictions.*

*The gaming industry is developing at a tremendous pace and today is a multi-billion dollar business with billions of active players of all ages, starting with preschool children. Information technologies of involvement and retention in the game are constantly being improved. Which leads to an increase in problem and pathological players.*

*The characteristic clinical and neurobiological features of these addictions, personality changes and negative social consequences are highlighted. The emphasis is not on the common clinical manifestations to all addictions, but on the specific to them disorders. Such as: the rapid formation and development of addiction to the stage where the game becomes the dominant need in human life with the replacement of even basic needs; episodes of altered state of consciousness (game trance) with impaired perception of time, events in the game, memory of them, affective narrowing of consciousness and changes in self-identification; the predominance of the cognitive component in the impulsive-compulsive syndrome, thoughts quickly become obsessive and develops a very intense and generalized attraction to the game (craving), with almost no struggle of motives; high suicidality: ideas in 50-80%, attempts in 15-31% of players. At IGD this question is not investigated. The rapid increasing of the personality changes, depression, anxiety disorders and social maladjustment.*

*Behavioral dependencies associated with IGD and GD gaming activities require deep and comprehensive study. The materials of this report can be useful in clinical practice to develop effective treatments for these disorders.*

*The search of studies was conducted using the following databases:*

*Scopus, PsycINFO, Science Direct, PsycARTICLES, PubMed, Wiley Online Library and Google Scholar.*

## Introduction

Dependence from the gambling and Internet gaming disorder are behavioral dependencies in the center of which is dependence from a certain type of the gaming behavior over which the control is lost, both in frequency of involvement in the game, as well as in time. A pathological craving for play appears and eventually increases to a compulsive urge, which is constantly embodied almost without a struggle of motives. The dependent person continues to play despite the negative consequences for his mental and physical health, personality, relationships in the family, with friends and in the team, in the professional sphere or in school. The pathological need for the game becomes dominant and replaces all other interests, hobbies, forms of activity, relationships end even the basic needs: food, sleep, intimacy, childcare, etc. There are some cases when players ignored the deterioration of physical health and even severe pain, they did not hear loud sounds such as screaming and crying children or pets.

*One teenage gamer, who was playing in the toilet hiding from his parents, was so carried away and detached from the surrounding reality that he did not hear any screams and knocks on the door of frightened parents, or even how his father broke down the door. He woke up only when somebody took his smartphone.*

Gamers and gamblers isolate themselves from the environment. Their relationships with family, friends, and work colleagues become conflicted, shallow, and consumering. Here's how one 24-year-old gambler described it: *"Before I started betting, I had relationships with my parents, girlfriend, friends, and work colleagues, which were not always smooth, but I had some feelings for them, they were important and interesting for me. And after I got carried away with sports betting, all people seemed to be depersonalized and divided into two categories: those that prevented me from doing this and those that contributed. And my attitude to them was determined by which of these two categories they belong to."*

At the moment, both of these addictions are recognized as mental disorders and are included in the ICD 11 classification as addictive behavior. The criteria for clinical diagnosis are proposed, which are very similar. It is also noted that all these symptoms must be observed for 12 months before been diagnosed. But the addiction is not formed in one day, there is a fairly long preclinical stage during

which we can observe other, lighter, but alarming in prognostic terms manifestations. We don't talk about addiction; we call it a social game, an over-engagement, a problem game. But in fact, we are already seeing the stages of addiction formation. This is important to understand for the study of prevalence because there is a huge spread of data in the work on this topic.

6C50 Gambling disorder	6C51 Gaming disorder
ICD -11	ICD -11
Disorders due to addictive behaviours	All ancestors up to top 06 Mental, behavioural or neurodevelopmental disorders Disorders due to substance use or addictive behaviours Disorders due to addictive behaviours
<b>Description</b>	<b>Description</b>
<p>Gambling disorder is characterized by a pattern of persistent or recurrent gambling behaviour, which may be online (i.e., over the internet) or offline, manifested by:</p> <ul style="list-style-type: none"> <li>• impaired control over gambling (e.g., onset, frequency, intensity, duration, termination, context);</li> <li>• increasing priority given to gambling to the extent that gambling takes precedence over other life interests and daily activities; and</li> <li>• continuation or escalation of gambling despite the occurrence of negative consequences. The behaviour pattern is of sufficient severity to result in significant impairment in personal, family, social, educational, occupational or other important areas of functioning. The pattern of gambling behaviour may be continuous or episodic and recurrent. The gambling behaviour and other features are normally evident over a period of at least 12 months in order for a diagnosis to be assigned, although the required duration may be shortened if all diagnostic requirements are met and symptoms are severe.</li> </ul>	<p>Gaming disorder is characterized by a pattern of persistent or recurrent gaming behaviour ('digital gaming' or 'video-gaming'), which may be online (i.e., over the internet) or offline, manifested by:</p> <ul style="list-style-type: none"> <li>• impaired control over gaming (e.g., onset, frequency, intensity, duration, termination, context);</li> <li>• increasing priority given to gaming to the extent that gaming takes precedence over other life interests and daily activities; and</li> <li>• continuation or escalation of gaming despite the occurrence of negative consequences. The behaviour pattern is of sufficient severity to result in significant impairment in personal, family, social, educational, occupational or other important areas of functioning. The pattern of gaming behaviour may be continuous or episodic and recurrent. The gaming behaviour and other features are normally evident over a period of at least 12 months in order for a diagnosis to be assigned, although the required duration may be shortened if all diagnostic requirements are met and symptoms are severe.</li> </ul> <p>Inclusions Compulsive gambling</p>

Gambling disorder	Internet - gaming disorder
DSM - 5 disease criteria	DSM - 5 disease criteria
A diagnosis of gambling disorder requires at least four of the following during the past year:	The proposed symptoms of internet gaming disorder include:
<ol style="list-style-type: none"> <li>1. Need to gamble with increasing amount of money to achieve the desired excitement</li> <li>2. Restless or irritable when trying to cut down or stop gambling</li> <li>3. Repeated unsuccessful efforts to control, cut back on or stop gambling</li> <li>4. Frequent thoughts about gambling (such as reliving past gambling experiences, planning the next gambling venture, thinking of ways to get money to gamble)</li> <li>5. Often gambling when feeling distressed</li> <li>6. After losing money gambling, often returning to get even (referred to as "chasing" one's losses)</li> <li>7. Lying to conceal gambling activity</li> <li>8. Jeopardizing or losing a significant relationship, job or educational/career opportunity because of gambling</li> <li>9. Relying on others to help with money problems caused by gambling</li> </ol> <p>A person with gambling disorder can experience periods where symptoms subside and gambling doesn't seem a problem in between periods of stronger symptoms.</p>	<ol style="list-style-type: none"> <li>1. Preoccupation with gaming</li> <li>2. Withdrawal symptoms when gaming is taken away or not possible (sadness, anxiety, irritability)</li> <li>3. Tolerance, the need to spend more time gaming to satisfy the urge</li> <li>4. Inability to reduce playing, unsuccessful attempts to quit gaming</li> <li>5. Giving up other activities, loss of interest in previously enjoyed activities due to gaming</li> <li>6. Continuing to game despite problems</li> <li>7. Deceiving family members or others about the amount of time spent on gaming</li> <li>8. The use of gaming to relieve negative moods, such as guilt or hopelessness</li> <li>9. Risk, having jeopardized or lost a job or relationship due to gaming</li> </ol> <p>Under the proposed criteria, a diagnosis of internet gaming disorder would require experiencing five or more of these symptoms within a year. The condition can include gaming on the internet, or on any electronic device</p>

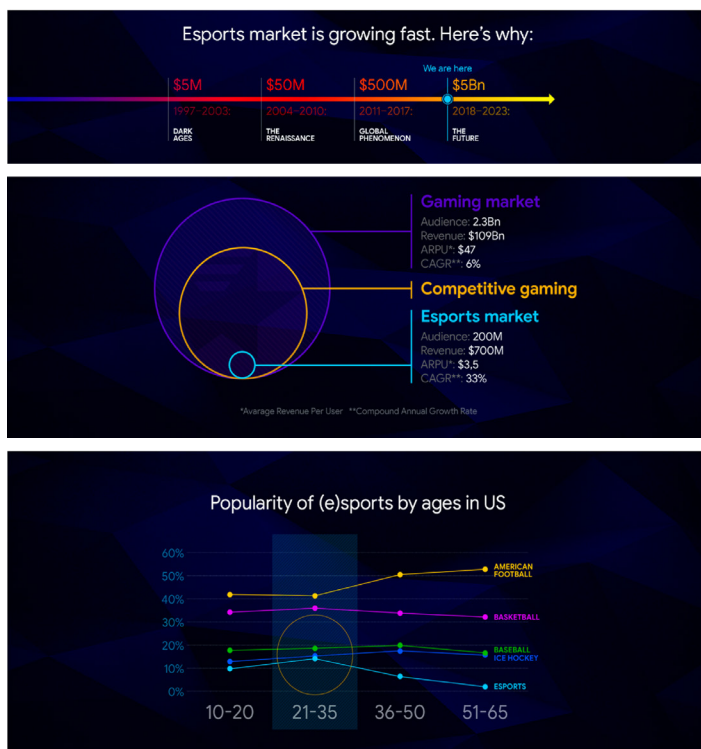
**Epidemiology  
Prevalence IGD**

In the detailed epidemiological review of 2017, which analyzed studies prior to May 2016, the prevalence of IGD in General samples varied from 0.7% to 27.5%. In the vast majority of studies, it was higher among young people under 35 years of age [1]. In European samples from 1.2 to 5.0% Analogical prevalence rates in the Middle East [2-11]. In the US, 0.3-1% [8]. In Asia, from 3.5 to 27.5% [2, 9].

A 2015 study by Russian scientists showed that gaming is widespread among students: 92% of high school students play computer games, 65% of College students, and 41% of University students. And almost half of high school students (45.5%), a third of College students (29.3%) and one in ten students of the University (13.4%) have signs of excessive enthusiasm for computer games or problem games [12]. The overall picture of prevalence studies suggests that this issue is poorly understood. And these indicators not even approximately reflect the real picture today.

There is a very wide range of data, which indicates that the criteria for selecting and analyzing data are not standardized. Studies were conducted among different age groups, and in a small number of countries. National studies are generally very rare. The article summarizes data from studies of 5-10 years ago with indicators of recent years. That at this pace of development of the game market is generally unacceptable.

Over the past 20 years, the gaming industry has increased its revenue by more than 100 times: from an annual revenue of less than \$ 200 million at the end of the 90's to \$100 billion already in 2017. The number of gamers is also increasing enormously. Active players are 1/3 of the world's population, 2.3 billion people as for 2017 and 2.73 billion with a forecast for 2021 [13]. And these are mostly children, teenagers, and young people under 35. Now I am presenting data from marketing research of gaming companies [50]. They do not spare money for these studies and clearly define their target audience [14].



Based on this data, it is not difficult to conclude that the number of active gamers, from which people with IGD appear, increases by hundreds of millions of people a year, not to mention a 5-and 10-year period. This is a completely different reality: what could be observed in 2010 and in 2020.

**Prevalence of clinical dependencies pathological and problematic gambling** according to various studies for the period from 2000 to 2016, it varies from 0.7 to 6.5% among adults and almost 2 times more from 0.2 to 12.5% among adolescents [14, 15]. This is despite the fact that gambling by teenagers is an illegal activity. The number of players experiencing serious subclinical problems is 2-3 times more. It is also well known that most problem gamblers never seek professional treatment, and no more than 5-10% of applicants. Moreover, studies of prevalence were conducted only

in individual countries, they were not global in nature and without constant accounting for changes, and (they were of a one-time nature) [16-18]. Therefore, these figures only very roughly reflect the real picture.

**Explaining this large spread of data, the authors note that:**

- ✓ Most of the gambling addiction studies among the teenagers were conducted in schools. All data are self-reporting and subject to many well-known deviations, such as memory reliability, social desirability, and the integrity of the responses received.
- ✓ Studies were compared for different time periods of gambling involvement: for a year and for the entire lifetime.
- ✓ Global and local regional studies were also summarized. Naturally, such different time and scale of the study will provide different indicators.
- ✓ In various studies different screening tools were used in order to assess problem gambling
- ✓ Many authors draw attention to the direct relationship between the legalization of gambling, easy accessibility and wide advertising, and the growth of people involved in gambling [19-29].

The following data is presented from interviews and surveys of gamblers on what prompted the start of the game, how they became interested and why they decided to participate in gambling, and revealed **the following conditions for starting gambling:**

- ✓ **Informing** from the immediate environment: friends, relatives, classmates, friends, and employees - 56%. Some of these people shared their experience in participation in gambling and the experience of winning.
- ✓ **Advertisement.** 36%. Interested in the party atmosphere, success, content and design
- ✓ **Job** In the gaming business sphere – 6%. Programmer, web-designer, employee of the gaming institution.

An important role in the increase in the prevalence of gambling and problem gambling, especially among teenagers, was played by the opportunity to participate in them through the Internet. This format of the game allows you to bypass age restrictions, parental control, provides anonymity, and is available at any time: you can play from your phone, tablet, or computer [22-24].

Annual global gambling losses are estimated at \$400 billion in 2016 It is expected that the prevalence of gambling will continue to expand among new populations with a high risk of developing addictions [25-29]. Over the past 10 years, gambling involvement has increased 17.5 times among different groups of the population. The government's interest in increasing revenue played a significant role [26]. Some studies have shown that the degree of harm (damage) associated with gambling is similar in scale to major depressive disorder, as well as alcohol abuse and alcohol addiction [30, 31]. 2.5 times more than for diabetes, and 3.0 times more than for drug use disorders [25]. In General, gambling addictions lead to various and sometimes very serious negative consequences for mental and physical health, personality, relationships in the family, with friends, work colleagues, for professional activities and education. Up to complete social maladjustment, suicide, and spiritual and moral degradation of the individual.

**Negative psychosocial consequences in GD and IGD**  
**These negative consequences were grouped in a table:**

**Table 1**

<i>Negative consequences in spheres</i>	<i>Gambling disorder</i>	<i>Internet gaming disorder</i>
<b>Social negative consequences</b>	<p><b>Finance</b> - debts that are paid off not only by the player's personal funds, but also by the family's money and property, business funds, firms, and enterprises (embezzlement)</p> <p><b>In relationships:</b></p> <ul style="list-style-type: none"> <li>✓ Lies; conflicts; distrust, manipulation of family members-80%, divorce 35%</li> <li>✓ Lies and manipulation in relation to friends, colleagues and partners at work.</li> <li>✓ As a result, the relationship ends or becomes superficial, consumer-oriented</li> <li>✓ The social circle is replaced by the game one.</li> </ul> <p><b>Education and profession:</b></p> <ul style="list-style-type: none"> <li>✓ loss of the job;</li> <li>✓ reduced academic performance, exclusion from school. [14 -18, 20 - 26]</li> </ul>	<p><b>Finance</b> - spending on games, in-game purchases, and your own funds or parents.</p> <ul style="list-style-type: none"> <li>✓ Fines, losses due to loss of interest in the work and carelessness.</li> </ul> <p><b>In relationships</b></p> <ul style="list-style-type: none"> <li>✓ Abandonment of previous hobbies or external activities, which leads to social isolation</li> <li>✓ Family conflicts and in the collective – lies, manipulations.</li> <li>✓ The social circle getting smaller and replaces by the game one.</li> </ul> <p><b>Education and profession:</b></p> <ul style="list-style-type: none"> <li>✓ Loss of the job because of that the employee comes sleepy, tired and the productivity getting low, many mistakes were done.</li> <li>✓ Loss in the job interest and satisfaction of what he does.</li> <li>✓ Bad performance up to exclusion from educational institution. [2, 8, 13,35]</li> </ul>
<b>Legal</b>	<ul style="list-style-type: none"> <li>✓ 92% stolen money and things from the house up to the complete removal of things;</li> <li>✓ 22,7% committed these actions outside the house;</li> <li>✓ 13,3% committed embezzlement of trusted money;</li> <li>✓ 6% committed robberies. [36-38]</li> </ul>	No reliable data available
<b>Damage to health</b>	<p><b>Damage to health is associated with an extremely unfavorable and destructive way of life:</b></p> <ul style="list-style-type: none"> <li>✓ Consequences of the chronic stress, stress in which the gamer lives</li> <li>✓ accompanying the game use of alcohol, drugs and smoking</li> <li>✓ Disorder of the normal diet and quality of food, sleep and wakefulness</li> <li>✓ neglect of health, lack of prevention and timely treatment of diseases</li> <li>✓ on the average, life expectancy of gamblers is 20 years less than in the general population</li> <li>✓ neglect of health, lack of prevention and timely treatment of diseases</li> <li>✓ on average, the life expectancy of gamblers is 20 years less than in the general population. [39 - 42]</li> </ul>	<p><b>Associated with emotional stress and sedentary lifestyle:</b></p> <ul style="list-style-type: none"> <li>✓ Deep vein thrombosis</li> <li>✓ Visual impairment</li> <li>✓ Hemorrhoids</li> <li>✓ Osteochondrosis spinal protrusion and herniated vertebral discs,</li> <li>✓ Diseases of the gastrointestinal tract due to eating disorders. [13]</li> </ul>
<b>mental health problems</b>	<ul style="list-style-type: none"> <li>✓ Dependence on the use of psychoactive substances (alcohol, drugs) 57.5-72%,</li> <li>✓ mood disorders (depression and bipolar disorder) 37.9-60%,</li> <li>✓ anxiety disorders 37.4 - 63%</li> <li>✓ personality disorders 25-93%</li> <li>✓ sleep disruption. [42, 44, 48, 49, 51]</li> </ul>	<ul style="list-style-type: none"> <li>✓ sleep disruption</li> <li>✓ obesity due to physical inactivity</li> <li>✓ irritability</li> <li>✓ irritability, aggression</li> <li>✓ empathy reduction</li> <li>✓ depression disorder</li> <li>✓ anxiety disorders, including panic attacks and social phobias</li> <li>✓ neurasthenia</li> <li>✓ substance-use behaviors</li> <li>✓ obsessive-compulsive disorder</li> <li>✓ attention deficit hyperactivity disorder (ADHD)</li> <li>✓ Personality disorders most of the all narcissistic, schizoid or unstable type. [13, 32-35, 46-48]</li> </ul>

<b>Suicidal risk</b>	<ul style="list-style-type: none"> <li>✓ Suicidal risk is very high in people with PG and is observed in 50%,</li> <li>✓ up to 80% report suicidal thoughts, and</li> <li>✓ 48-49.2% have persistent suicidal ideas of an obsessive nature,</li> <li>✓ 12-35.8% commit suicide attempts. - The average age of death was 51 years, and the average age of suicide was 32.5 years.<sup>37-39</sup></li> <li>✓ The main causes of death are self-murder (31%), overtaxing of cancer (16%) and diseases of the circulatory system (12%).</li> <li>✓ The death rate as a result of suicide was 15.1 times higher for men aged 20-74 than for the General population, and 19.3 times higher in the 20-49 category. [39 -41]</li> </ul>	<ul style="list-style-type: none"> <li>- Suicidal thoughts</li> <li>- Ssuicidal behaviours (suicidal ideation and suicide attempts)</li> <li>- The risky and the pathological internet users showed significant higher rates of depression, deliberate self-harm and suicidal behaviour compared to students with regular internet use.</li> <li>- Remarkably, there were no significant differences of levels of depression and suicidal behaviour between risky and pathological users. These results suggest that not only pathologic internet use but also risky internet use is associated with symptoms of depression, self-harm and suicidal behaviour. [166-167]</li> </ul>
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**Clinical and neurobiological features of practical understanding from the perspective of a new hypothesis**

GD (Gambling disorder) and IGD (Internet Gaming disorder) are the only officially recognized behavioral dependencies associated with game activity so far, but not with the use of psychoactive substances. Outwardly, such disorders look like a strong pathological attraction to the game that dominates all other needs with loss of control over game behavior that is why these dependencies are called behavioral dependencies. However, not in form, but in essence - they are informational and dependencies. They are the result of the interaction of information technology - the game - with the human mind. To be more accurate, they are the result of the sophisticated, aggressive and manipulative impact of those information products to the mind and brain.

Consciousness is primarily a phenomenon of information and all its cognitive functions (thinking, memory, perception, etc.) are intended for information exchange. The first and key uniqueness of gaming dependencies is manifested in the way in which information in its pure form, without any effect of a toxic chemical substance, can become addictive with such significant changes, and not only in behavior, cognitive functions, emotional and motivational sphere, worldview and personality values, but also in the structure and functions of the brain. In other words, how heavy addiction may appear as a result of work of mind that could destroy the spiritual and intellectual potential of a person, destroy all his/her relationships and lead to degradation of the individual. Moreover, this dependence by no aspects concedes to in its malignancy, neither in terms of development speed (progredience), nor in its consequences, to the dependencies on alcohol and drugs, and in many ways even surpasses them.

In spite of the abundance of a variety of research and scientific hypotheses, clinical observations, we still know very little about the structure of the pathogenesis and gambling dependence, not to mention the clinical effectiveness of current therapeutic approaches. Taking into account the speed of development of information technologies and how often they are used not to help but to the detriment of a person, it is possible to predict a further increase in information dependencies. GD and IGD are already an order of magnitude superior in prevalence to all SUD together, even if they are based on well-known, clearly underestimated official data. That is why it is so important to study them deeply and comprehensively.

Over decades, studies have not identified a particularly vulnerable category of people prone to behavioral addictions. People of different ages, gender, characters can become dependent. They may have a family or to be single, with and without mental disorders of varying severity and nosological categories; with different social status and material security: from unemployed to millionaires; different level of education: from preschool to holders of scientific degrees. Now it can only be confidently asserted that dependencies, from mild subclinical levels to severe clinical ones, develop in those who play. In this review report on the topic of addictive behavior related to gaming activities, it is proposed to consider gaming addictions (in particular, IGD and GD) as a result of the influence of gaming information technologies on the human mind and brain, taking this as a hypothesis.

**Neurobiological research**

To understand the changes in the structure and function of the brain, to identify potential cognitive and brain disorders with behavioral addictions some neurobiological research is conducted.

**Research may be distinguished according to the implementation technology and methodology:**

**Neuropsychological** - carrying out a variety of behavioral and cognitive tests / tasks for the study of disorders mainly executive functions. They are often combined with other methods, such as neuroimaging.

**Neuroimaging using MRI such as:**

- The study of functional neural networks relations at rest (rsFC) may allow identifying dysfunction of neural circuits, which lies at the basis of various neuro - mental, disorders;
- The study of functional connections in the brain when performing certain tasks;
- Morphometric - structural and morphological changes in the brain are studied.

1. **EEG studies** - electrical activity in various parts of the cerebral cortex with gaming addictions.
2. **Neurochemical** studies of changes in the synthesis of neurotransmitters using a PET Scientific research has developed mainly in the following areas:

**A study of executive functions and decision-making processes**

Executive functions are directly related to voluntary or selective attention - the ability to direct, concentrate attention on the

processes of interest and focus, hold attention, despite distracting factors. Executive function refers to the capacity for planning and forecasting, search and error correction - the opportunity and the ability to use the reverse link, to analyze, to draw conclusions. In the study of executive functions, the following components are tested:

- **working memory:** the volume memory in which information is stored, directly related to the task, which we are now engaged;
- **Cognitive flexibility** - the ability to quickly switch between different programs of behavior or between the different targets;
- **Inhibition control** - the ability to keep their motivation or desire, which are caused by environmental stimuli, in accordance with the rules, which govern the behavior, or in accordance with the long-term goals.

Of course, the implementation of executive functions is associated with the holistic work of the whole brain, but most of all with the **prefrontal areas of the frontal cortex ventromedial prefrontal cortex (VMPFC)**.

Neuropsychological studies show deficiencies in the decision-making, attention and working memory, like pathological gambling players as well as with Internet gaming disorder, as well as decrease the overall productivity inhibition control and cognitive flexibility. These disorders are similar to dysfunction in the frontal lobes, but without organic structural damage, as in SUD. They are studied using various neurocognitive tasks, and they combine the neuroimaging of fMRI associated with the task. More information about executive function violations with GD can be found in the following reviews, and with IGD [32-61]. Let us dwell on those that underlie impulsivity, compulsiveness, pathologically altered processing of rewards and losses, as well as the reaction to environmental signals related to gambling with GD or Internet games with IGD. These are the symptoms that are most commonly found in GD and IGD and which are most often addressed in research and reviews. But we will focus on those manifestations, these violations, which are unique to game addictions.

### **Impulsiveness**

Impulsivity refers to behavior that is disinhibited to a degree where it is poorly conceived, premature, unduly risky and inappropriate to the context in which it is carried out, with potential adverse consequences likely to follow [55]. In impulsive behavior, we observe a violation of decision-making, concentration and concentration of attention, its distractibility to incentives related to remuneration, as well as a violation of planning, forecasting and analysis of results, taking into account the reverse link. Impulsivity is manifested in two versions:

- **Impulsive action** -motor or response impulsivity (also termed impulsive action) impaired ability to suppress motor reactions. It is studied using these behavioral problems, as the Go / No-Go Tasks, continuous test performance tests and stop-signal tasks;
- **Cognitive or decision-making impulsivity** (also termed as impulsive choice) - it refers to the preference for selecting more modest immediate (smaller, sooner) rewards instead of more sizable long-term (larger, later) rewards.

It is studied with the help of tasks that measure the temporary

discount (deferral, postponement) of a reward. Impulsive choice is associated with a decrease in the ability to put off pleasure, as a result of which an unfavorable decision is made. The number of risky decisions is increasing. Measured decision-making, which have been assessed using such measures as the Cambridge Gambling Task and the Iowa Gambling Task.

### **Motor or response impulsivity (also termed impulsive action)**

In most studies of the impulsivity of action with GD and IGD, no behavioral differences were found compared with the control group. However, with a distracting game signal, there were more skipping errors in Go / No-Go Tasks, and tasks were slowed down. Also, changes in activation in various brain structures were identified in neuroimaging studies of the neuroimaging study fMRI (fMRI) during neuropsychological tasks.

In a 2015 review of the results of neurobiological studies and their comparative analysis in patients with IGD and GD, “IGD patients have shown to have increased brain activity during no-go trials compared to controls mainly in prefrontal areas (superior, middle, and superior medial frontal gyrus, anterior cingulate cortex, inferior parietal lobule, pre central gyrus, precuneus, and cuneus)” [62].

In the same study, it was found that activity in the medial frontal gyrus correlated with impulsivity rate and severity of addiction. In this connection, it was concluded that impaired function of the PFC might be th linked to high impulsivity in adolescents with IGD. In the other study of the same survey slowdown was detected in supplementary motor area (SMA) and pre-SMA in the “no go” compared to the “go” tests for patients with IGD compared with control group (Chen and others, 2015) [63]. These areas are included in the network of frontostriatal response inhibition. Reduced activity in them might indicate impairment of inhibitory and selective control over behavior in persons with IGD. In another study, activity in the orbitofrontal cortex (OFC) and the bilateral caudate nucleus was increased, the activity of the islet lobe (insula) during inhibition of response in patients with IGD was lower than in the control group. As is known, error processing was associated with activity in the anterior cingulate cortex (ACC) and insula. Based on the foregoing, the authors hypothesized that for the patients with IGD; inhibition of undesired reactions requires a larger response in the frontostriatal network, than is required for control.

In studies of **impulsive actions** using the Task stop - signal and the Go / No-Go Task patients with PG have a similar picture. Based on the results of several studies summarized in a meta-analysis, there was no impaired performance among patients with PG compared to the control group. There were also no time delays or they were minimal when performing stop-signal tasks [64-66]. Data for neuroimaging fMRI indicate excessive hydrochloric activation dorso-lateral prefrontal cortex (dlPFC) and anterior cingulate gyrus (ACC). A study demonstrates what is behind the increased impulsiveness and violation of inhibition control in problem gambling, namely, the pathological pattern of attraction to the game, which has acquired special emotional significance of rewarding activity as a result of aberrant (erroneous, deviant) learning, and not any other causes of impaired executive cognitive function [67]. During this study, participants with problematic gambling and healthy control completed the Go / No-Go Task,

during which they were shown photos with emotionally positive, negative, neutral and game content, and they also performed fMRI neuroimaging. We found that during the demonstration of neutral and negative images, inhibition of the response with No-Go required more effort and time, which was seen in the increased activation of DL PFC and ACC. Conversely, while displaying casino games and positive photos, participants with the PRG (problem gambling) worked better: they had fewer behavioral errors in the test and expended less effort on the brake reaction than the HC (healthy control group), and, accordingly, there was a low activation of I DL PFC and anterior ACC.

### ***Cognitive or decision-making impulsivity (also termed impulsive choice).***

It was found that patients both with IGD and in PG showed precisely the impulsiveness of choice or cognitive impulsiveness that is reflected in the violation of decision-making [67-72]. The studies have lower probabilistic discount rates than in the control group, which indicates disadvantageous decision-making in risky situations. Risky choice selection was associated with reduced activity in the inferior frontal and precentral gyrases of IGD patients compared to HCs, and in patients with a gambling disorder with altered VMPFC activity. Other studies have shown an increase in activity associated with assessment in the intra-dark groove and ventral striatum [73]. The results of fMRI (fMRI) and neuropsychological tasks indicate that both patients with IGD and GD are characterized by poor risk assessment and decision making in risky situations.

**Compulsiveness** - repeated stereotypical actions, persistent, perseverative, which are excessive and inappropriate in this situation and do not have an obvious connection with the goal despite the negative feedback. If impulsive actions are performed with the aim of earning rewards as soon as possible, compulsive actions are usually carried out under the influence of a strong obsessive drive, not related to remuneration, but in order to reduce, internal tension and negative emotional state, relief. With IGD and GD, this is a persistent return to the game and the continuation of the game despite losses and negative consequences. Moreover, obsessive and stereotyped are not only actions, but also thoughts about the game, emotional states. The most striking example of compulsive behavior - is Chasing Losses - escalation of play behavior at a loss, especially in relation to the cash rate with problem gamblers or pathological gamblers. With the progression of gambling addiction, initially impulsive behavior is gradually being replaced by compulsive behavior, and it happens quite quickly. Compulsiveness is observed at preclinical stages with problem players. In the study, the symptom of the chase for losses was identified as the leading one among gamblers at the subclinical level of a problem game and as a sign of progressive dependence when there are no serious negative social consequences yet [74]. This behavior is absurd and illogical even for the process of the game itself reflects violations in the cognitive sphere. Under the influence of this template, a person does not take into account the negative experience of the previous game, but continues to play and make bets and increase their size, guided by false mental assessments and interpretations of what is happening, that is, cognitive distortions. This phenomenon is related to the “gambler’s fallacy”, in which gamblers perceive that a series of losses - or consistent outcomes (e.g. ‘red’ coming up in roulette) indicates that a reward or other outcome (e.g. ‘black’

coming up in roulette) is more likely [75]. “Chasing Losses” can be called the calling card of gambling addiction. Previous studies based on the DSM criteria and not only them identified a whole class of gamblers at a subclinical level according to the severity of the “preoccupied chasing losses” dependency [76-79]. This example clearly shows how compulsive behavior arises as a result of cognitive errors. It is motivated by justification of mental evaluations and interpretations. The symptom of “chasing the losses” clearly demonstrates how the addiction program or game dominant begins to subjugate and change all cognitive processes, the reward system, and therefore the whole emotionally motivational sphere and, as a result, human behavior. How a player begins to ruin his life. Indeed, subjectively, he wants to win, but objectively does everything to lose. In slot machines, manipulative technologies are intentionally used to initiate and enhance the behavior of the “chase for losses”. They apply to the “almost missed” results of the game sound and visual effects, the same as when winning [80, 81].

Important components of compulsive behavior that are associated with repetitions of unproductive actions according to a pattern of a formed habit are the inability to adapt flexibly to the situation and excessive dependence on a previously formed (learned) pattern that has become automatic as a result of frequent repetitions and not sensitive to goals. Cognitive flexibility is studied using neuropsychological tasks in which they either manipulate various unforeseen circumstances, or change conditions (the ability to switch attention between tasks), or test the ability to inhibit an automatic response.

In a recent meta-analysis, the results of 29 studies of GD compulsivity based on 4 major neurocognitive domains of this phenomenon, which were proposed in a large theoretical review with specialists in this field, were summarized and analyzed [82, 83].

- ✓ A contingency-related cognitive flexibility;
- ✓ Task / attentional set shifting;
- ✓ Attentional bias / disengagement;
- ✓ Habit learning

In order to study the domains of compulsivity, neurocognitive tasks were selected that measure the executive functions that reflect any of these components. As a result, it was found out, that the persons suffering from gambling, compared with HCs, demonstrate the deficiency of performance and cognitive flexibility in a wide range associated with compulsive neuropsychological functions, in all domains of compulsion. It shows again how totally and generalized the obsession (compulsiveness) covers a person’s consciousness and how it determines his/her behavior up to a complete loss of control.

In a study [84]. It was investigated cognitive inflexibility in the group of pathological gamblers, as via tasks involving a reward element (probabilistic reversal learning task) and without it, using the task measuring general of cognitive inflexibility (i.e. response perseveration) - Wisconsin card sorting task. Then the results obtained were compared with each other and with those that were obtained in the control group (without GD members). The results showed that participants with PG showed cognitive rigidity only when performing tasks related to rewards. From which it was concluded that a violation of cognitive flexibility - cognitive rigidity in people with a gambling disorder is a result

of an aberrant reward-based learning, and not based on a more general problem with cognitive flexibility.

It was also noted that the picture of violations corresponds with dysfunction of the orbitofrontal cortex, the ventrolateral prefrontal cortex, and the ventral regions of the striatum in gamblers. Studies have shown similar results [85]. Changes in cognitive flexibility have been studied using a shift of attention approach between tasks for IGD members. Participants were instructed to focus only on targets and ignore distracting stimuli. As distracting incentives, photos related to the World of WarCraft game and photos of fruits were chosen. As a result, participants with IGD showed not only a decrease in inhibition of automatic reactions, but also a deficit in attention switching, a marked slowdown with a deviation towards Internet gaming incentives.

In a study the participants of three diagnostic categories IGD, GD, AUD were compared for compulsiveness using the Intra-Extra Dimensional Set Shift (IED) (assimilation and rule change test that was used to assess visual discrimination, multiple attention functions, and assessment of a person's ability to shift and flexibly distribute attention) [86]. The test did not reveal significant differences in IGD compared with a healthy control group in terms of compulsiveness. Such a discrepancy in these two behavioral studies may be because in the first, stimuli associated with the game were applied, while in the second, neutral symbols were used. And, accordingly, it confirms that participants with IGD suffer from aberrant learning based on remuneration, and not from general cognitive inferiority. It should be noted that in this study there was a very small sample of 15 participants.

In a recent study on a large sample of 225 participants (IGD, N = 86; AUD, N = 39; OCD, N = 23; healthy control, N = 77) compared baseline neuropsychological profiles of impulsivity / compulsivity of patients of three diagnostic categories [87]. In the study of compulsiveness, as well as in the previous study, the Intra- Extra Dimensional Set Shift (IED) was used (the assimilation and rule-changing test, which was used to assess visual discrimination, the multiple attention function, and assess the person's ability to shift and flexibly distribute attention). Within the domain of compulsivity, IGD patients showed the worst performance in IED total trials measuring attentional set shifting ability among the groups.

The researchers came to the conclusion that the violation of the cognitive flexibility and other features identified neurocognitive dysfunction in IGD are connected with a feature of impulsive and compulsive behavioral dependence, and not with general cognitive deficits. In general, it should be noted that there are very few studies of compulsivity in IGD, although in the clinic we observe frequent and quite pronounced symptoms of obsession, especially with severe dependence in the later stages.

Brain networks involved in obsessive behavior and were located in following studies:

- using tasks on reversal learning (DLPFC, lateral OFC, and caudate nucleus)
- task switching (basal ganglia, in conjunction with the prefrontal cortex) and
- Habit learning (supplementary motor cortex, premotor cortex and shell zone) and habit learning (supplementary motor area, premotor area, and putamen [62].

### *Interim summary*

According to the results of scientific research, we observe a pronounced obsession with game behavior, with impaired cognitive flexibility, which, according to some studies, is superior in strength to compulsivity in SUD (in AUD in particular). However, compulsiveness in GD is a particular manifestation of dependence, as it is associated with aberrant reward-based learning. Moreover, compulsiveness testifies to the progression of dependence: serious changes in the reward system up to the pathological self-destructive attraction to the game raised to the degree of dominant need, highest value, and the only pleasure. In the clinical picture at this stage, we observe the fact that the game becomes dominant in the human mind and supplants all other desires, interests and goals. The control over emotions and pathological attraction to the game is even more reduced and, accordingly, the person loses the degree of freedom - freedom of choice. Decisions and actions become not just impulsive – they become automatic, stereotyped and dictated by the game dominant.

Thus, we can observe how the game dominant modifies the reward system (in the reward system) sequentially subordinates all cognitive functions of a person's consciousness from perception, thinking to decisions and behavior. And this is just an informational template in the consciousness and subconscious of a person - a cognitive and behavioral stereotype with one vector, with one focus - to play. Play no matter what. To play without reliance on feedback, on efficiency: how advantageous are its solutions. In other words, at the compulsive stage of the development of addiction, we observe a paradoxical phenomenon: inexplicable self-sabotage: a person seems to be programmed to participate in the game despite constant losses. Moreover, all of its cognitive functions and the reward system determine and realize to a greater extent the task of losing, and it is losing that keeps him in the game. The only significant reward is the very possibility of participation and continuation of the game and the only condition for a temporary, but at least some relief of the internal emotional negative state.

Therefore, we have come to changes in the reward system for gaming addictions. In many scientific studies, the award system is designated as the main target for the formation of dependence. As soon as the "capture" takes place - retraining the reward system for a narcotic substance or, in our case, a game information technology of the type: game = pleasure (excitement, strong vivid emotions, drive, euphoria, etc.), and the absence of a game, respectively = suffering, begins progress addiction. At the end of this path, the formula will change to: a game = only pleasure, and then even: game = at least a little relief. When it comes to the pathological need for a game, this is not entirely true. A person has no need for a game. The game is proposed as a way to fulfill other egoistic needs, mainly in confirming one's own significance. The game industry is an industry of states, its products deal with only one thing - it stimulates emotions, creating illusions: freedom from problems, competence, omnipotence, superiority, recognition, gaining attention and respect, the possibility of quick and easy achievements with a minimum of responsibility.

"I'm cool in the game, even very cool. Everything is working out for me. I am not afraid of anything, because everything can be replayed. I am praised and respected. However, in life, there are only problems and I'm constantly not good, they constantly



scold and teach. All the time, everything is not allowed. I rarely get something good,” and this is the answer to the question: what attracts a 9-year-old gamer to games.

### ***Sensitivity to reward and punishment***

The parts of the brain that are involved in the processes of motivation, emotional response, the processing of rewards and punishments, as well as the reinforcement of learning are combined under the term “mesocorticolimbic reinforcing system.” The striatum is considered the central modulating unit in this network of interconnected cortical and subcortical structures. It includes: ventral segmental area / substantia nigra (VTA / SN), anterior cingulate gyrus (ACC), and ventromedial prefrontal orbitofrontal cortexes (vmPFC; OFC), insula, ventral pallidum, nucleus accumbens (NAc), basolateral amygdala and hypothalamus, and its key modulatory influences: ventral tegmental area / substantia nigra (VTA / SN), anterior cingulate. Cortex (ACC), ventromedial prefrontal and orbitofrontal cortexes (vmPFC; OFC), insula, ventral pallidum, nucleus accumbens (NAc), basolateral amygdala and hypothalamus.

### **Changes in the remuneration system are studied in two main directions:**

1. Sensitivity to reward cues (cue reactivity).
2. Sensitivity to wins and losses.

### ***Sensitivity to reward cues (cue reactivity).***

Studies of the reaction of the mesocorticolimbic reward system to the incentives provided related to a computer or gambling game, depending on the type of addiction. As an incentive, visual and audio effects are used. For example, photos, words, videos, etc. During such studies, various behavioral tests and brain scans in MRI magnetic resonance imaging (fMRI) are carried out and deviations in the results of neurocognitive tasks and changes in the activation of various brain structures are recorded compared to the control group. Other instrumental methods are also used in the study of cue reactivity, for example, functional EEG for studying changes in the bioelectrical activity of various parts of the cerebral cortex, and PET with the use of radioisotopes in order to study changes in neurotransmitter processes. The autonomic parameters of the autonomic nervous system can also be measured: heart rate, blood pressure, changes in the electrical conductivity of the skin.

The vast majority of studies that with **IGD**, that with **GD** demonstrate an increase in activation in the structures of the mesocorticolimbic reward system in response to ecologically (associated precisely with the form of game activity to which the dependence has developed) signals [88-97]. It was also found that activity in these brain regions is positively correlated with the strength of subjective inducement to the games.

### ***Sensitivity to wins and losses.***

Studies conducted in this direction demonstrate very conflicting results. In patients with **GD**, in early studies using the Monetary Incentive Delay Task (MIDT), fMRI neuroimaging data showed hypoactivation in the mesocorticolimbic reward system with wins [65, 98-100]. And in later studies, which changed the conditions to more appropriate gambling in reality, on the contrary, magnetic resonance imaging (fMRI) was observed during neuroimaging in the fMRI hyperactivation in the mesocorticolimbic reward system

[73,101-103]. However, the research conditions themselves in this second group, where hyperactivation in the brain structures of the reward system was observed, were not directly related to the gain. In one of them, they studied the reaction to the expectation of a result, in the other, activation in a high-risk situation, in the third, the reaction of the brain to the so-called “almost missed” near-misses - losses close to wins when playing on a slot machine [103]. And by the way, in this latest study no increased striatal responses were noted after winning. These facts were most fully covered in recent review [104]. Mostly unequivocal were the results of the reaction to losses. In most of the research, hypoactivation was noted in the corresponding structures of the mesocorticolimbic reward system associated with the processing of losses, which indicates a decrease in sensitivity to losses.

In IGD, hyporeactivity is also noted in the mesocorticolimbic reward system, in particular, in the posterior part of the cortex of the cingulate gyrus when losing and mixed results when winning, as is the case with GD. Immediately it should be noted that the sensitivity to monetary wins and losses can be studied with a monetary card guessing task. In this task, participants have to choose between two playing cards. Depending on the color of the card, the participant either wins (red) or loses (black) money. Using this task, an fMRI study reported increased orbitofrontal activity during win conditions and decreased cingulate cortex activity during loss conditions in IGD patients compared to HCs [104, 105, 62]. As a result, it was concluded that individuals with IGD seem to be characterized by enhanced sensitivity to wins combined with lack of consideration of losses.

However, another study studied the change in the activity of the mesocorticolimbic reward system using different types of awards and feedback: monetary, social (praise), performance feedback (stating the fact of the success of the completed task) using functional magnetic resonance imaging (fMRI) [106]. Results showed reduction of the level of self-activation of the brain and decrease in sensitivity to rewards, regardless of the type of reward and feedback connection. The IGD group was only sensitive to error monitoring, regardless positive feelings, such as a feeling of satisfaction or achievement. These findings suggest show reduced levels of self-related brain activation and decreased reward sensitivity irrespective of the type of reward and feedback. AIA may be only sensitive to error monitoring regardless of positive feelings, such as sense of satisfaction or achievement.

It should be noted that, in general, there are very few studies of sensitivity to victories and losses in IGD to draw any conclusions. And in those that we have now the same test was used, as when studying this phenomenon in individuals with GD. Which is not correct, since for patients with a gambling disorder such a test can be considered close to the real gaming situation, but for people with online gambling disorder, no. For gamers, significant victories and defeats lie in a completely different plane - these are their victories and losses in the game. Therefore, for future research it is important to study the reaction of mesocorticolimbic reward in the conditions of victories and losses during the computer game.

### ***Interim summary***

Data from neurobiological studies of changes in the brain's reward system (mesocorticolimbic reward system) demonstrate

that the entire emotional motivational sphere is retrained in such a way as to support pathological self-destructive behavior-constant participation in gaming activities and this becomes the main dominant desire, and, consequently, the only significant reward. The ability to participate in the game is accompanied by positive emotions, detachment from problems and a sense of relief, the inability accompanied by negative emotions, that is, leads to subjective suffering. Winnings become important not in themselves, but as an opportunity to continue playing, that is, as a reason to play further and more. A blunted reaction to losses leads to less cautious behavior in the game, to greater risk and mistakes, to impulsive choices and compulsive “chasing losses”, to ignoring the negative consequences of the game. The decrease in the motivational significance of wins leads to the fact that after winning, a person can not stop, not satisfied with this and continues to play further. While reduced sensitivity to losses leads to an escalation of gaming behavior when failures and negative consequences of the game. The only thing that motivates the game dominant in consciousness is to constantly play, so we see the activation of the reward system of the brain in response to motivations associated with the game. Moreover, the reward system is retrained to maintain and strengthen this motivational dominant so as to constantly engage and keep the person in the game. Play constantly, play no matter what, do not stop when victories and winning, play and lose money, time, life, lose even what you do not have.

#### ***Clinical manifestations in relationship to neurobiological data***

***A game dominant*** is a dominance over all other needs, the game action attraction desires and interests associated with its effects and states. This is the symptom that underlies the DSM - 5 and ICD 11 diagnostic criteria for gambling and internet gaming disorders [53, 54]. The gaming dominant is formed under the condition of a certain subjective vulnerability of the individual at that time under the influence of game information technology. It emerges at the moment of gaming experience on the basis of strong contrasting emotions and new unusual impressions and states of consciousness, mainly due to the stimulation of the player’s sense of self-importance. It manifests itself in thoughts, fantasies, memories of the game and the desire to play. To enhance it you only need to repeat the game experience. As a result, a stable cognitive-behavioral pattern with a specific information program for implementation is formed. In the process of capturing and reconstructing the emotional and motivational sphere and all cognitive functions (functions of consciousness) “under itself” through the distribution of attention, dependence progresses. In neurocognitive tests and MRI magnetic resonance imaging (mri) neuroimaging, we observe impaired Executive functions and changes in the brain’s reward system as a result of aberrant reward-based learning. In the brain, this is reflected in various functional and structural changes, mainly in the front-striatal region. The game dominant carries the same motivational message as the information game technology that contributed to its emergence: to engage and keep in the game. And the fact that it is so confirmed thanks to numerous neurobiological studies, the review of the results which was made above. For this reason, the idea arose to consider GD and IGD from the position of the hypothesis that these behavioral dependencies are informational in nature and are the result of the gaming technologies impact on human consciousness.

#### ***The cognitive aspect. Clinical example.***

Clinicians note the dominance of the cognitive aspect in the development of addiction to gambling and Internet video games, especially when there is an increase in gaming cravings-strong to the point of compulsive attraction to the game, that often leads to gaming disruptions and unsuccessful attempts to refuse and take control of gaming behavior [58, 96, 107]. Even when a person with GD or IGD is not in the game and is busy with completely different things, thoughts about the game comes constantly. In the mind, memories of previous game episodes constantly popes up, a person replays some moments in the imagination, plans the next game, invents “winning” strategies, dreams and fantasizes about how to play next. At work, school, during communication, during training-the player does not give himself to anything fully because in his mind thoughts about the game predominate. When trying to abstain, they become very intrusive, come in bursts in the form of bright three-dimensional photographic images and scenes, as in a movie, accompanied by strong emotions, a thirst to play, do not let you sleep, especially activated before going to sleep up to eidetic hallucinations, game scenes fill dreams. In clinical studies, a lot of attention is paid to cognitive distortions and irrational beliefs of the player, which lead to erroneous conclusions and decisions, to return to the game and continue playing. [107- 109]. According to clinical observations in their own practice, the player’s consciousness is completely absorbed by game thoughts and associations, and almost every such thought, any association leads to the game. Patients, undergoing treatment and rehabilitation for gaming addictions were asked to write their thoughts in a diary, especially when they were compulsive and then performed content analysis of these records. As a result there were clearly two stages in the content of thoughts: the motivational part and the imperative part are also in reverse order: first the imperative part and then the motivational part. In the motivational part, the involvement in the game was explained, justified, and justified. Therefore, these thoughts were called motivational-they convinced to start or continue playing. And imperative thoughts, thought-orders, included scenes and images in which the player was already playing, experienced as a strong desire-impulse or obsessive desire - Play, if it is expressed in a word, but they are rarely verbalized and realized. It is interesting that the memories associated with the game are extracted from memory very selectively: you remember the winnings and how you successfully recouped, losses are forgotten.

For example, a 23-year-old patient, doctor - an Intern. Playing experience 7 years. 3 years internet gaming disorder, 4 years GD, moderate severity (sports betting). In the history of 2 suicidal attempts after the last game episode, which lasted 2 weeks, provoked the suicide of the girl and large debts. Here are excerpts from interviews that clearly show the content of the player’s thoughts, cognitive distortions, memory selectivity, motivational part, justifying, leading to the continuation of the game and what such thoughts lead to-the imperative part:

- Everything changed when I won \$ 2000 at a time. I came up with the idea that like this I can earn 10,000-15,000\$. You can win if you play with a cold mind. Lost everything. Every time pushes into the game the idea that I can cope with emotions and will not burn and win.
- Thoughts are instantaneous and it doesn’t matter what mood I’m in and what’s going on: everything still leads to bets. If you have money, you can make a bet, if you don’t have money, you can

borrow, bet and win, give a loan, and you will be left with it. The girl left me because of gambling, then returned, but made a condition: "Promise me that you will never, ever play again." I flew for a week, and a week later I started to think: "why is she bossing me around? Where is love, acceptance? Decides for me how to live and what to do?" I secretly went to a gaming club, played video games, and started betting. She waved her hand: "You're an adult, you decide for yourself." Thoughts: "Well, if she doesn't care, then you can continue."

- 3 times tried to quit, completely returned to normal life. I studied a lot in my specialty, made friends, developed, played sports-Boxing, ate normally. And then snapped. The reason - thoughts about the game, about the bets: I'll bet on a cold head, once and all, I'm already out of it. Now I could stop. The main thing is to stop during the game, keep control and keep a cool head. After losing, anger at the office and thoughts: "They unfairly took my money, you need to return it in any way."

- My father asked: "Are you a fool to take such sums at such high interest rates?" At that moment, you don't think about it in the long term. The main thing is to keep playing. I'll win it back. This is how memory works: you forget all your losses or downplay them. I remember only how I recouped earlier. I logically knew that if I started losing, I should stop and not play any more. But there are thoughts that so much has already been invested in this and we need to continue now. I try to fall asleep to switch from the game, but my thoughts are a continuous stream, such overexcitation, excitement is irresistible. When I did stop - the girlfriend helped, then the next day I returned the money.

Doctor – Did you always return?

- No, not always. Sometimes I went to the second round even harder. I played it back, then I thought: "Can I earn money and go to (+) instead of (0)? and I bet again and again I lost a lot... You see, it has been erased from my memory: what I played back remained, and what I then lost was not remembered. In relation to debt, such thoughts: "Debts are not a problem - I can always close them after recouping."

Interestingly, here we are talking to you and came up with these thoughts: "You are an idiot for telling your parents and blacklisted yourself in a bookmaker's office. You always close, at least in (0) went out. You would have close it if you'd played any more. As it was, you blacklisted yourself. Now such a problem to recover. I backed myself into a corner. If I didn't do this, I wouldn't be considered a complete drug addict, I wouldn't be controlled like a teenager, I would be trusted."

D. - and what does this lead to?

- Deceive, manipulate and play further. By the way, even the plan of how to register and where it can be done has already been scrolled in my mind.

Laughs.

D.-Is there any other way to pay back debts other than playing games?

- No, it's not realistic for me to earn that much even in a month. It's a vicious circle. You see, with the game there is some chance, but without the game it is a multi-year debt hole.

D-I Understand, but is there any way to stop after winning?

- Now I have an idea: "I'm not going to spend another cent!"

D -Was It?

- Several times

D - Really? What are we talking about here?

- Laughs. How everything is twisted. No, of course not. Continued to bet, if not on this day, then the next. God, but it's literally every thought that leads to this...

D. -How do you feel now?

- There is no desire to play, no desire at all. I am so tired mentally, completely exhausted.

D. - that is, you will rest, gain strength and can continue?

- Laughs. It turns out so. It turns out that I have already decided, but I'm deceiving myself, like I've given up, I've had enough. How important it is not to lose awareness, this position of the Observer in relation to thoughts. How did I lose my temper last time? With a colleague at work about the last game of a football team started talking and came up with the idea to go to the site to see ratings only and only... after 2 weeks I woke up with such debts that I did not remember when I borrowed, how much and where.

In studies of sensitivity to reward cue (cue reactivity), we observe a process of increased attraction to the game, which is reflected in the hyperactivity of the mesocorticolimbic reward system during the demonstration of gaming stimuli. We can also observe the activation of areas in the brain associated with memories, the very fact that associations are tightened presumably about the gaming experience, judging by the fact that the attraction to the game increases. Just as external stimuli increase attraction, so do internal images: thoughts, memories, and fantasies about the game. This is a very interesting direction for future research: how the attention to thoughts about the game will be reflected in the activation of various areas and structures of the brain, in particular in the activation of the mesocorticolimbic reward system on FMRI, as well as in changes in the bioelectric activity of the EEG cortex.

In the Study provides interesting EEG results of patients with GD and IGD that just confirm clinical observations of high activity of consciousness: thinking, memory, with emotional dysregulation and increased attraction to play [107-110]. The results show an increase in power in the beta range, which suggests increased excitability of the Central nervous system. Moreover, the authors note that the severity of gambling (CPGI-PGSI) was positively correlated with absolute beta power. Significant results appeared in the left frontal and Central areas. It was also reported that an increase in the strength of beta activity in response to positive responses is associated with the activation of a largely subcortical network covering the main areas of the reward system. The IGD group had a higher absolute strength in the gamma range (30-40 Hz) compared to the AUD group with a healthy control of [111]. Increased activity in higher frequency ranges (beta and gamma) is associated with pathological excitability of the Central nervous system in gaming addictions.

### *Altered States of consciousness in GD and IGD as a dependency factor*

From the clinical observations, thanks to the self-reports of the players themselves, it is well known that during the game, as the addiction progresses, a person enters an altered state of consciousness like a trance or hypnosis. In the scientific literature, the term flow state, flow experience, or dark flow of a dark stream occurs, but the definitions of game trance or hypnosis better characterize these States [112, 113]. When stream conditions during meditative practices, for example, expanded States of consciousness, perception becomes three-dimensional, holistic, the clarity of understanding, consciousness and the brain work

optimally, people are emotionally calm, balanced and predominant parasympathetic tone of the autonomic nervous system. And with altered States during the game, on the contrary, the consciousness becomes affectively narrowed on the game process, the player is emotionally overexcited to euphoria, the Central nervous system is also overexcited and the sympathetic tone of the autonomic nervous system prevails [114]. During a gaming trance, a number of clinically significant effects are observed, since they increase the dependence itself, or increase the risk of its occurrence, as well as the risk of negative consequences of the game [12, 115].

- **Detachment from problems, the disappearance of the entire surrounding world, complete absorption in the game process** with GD or computer game with IGD, which become the only reality for the player. Change of self-identification up to merging with a slot machine or game avatar [116-118]. Increases the sharpness of perception of sounds and color effects in the game. And in the case of a computer game, the sharpness of perception of the game world to the point that the player ceases to perceive the flaws and imperfections of computer graphics. For its narrowed perception, the game space becomes a full-fledged three-dimensional reality, the same as the real world [12]. By the way, the design of online games and gambling in online casinos very much contributes to this immersion, so its realism is very seriously worked on. In addition, games that require social interaction (team online video games) with others present contribute to the development of online flow and thus increase the risk of IGD regardless of the gamer's biological gender [119, 120]. That's how the game design has changed over the last 20 years.



- **Tahihronia - changing perception of time.** The player feels that they spent much less time playing the game than they actually did. In casinos or gaming halls, daylight and clocks are specifically excluded for the effect of losing time. The computer game introduces its own daily cycle, and full immersion in the game world with such a density of events eliminates the realistic perception of time [12, 120].

- **Violation of memory for certain events and circumstances of the game.** We have already given an example of how this happens. For example, only wins or almost wins are remembered, which, as has already been proven, motivates to continue playing, and losses are forgotten or minimized (remember that the sensitivity of the mesocorticolimbic system to losses is reduced). As a result, a person does not remember how much he lost, and how much he won, as well as where, when and how much he borrowed. Memory is also erased for behavior in the game, especially for

episodes of aggressive behavior toward family members when they tried to interfere or stop participation in the game [113].

- **Affective narrowing of consciousness on the game process, up to "tunnel" perception.** With complete emotional detachment from problems, there are actually strong emotional swings about the events in the game. From euphoria to dysphoria, from anticipatory excitement to utter despair. Sometimes the whole spectrum of emotions is experienced in one game, from peak positive to peak negative. For example, excitement, as the peak emotional state of excitement is set by the degree of risk, that is, the higher the bet, the greater the degree of excitement. Emotional swings in Internet video games are set by the events of the game, the wins and losses in the game, and what happens to the avatar, since there is a partial or complete avatar self-identification [114-118].

It was mentioned earlier that the game industry is an industry of States and ISS or dark flow is intentionally caused by game technologies that literally hypnotize the player. A rapport is established between gaming information technology and human consciousness. Dark flow state itself with the effect of detachment from life's problems and from negative emotional experiences about them, with the subsequent stimulating and euphoric effect (or immersive pleasure) can be very desirable for the player and increase the attraction to the game, and therefore the development of addiction [119-122, 119].

With the huge importance of ISS in the game: episodes of dark flow, for the development of addiction and negative psychosocial consequences, they are very little studied, especially instrumentally. And this gap needs to be filled by future research on this phenomenon, which is absolutely unique for gaming behavioral dependencies [123, 124]. Neurobiological studies confirm that dependent Internet gamers exhibit increased activation in brain regions such as the angular gyrus (AG), inferior frontal gyrus (IFG), precuneus, and in the medial prefrontal cortex (MPFC), during avatar reflection compared to self-reflection [125]. For reference, these brain regions are associated with the processing of identification, empathy, and the process of self-determination in healthy subjects. In research there was a decrease in bilateral brain activation in the AG and the middle occipital gyrus during self-perception and hyperactivity of the left angular gyrus during perception of avatar movement in the game decreased bilateral brain activations in the AG and the middle occipital gyrus during self-perception and higher activations in the left AG during avatar-perception and correlation with the severity of symptoms [126, 127]. Based on this, it was concluded that the stronger the player's identification with the avatar, the heavier the dependence.

«Twelve internet-addicted adolescents and fifteen adolescents without addiction reported whether short phrases described themselves, a well-known historical person, or their own game character while undergoing a functional magnetic resonance imaging (fMRI). Different patterns of activity emerged for adolescents with internet game addiction compared to healthy adolescents when they were thinking about themselves, another person, and their game characters. Specifically, when addicted adolescents were thinking about their own game characters, more global and significant medial prefrontal (MPFC) and anterior cingulate (ACC) activations were observed, than even when compared to thinking about themselves. The ACC activation was

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*correlated with the symptom severity. The activation patterns demonstrated that addicted adolescents were most attached to their game characters and equated their game characters to human» [43].*

That constant play, if it becomes a dominant activity, changes the brain, causing functional and structural rearrangement, is confirmed by functional studies of the brain at rest (rest-state fMRI) and morphometric studies. Using MRI (fMRI) neuroimaging techniques, you can learn how functional connections between different parts of the brain change if a person's attention and, consequently, perception is more involved in the virtual world than in the real one. One method for measuring brain connections at rest is regional homogeneity (ReHo). Patients with IGD showed increased regional homogeneity (ReHo) in the brainstem, lower parietal lobe, cerebellum, and middle frontal gyrus, which are associated with sensory-motor coordination [128]. and in the temporal, occipital, and parietal regions of the brain, which are responsible for visual and auditory functions, ReHo decreased. IGD individuals showed enhanced regional homogeneity (ReHo) in the brainstem, inferior parietal lobule, cerebellum, and middle frontal gyrus that relate with sensory-motor coordination. IGD individuals also had decreased ReHo in temporal, occipital and parietal brain regions that are responsible for visual and auditory functions.

In the study, analyzed activation in brain regions the patients with IGD in the animated ball-throwing game the task composed with ball-throwing animations [129]. Which could trigger the "disembodied state" experience. Teenagers with IGD often feel "out of body" when they are immersed in cyberspace. In this animated task, we studied neural activity in this phenomenon of ISS (altered state of consciousness) in the game and compared it with a healthy control group. Undergrowth with IGD showed higher activation in the area of the left temporo-parieto-occipital junction, right parahippocampal area, and other areas, compared to the control group exhibited higher activation in the area near the left temporo-parieto-occipital junction, right parahippocampal area, and other areas than the control group. The duration of constant Internet games was significantly correlated with the activity of the posterior area of the left middle temporal gyrus in the addiction group. These results show that adolescents with IGD easily manifest brain activation the disembodiment-related activation of the brain is easily manifested in adolescent with IGD, associated with the "disembodied state", which means they quickly dive into the ISS and go into the virtual world, which we know increases addiction.

### ***Emotional dysregulation and stress in GD and IGD***

Many people, both children, teenagers, and adults, begin to get involved in gambling or Internet video games in order to relax, disconnect from problems, or from hard work and thus improve their emotional state. As the players say themselves: "Remove stress". Of course, they do not go away from the problems into the game, but switch their attention from thoughts about problems and emotional experiences about these mental assessments and conclusions about life circumstances. All their problems are made largely by the work of the mind, nothing else. But instead of looking for solutions, changing themselves, changing the situation, as we say, growing up, developing, taking responsibility, making efforts, a person is immersed in virtual reality or the world of

gambling. From one illusion with negative images, thoughts, and emotions created in one's own mind, a person goes to another, created by information technology [130, 108, 131]. The primary psychotropic effect of this switch, associated with detachment from negative thoughts, disappears quite quickly. The game itself is an emotional stress. Participation in the game is accompanied by strong excitement, like the action of stimulants, contrasting emotions that resemble swings or swings of a pendulum: from extreme euphoria to all sorts of negative emotions. A constant game at the level of problematic and pathologic is a distress that is caused not only by events in the games, but also by their negative consequences. The arousal phase is followed by an exhaustion phase with asthenic emotions, depression, lack of desire and strength to do anything, and cognitive dysfunction. All this we observe in patients with IGD and GD [132, 133]. Indicators of experienced distress are functional and structural changes in the brain, vegetative shifts, changes in the secretion of hormones of the hypoadrenal system and neurotransmitters: cortisol, norepinephrine, and epinephrine.

***Morphometric and functional neurobiological*** studies on patients with IGD determine the dysfunction of the right dorsomedial prefrontal cortex (dmPFC), the bilateral insular lobe and the orbitofrontal cortex (OFC), the right amygdala, and the left fusiform sulcus. These areas of the brain are associated with emotional regulation, inhibitory control in relation to undesirable behavior. Previous morphometric studies have shown that IGD is associated with structural abnormalities in gray matter (GM), such as decreased gray matter volume (GMV) in the frontal, cingulate, insular, parietal cortex, and amygdala. In the same zones, a decrease in the volume of gray matter is found in post-traumatic stress syndrome as a result of severe chronic distress and depression [134]. A decrease in the volume of gray matter in these areas of the brain is observed due to the debilitating effect on the Central nervous system of chronic distress. The amygdala is known to be a critical region of the brain for regulating effective control and emotional/social behavior [135,136]. And the fusiform gyrus is involved in processing facial emotional signals and plays a very important role in recognizing emotions [137]. Research showed, the density of GM (gray matter) in the bilateral amygdala decreased, and the Association between the prefrontal cortex/Insula and the amygdala increased in individuals with IGD, which may be related to the dysregulation of their emotions. Participants with IGD also founded lower white matter density in the inferior frontal gyrus, insula, amygdala, and anterior cingulate cortex brain regions that are involved in emotional regulation and decision-making, behavioral inhibition [138, 139].

In patients with PF, there was a decrease in the content of gray matter in similar areas of the brain according to the results of morphometric studies. In structural MRI studies a significant decrease was found in the orbitofrontal cortex (OFC), in the anterior cingulate cortex (ACC), in the amygdala and hippocampus. A decrease in white matter density in studies using DTI diffusion-tensor imaging was observed in corticolimbic tracts [137-145]. All these structural changes in the brain are associated with emotional dysregulation and appear in part as a result of constant severe emotional distress during gambling. The results of morphometric and functional studies of the brain can be found in the corresponding reviews: in GD and in IGD [60- 62, 134-146].

### Changes in the level of neurotransmitters and vegetative stress indicators

The fact that gamblers and Internet gamers experience stress during the game, problem and pathological players experience emotional distress can be confirmed by the results of studies of the sympathoadrenal system and the hypothalamic-pituitary-adrenal axis (HPA-axis). There is a high activation of the sympathoadrenergic system and the HPA axis, both in GD and IGD during the game, before and after the game. What is shown in the increase in heart rate (HR), increase in blood pressure (BP) and increase in skin conductance level (SCL) [12, 147-149]. Increased levels of cortisol, norepinephrine and epinephrine, both during gaming sessions and the day before in anticipation of the game [147-152]. As we know, these hormones and neurotransmitters cause physiological and mental arousal and affect the peripheral and Central nervous system. Also, cortisol levels increased, both during the game, and for a long time with a problem game [153, 150, 154]. This increase was similar to an increase in cortisol levels in people who were exposed to acute stress factors [155, 156]. This arousal, in addition to the stimulating effect of dopamine, which is

the main neurotransmitter of the reward system, and the level of which also increases significantly during the game, is very attractive to players and can contribute to addiction [154, 157]. Outside the game levels of dopamine, cortisol, norepinephrine, epinephrine with GD and IGD gets down to the normal level or even much lower of the normal level, depending on the severity of clinical manifestations [150, 158-160]. These results are an indicator of the change of the excitement phase to the exhaustion phase. There are works, though they are very few that demonstrate how over time, with increasing severity of symptoms blunted stress response and reduced cortisol levels during the game, as well as on the playing incentives, smoothed curve of measurements of the diurnal cortisol. This indicates the severity of the disease (astheno-depressive phase) and deep exhaustion of the Central nervous system as a result of chronic distress [158-161]. This dynamic change in stress responses is associated with severe consequences for mental health [162-165]. Changes in the level of neurotransmitters in the brain were measured using positron emission tomography (PET), as well as by measuring levels of norepinephrine, monoamine metabolites, and peptides in cerebrospinal fluid, plasma, and urine.

### Features of the clinical image and psychopathological syndromes

Table 4

Clinical syndromes	Gambling disorder	Internet gaming disorder
<b>Addiction syndrome</b>	<ul style="list-style-type: none"> <li>- time is increasing, frequency and bets in the game</li> <li>- loss of control over time in the game and number of money spent in the game</li> <li>- very fast formation of the addiction (sometimes from the first time – reactive imprinting, especially in large win at the start)</li> <li>- the game becomes the dominating need, replacing other interests and relationships. The rest of the life, people (relatives, friends, acquaintances, colleagues), job, are evaluated just like a tool for the game</li> <li>- high providertest: 4-5 months-1.5 years until the game becomes the main priority. For women, 2 times faster</li> <li>- constant obsessive thoughts about the game, in the form of bright 3D images: fantasies, memories, feverish planning of the upcoming win</li> <li>- a strong compulsive desire (craving) to play, almost without a struggle of motives</li> <li>- pathological attraction is intense and generalized</li> <li>- euphoria, emotional excitement which comes when a person decided to play</li> <li>- reducing mood, dysphoria, discomfort, tension when unable to play. [40-42, 48, 51, 52-54, 58, 96, 109]</li> </ul>	<ul style="list-style-type: none"> <li>- increase the time spent playing and the frequency of games</li> <li>- loss of control over time in the game</li> <li>- first, games are given great importance, then they become a priority activity to the detriment of all other interests and communication, study, work, and development</li> <li>- to the detriment of even basic needs (food, sleep, etc.), can even ignore severe pain</li> <li>- it becomes very difficult to limit the game activity, and then it stops only under external pressure</li> <li>- obsessive thoughts and images of the game, thinks about the game even when not playing</li> <li>- Strong compulsive desire to play (craving)</li> <li>- positive emotions, high spirits, anticipation by making a decision.</li> <li>- negative emotions (dysphoria, irritability, anxiety) and reduced mood while limiting the game. [1-3, 8, 12, 34, 44-46, 108, 165]</li> </ul>
<b>Altered state of consciousness «play trance»</b>	<ul style="list-style-type: none"> <li>- the gambler enters this state during the game or before the game</li> <li>- there is a strong emotional excitement, excitement under the influence of bright photographic images, three-dimensional images with all the incentives to play and fantasies on this topic</li> <li>- memory works selectively: only winnings are remembered</li> <li>- in 92%, tachychronia is a change in the perception of time</li> <li>- more than 54% have detachment, the disappearance of the entire world around them, merging with the machine or dissolving in another game process</li> <li>- increases the sharpness of perception of sounds and game effects</li> <li>- memory impairment for certain events and circumstances of the game</li> <li>- the state of the game trance, according to the picture of the EEG and the reaction of the autonomic nervous system, corresponds to the picture of the hypnotic state</li> <li>- in a trance, the player will play until he is left with no power or money. [58,112-114,122]</li> </ul>	<ul style="list-style-type: none"> <li>- Transfer of attention and perception to the space of the game with</li> <li>- fixing the gaze and fading in a stationary position, while not feeling discomfort, tension, or even pain</li> <li>- avatar self-identification - violation of self-perception of yourself as a game character</li> <li>- Tachychronia (acceleration of the flow of time)</li> <li>- detachment from people, worries, problems, promises</li> <li>- “animating” virtual reality while the resolution of the graphics is no longer perceived</li> <li>- the perception of information from the outside world is blunted, the corneal reflex is decreasing</li> <li>- game events evoke strong emotions</li> <li>- derealization and inhibition after the game: the real world is perceived as unusual, doubts about whether he is in the real world or virtual appear. [12,43, 115-121,123-127,129]</li> </ul>

<p><b>Stress while playing</b></p>	<ul style="list-style-type: none"> <li>- The primary psychotropic effect of gambling is illusory and quickly fades: "I play to relax, to distract myself."</li> <li>- The player is in a state of severe emotional distress during the game, before and after the game, when he is facing the reality of increasing problems in family relationships, at work, and growing debts</li> </ul> <p><b>Distress of the gambling gamers confirms:</b></p> <ul style="list-style-type: none"> <li>- studies of the autonomic nervous system: enhancing sympathetic effects,</li> <li>- changes in the concentration of neurotransmitters in the brain and stress hormones in the blood increases the level of epinephrine and norepinephrine</li> <li>- the characteristic changes in the biorhythms of the brain on EEG</li> <li>- in brain structures on MRI, which then manifests itself in a decrease in impulse control and cognitive flexibility, and in emotional dysregulation in neurocognitive studies. That is, functional disorders of the prefrontal and paraorbital cortex and subcortical structures of the intermediate brain.</li> </ul> <p>[110, 133, 147 -155, 158-160]</p>	<ul style="list-style-type: none"> <li>- The more game experience and the more developed the ability to dive into the game is, the higher the subjective toning effect</li> <li>- But objectively, the player is in a state of simulated stress</li> <li>- events and experience of the game are perceived as real so the player experiences strong emotions: euphoria is replaced by negative emotions due to failures in the game</li> <li>- manifestations of stress are confirmed by studies of the autonomic nervous system function, EEG and MRI, as well as various tests of changes in the emotional state and cognitive functions</li> <li>- signs of exhaustion and vegetative dystonia are consequences of stress</li> </ul> <p>[12,32, 33, 45, 130-132]</p>
<p><b>Deep exhaustion of the Central nervous system as a result of chronic distress (Asthenodepressive syndrome after the game)</b></p>	<ul style="list-style-type: none"> <li>- reduced mood up to severe depression with devastation, anxiety, self-hatred, despair</li> <li>- thoughts of an accusing, critical nature in relation to yourself or others (to the gambling establishment, family members), frightening content, regret and justify himself</li> <li>- episodic or obsessive suicidal thoughts may appear</li> <li>- weakness, exhaustion, emotional hypersensitivity, drowsiness, apathy</li> <li>- vegetative dystonia</li> <li>- irritability, dysphoria, tension.</li> </ul> <p>[41, 52, 140-145, 161]</p>	<p>Resembles the state of the nervous system after the action of stimulants</p> <ul style="list-style-type: none"> <li>- after the game, the mood drops dramatically</li> <li>- apathy, lack of desire and strength to do something, study, communicate</li> <li>- internal tension, alarm</li> <li>- fatigue, reduced concentration, slow thinking, slowness</li> <li>- emotional hypersensitivity, irritability</li> <li>- autonomic dysfunction</li> <li>- changes in EEG biorhythms characteristic of asthenia.</li> </ul> <p>[33, 111, 130 - 132, 134 -139, 159, 160]</p>

## Conclusions

GD and IGD show very many common intersections in clinical manifestations and neurobiological changes, as well as in negative psychosocial consequences and comorbid psychopathology. We considered the game dependencies GD and IGD as the result of interaction, or rather the impact of a certain information technology - the game on the human mind. As a result, under the condition of a certain subjective vulnerability, a stable game dominant (pathological attraction, need) is formed, the only motivational premise of which is involvement in gaming activities. The game dominant gradually and consistently subordinates the brain's reward system, emotional-motivational and cognitive sphere. As a result, human values, worldview, and behavior change. The ability to return and participate in the game becomes the dominant need, value, interest, and the only meaningful reward. This core symptom persists and only gets worse at all clinical stages of the disorder. The motivational message of the game dominant coincides with the main motivational message of game information technologies - the involvement and retention of human attention in the game.

Neurobiological studies have found that changes in Executive functions, impulsive choice with the inability to postpone pleasure, impaired decision - making with increased risk, and even deliberately losing options, cognitive rigidity with compulsive repetition of self-destructive, inappropriate, template behavior without taking into account feedback, are associated with aberrant learning of the reward system. Decreased activation is found in brain structures associated with the mesocorticolimbic reward system: that is, hyporeactivity when losing and ambiguous reaction to winnings (then Hypo, then hyperreactivity), but definitely hyperreactivity in response to stimuli associated with the game. Thus, participation in the game becomes the only significant reward.

## In the clinical manifestation of the gaming dependencies we can see the same for all addictions signs:

1. The appearance and increase to compulsive desire of a pathological need, an attraction to the game
2. Increasing the duration and frequency of game episodes, as well as the funds spent, up to the denial of the problem and loss of control over the game activity
3. The game becomes the dominant need, displacing all other interests and activities including even basic needs.
4. Pathological behavior is repeated despite the negative consequences.
5. Discomfort and negative emotions when it is impossible to realize the pathological desire, comfort and positive emotions when implementing (returning to the game).

## Clinical manifestations that are unique for this dependence are also noted.

1. **Game addictions are formed without the influence of the substance on the neurons of the brain.** They are called behavioral, in the sense that they have a certain (game) behavior that leads to the desired effects. But there is a certain information product - the game, which affects a person's consciousness. And as the result pathological need, a strong dependence appears, which fully changes the brain activity, absorbs all of life's time and attention of a person, destroys his personality, relationships, ability to love, to feel satisfaction, to be happy, to learn and to develop.
2. **Personality changes in terms of spiritual and moral degradation are rapidly increasing:** lies, manipulations, egoistic, consumer attitude to close people, friends, colleagues, who are considered as resources for playing, and

empathy decreases. The circle of communication is narrowed down to social isolation and replacement of society with gaming. The idol of a person becomes a game, or rather he by himself is in the game, egoism and narcissism increase. The player stops caring about others, on the contrary, solves his problems at the expense of other people's life resources. He loses responsibility, the ability to love, to feel gratitude, that is, the highest human feelings.

**3. Altered state of consciousness-game trance or hypnosis**

In these States, the mind is affectively narrowed on the game, he loses the ability to adequate critical thinking and objective assessment of what is happening, memory for the sequence of events, perception of time, space, and self-perception is violated. In this trance, the person fully identifies himself with the avatar-the hero of the game or with the game image in a gambling game. This is confirmed by MRI studies. This condition is dangerous, especially for children and teenagers, because they automatically learn the worldview, behavior patterns and values embedded in the characters of games and its ideological concept without critical thinking. And if you consider that game plots are built on consumer attitudes, deception, cunning, greed, manipulation, competition and violence, it is not difficult to guess what children and young people learn.

**4. The ideator component predominates in the formation of pathological attraction and behavior.**

Constant obsessive thoughts about the game, even when not playing, flow through memories, fantasies, and planning game events. That is, in the thoughts in the imagination, the player is constantly in the game. Thoughts come in the form of a very bright images, three-dimensional images, entire movies. This causes strong emotions and a strong, generalized compulsive attraction to the game, which captures all thoughts totally, is attached to any event, literally every Association leads to the game.

**5. The game is an emotional stress** that energetically drains the nervous system and the body, depriving the vital energy, tone and motivation for something else, behavior. It is an additional load on the brain, not rest and relaxation, as it is served by the gaming industry.

**6. Outcome-astheno-depressive symptoms and conditions** that are caused not only by the stimulating effects of games, but also by emotional stress. This is also facilitated by the fact that social consequences accumulate in the form of all sorts of problems, debts and conflicts in relationships. These problems were not solved by themselves as long as the person was removed from them in games, but only accumulated and worsened. This is also a source of stress and the only solution that the formed game dominant will offer through thoughts and motivations is to return to the game again. This closes the vicious circle of addictions.

There are a lot of white spots and contradictions in research on gaming addictions, so it is necessary to further in-depth and large-scale study of all their aspects, especially the prevalence, cognitive distortion and thought content, compulsivity, emotional distress and dysregulation, altered States of consciousness in GD and IGD. These studies will provide an opportunity to study how information gaming technologies create conditions for addiction; develop effective methods of prevention, treatment and rehabilitation. In future studies, it is very important to form a sample of patients taking into account the clinical stage, that is, the

severity of symptoms, and in research conditions, the stages of the game cycle must be strictly observed. It is also important to strive for research as close as possible to the real game situation. This way we can avoid contradictions as much as possible and come to objective results.

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