

## CLINICAL PSYCHOLOGY

### **Higher mental functions and time perception in internet-addicted teenagers**

Anna V. Katasonova\*, Sergey V. Perkovsky, Natalya A. Kravtsova

*Pacific State Medical University, Vladivostok, Russia*

\* Corresponding author. E-mail: calvaria@mail.ru

Statistical data about Internet users indicates that Russia ranks first in Europe in terms of its number of Internet users. Young people prevail among Russia's Internet users. Internet dependence behaviour is given a definition. The behavioural peculiarities of Internet addicts are considered. Time perception is a background for psychical processes. The time focus of the human psyche reveals itself in the speed and duration of perception, impression, memory, thought and emotions peculiar to people with a certain temperament and of a certain age, sex and group. Time perception is an integral part of our mental processes. A human being is inclined to consider all events and processes taking place around him as a process which takes time. The time perception of every person is always specific, and it is reflected in his or her thought and behaviour. The results of studying higher mental functions and time perception in internet-addicted teenagers are given. The obtained results have revealed distraction at the end of the study due to the high exhaustiveness of the neuro-dynamic component of mental activity, as well as the poorer ability of Internet addicts to be conscious of themselves in time. Given the absence of a clear pattern of their roles in real life, Internet addicts may often find that their addiction results in mental conflicts and self-aggression. In turn, it may result in impulsion, confusion, certain problems with explaining personal actions, wishes and motives. Internet-addicted teenagers have a more pessimistic attitude towards their time and life activity. When running into hardship, their behavioural performance and incentives to overcome barriers may be limited.

**Keywords:** Internet addiction, time perception, higher mental functions

The problem of dependence (addictive) behaviour has been considered urgent by psychology for the past several decades. Addiction development mechanisms were first described by classic psychoanalytic literature in the early 20th century. Forms of dependent behaviour alter, depending directly on the scientific and technical development of society. A low level of tolerance for real-life hardship results in the

desire to escape from reality, which is the basis of dependent behaviour. However, the forms and ways of escaping from reality vary considerably and are very often pathological in their nature. Internet addiction is one such form.

The number of Internet users is growing quickly all over the world. In terms of its total number of Internet users, Russia ranks first in Europe, now outranking Germany, the former leader; its number of users ranked sixth in the world in 2012. According to February 2013 data from by the analytic company TNS<sup>\*</sup>, 76.5 mln Russians (or 53% of the country's total population) go on-line at least once a month. The number of mobile Internet users is growing exponentially. It grew by 48% in 2013 alone. According to RIA Novosti, about 95% of smartphone owners in Russia use them for sending SMS messages, 66% use their phones to surf the Internet and work with applications and more than 50% use them for communicating via social networks and checking their e-mail. Games, social networks and maps remain the most popular applications in Russia. Moreover, social networks have roped in 80% of Russia's daytime audience<sup>\*\*</sup>.

Nowadays, young people (age 18 to 24) account for 37–38% of all Russian Internet users. Additionally, it may be noted that the number of young people that use the Internet is growing faster than in other age cohorts. The fact that the number of social network users is growing among schoolchildren who are as young as nine years old is worth taking note of.

Internet addiction is defined as an obsessive desire to connect to the Internet and a morbid inability to remain disconnected from it for a period of time. Internet addiction reveals itself in situations where people are so engrossed in their Internet lives that they begin to forsake their “real” lives, avoiding face-to-face contacts within their social environment. As a result, their communication skills and ability to adapt begin to worsen. These Internet addicts begin to find it more and more difficult to establish contacts with their environment and to suffer stress when communicating with strangers.

Time perception is a background for all mental processes. It makes it possible not only to actively perceive the world and pattern behaviour, but also build up relationships with other people. We can't abandon the notion of time; whether it is in everyday life or when describing most scientific phenomena. Time affects all mental processes, penetrating and uniting them. The time focus of the human psyche reveals itself in the speed and duration of perception, impression, memory, thought and emotions peculiar to people with a certain temperament and of a certain age, sex and group (Mikadze, 2008). Time perception is an integral part of our psychological processes. A human being is inclined to consider all events and processes taking place around him as lasting in time. The individual peculiarities of time perception are directly reflected in the thought patterns and behaviour of every person (Bolotova, 2006).

We have carried out an empiric study of time perception in Internet-addicted teenagers.

\* TNS (TaylorNelsonSofres) calculates the number of Internet users older than 12 years old living in cities with a population of 100,000 and more.

\*\* Data from the 17th RIF+IBC 2013 Conference (RIF — Russian Internet Forum, IBC — Internet and Business Conference) held near Moscow on 17–19 April.

## **Research material and methods**

Sixty people between the ages of 17 and 22 participated in the study, including 26 women and 34 men. The empirical group (EG) was formed after a pilot study was carried out on the basis of G.V. Lozovaya's Diagnostic technique of proneness to different types of addiction and Kimberly Young's Internet Addiction Test. The above-mentioned techniques allow Internet significance level to be evaluated for the people in the study. This is achieved by revealing the high-priority needs of the people in the study with regard to perception — both objective and subjective — of time spent on computer activity.

According to the test results, 19 young men and 11 girls with a high level of Internet addiction were included into the empirical group (EG). The group was distributed as follows: eight people under the study were high-school students, 15 were college and university students, and seven worked from home providing freelance services. All of the groups included in the study, to a great extent, substituted real communication with social network activities and chatting. This group was also characterized by the fact that the amount of time they spent on computer activity outweighed the time they spent on household and day-to-day activities.

The control group (CG) consisted of 15 girls and 15 young men who didn't demonstrate signs of Internet addiction. The group was distributed as follows: six were high school graduates, 19 were college and university students, and five were young men who worked in commerce and management. The subjects in the control group preferred "live" to virtual communication and used social networks primarily to communicate with geographically remote persons. The people in the study from this group are characterized by having the ability to set priorities when planning their days.

When developing a set of methodological material, we assumed that time perception is a process which depends immediately on other intellectual activity areas. That is why any neuropsychological factor's loss or distortion causes qualitative changes in time perception structure, which is the reason for studying higher mental functions in Internet-addicted teenagers. During the course of the study, we used the neuropsychological album for diagnosing higher mental functions under the editorship of E.D. Khomskaya and the time semantic differential method. In addition to conducting a qualitative analysis of the defect, we used a quantitative analysis based on the four-score task performance evaluation system developed by A.R. Luriya.

Score 0 — substantially correct performance of tasks without errors;

Score 1 — 75% of tests correctly performed, 25% errors;

Score 2 — 50% of tests correctly performed, 50% errors;

Score 3 — 100% of tests performed in error.

The calculation of error percentage in each test enables us to make a curve which reflects the symptom distribution within the syndrome and its nucleus as of the time of examination.

We estimated the obtained results by means of calculating the Mann — Whitney U-test.

## Research results analysis and discussion

Our neuropsychological test analysis has revealed the following general characteristics of higher mental functions in Internet-addicted youths: they were distracted by the end of the test, and they had problems with spatio-temporal gnosis and intellectual activity. The significantly relevant differences ( $p \leq 0.05$ ) obtained are presented in table 1.

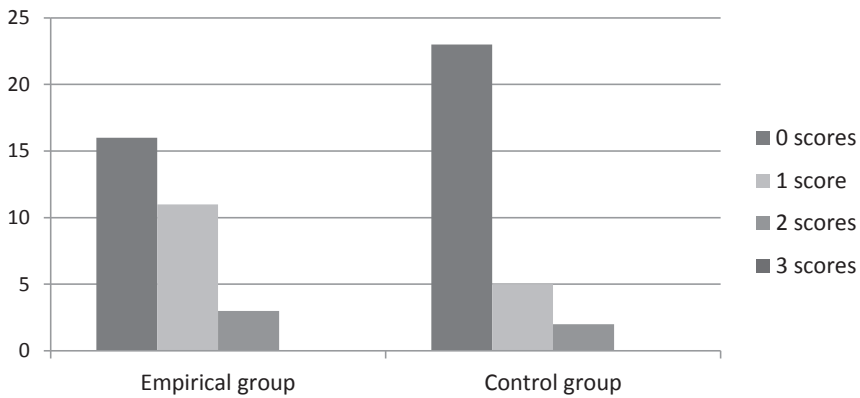
**Table 1.** Checking the homogeneity of intellectual features: levels in empirical and control groups

No. in sequence	Parameter of intellectual feature	Volumes of compared samples	Mann–Whitney U-test	Significance value of hypothesis rejection $\alpha$ (one-sided test)
1	Attention (beginning of study)	30/30	494.0000	0.452
2	Attention (end of study)	30/30	<b>579.0000</b>	<b>0.026</b>
3	“Fist–sharp of hand–palm” test	30/30	515.0000	0.192
4	Reciprocal coordination	30/30	466.0000	0.782
5	Visuospatial gnosis	30/30	<b>561.0000</b>	<b>0.045</b>
6	Mnestic activity	30/30	543.0000	0.084
7	Understanding essence of stories	30/30	457.0000	0.906
8	Counting operations	30/30	<b>327.0000</b>	<b>0.042</b>
9	Understanding logical and grammatical structures	<b>30/30</b>	<b>576.0000</b>	<b>0.029</b>
10	Emotional-volitional area	30/30	<b>474.0000</b>	<b>0.045</b>

Attention is the most important mental process closely associated with general and channelled activity, intentions and motivation. During the course of our research, we evaluated voluntary and involuntary attention, the ability to focus and refocus attention, attention allocation ability, and range of attention. The attention of the subjects in the study was evaluated during the course of conversation with them and in all further studies. In order to identify the peculiarities of attention, we also used Schulte table. In this test, the subjects were required to find and to name all numbers from 1 to 25 in the right order. The test was performed against time, and both total time and the time it took a subject to find the first 5, 10, 15, 20, and 25 were recorded. The standard time it takes to perform this test is 40 sec. The ability to distribute and control attention is one of the most important components of time perception; it is reflected in one’s subjective estimation of the stream of time. Moreover, the level of attention control is directly connected with the ability to plan activities and use time efficiently.

The attention test, according to the Schulte tables carried out at the end of the study, has shown the difference between the empirical and control groups, which were expressed both quantitatively and qualitatively. Figure 1 presents the test results. According to these results, 11 subjects from the empirical group have shown

apparent fluctuations of time intervals when looking for numbers in the tables, as well as the irregularity of time intervals. Three of the subjects needed long time intervals (more than 40 seconds) to find numbers. Therefore statistical analysis has found that Internet-addicted young men are significantly more likely to have apparent time fluctuations when looking for numbers in Schulte tables ( $p \leq 0.05$ ), and that there is an increase of time required to perform the test at the end of the study because of problems with refocusing, focusing and scope of attention. That allows us to conclude that the function of controlling frontal areas has worsened and that mental activity is characterised by a higher level of exhaustiveness. These brain area disturbances or decline in activity may bring about a short attention span, impulsivity and a lack of clarity in aims, causing mistakes in future planning. As a result, the brain's executive functions fail to manage time, propositions, impulses, or organisation efficiently and they fail to provide a sufficient level of critical thinking.



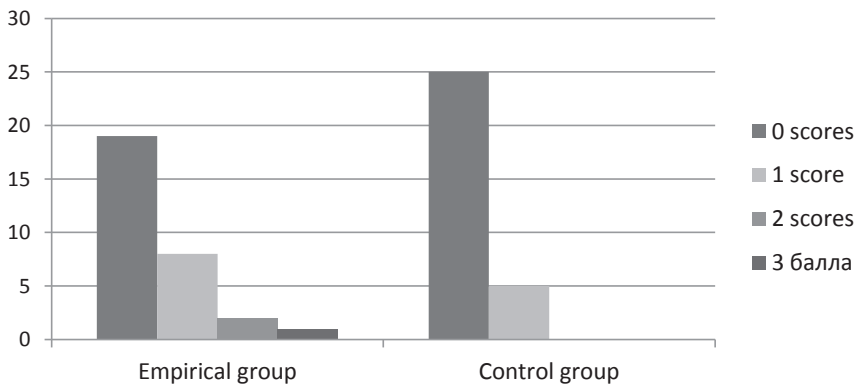
**Figure 1.** Results of attention test performance by the empirical group and control group at the end of the study

The exhaustion of the brain's attention span revealed during the course of the research may be accounted for by the fact that the human brain is not meant to spend long periods of time detecting information that comes from different sources. A long and deep immersion in the digital world results in a particular overstrain. Most respondents from the empirical group who spent numerous hours at a time working on the Internet admit that at one time or another they begin to make many mistakes. Before logging off, they felt spent; they were fatigued, irritated and upset.

In the course of the spatio-temporal gnosis study, we have found that the Internet-addicted youths showed worsened spatial orientation significantly more commonly ( $p \leq 0.05$ ).

Tests for letter and number recognition and choice, "blind clock" were carried out to study visual-spatial perception. Eight people involved in the study from the empirical group found it difficult to perform tasks, and two made mistakes which were corrected only after the experimenter had indicated them. Also, one person from the group undergoing the study refused to perform the test in a timely manner. Figure 2 shows the study results.

Clock hands mirroring, mistakes in perception of the movement of clock hands, may indicate certain problems of spatial orientation. Some persons in the study from the control group (four people) declared they had difficulties perceiving surrounding objects following periods of exposure to virtual reality. Moreover, when moving in space, their motion coordination worsened and resulted in involuntary interference with objects. Consequently, such peculiarities imply a reduced ability to remain aware of spatial relationships, which are tightly connected with time perception. Within this test, time perception evaluation meant the discovery of a socially-accepted standards-forming structure which allows one to interact and orient oneself in social activities. The problems associated with how one perceives live day-to-day affect adaptive capacity and personal performance. Accurate time evaluation allows for communicating, cooperating, and interacting in society. That is why a failure of synchrony influences any collective activity. This in turn may result in mal-adaptation and intrapersonal conflicts.

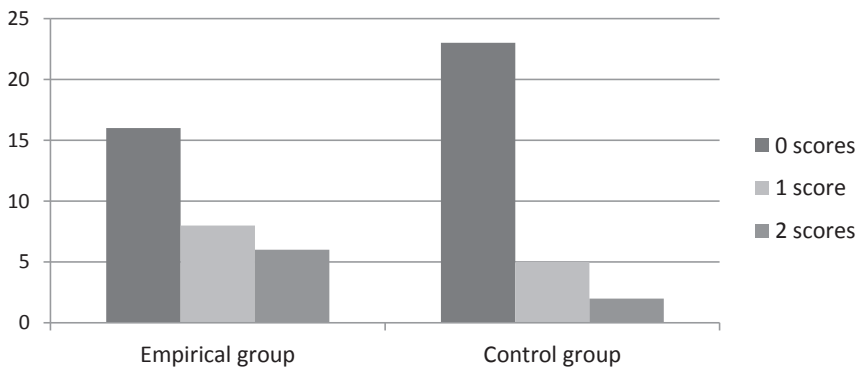


**Figure 2.** Results of gnosia test performance

Yu.V. Mikadze, N.K. Korsakova (2002) and A.V. Semenovich (2002, 2007) noted that spatio-temporal ideas are derivative of one's body image and can transform as independent only "on the ground of ideas about one's own body image and motion activity in a given real living space". Therefore, we suppose that the detected worsening of spatial awareness influences emotional adaptation and behavioural reactions, as well as communication, cognitive activity and motion. Most respondents were observed to have a lower level of educational motivation, lack any need for self-improvement, were indifferent to what was going on around them and lacked motion in reality.

When estimating the level of speech development during the course of the study, we found that Internet addicts have some speech development peculiarities. The young people from the empirical group were the only ones to use clichéd speech; their vocabularies were poorer than those of the CG respondents. It has also been noted that they have problems creating and maintaining interpersonal contact due to the difficulties they had finding words. Their speech was emotionally inexpressive, monotonous and wasn't accompanied with corresponding facial expression and gestures.

The analysis of the test results with respect to Internet addicts has shown that they coped with tasks involving the understanding of logical and grammatical structures worse. The data obtained are shown in Table 3. During the course of the study, we evaluated the ability to understand prepositional structures with the help of illustrations, as well as grammatical structures (such as *Point to the pencil with your copybook, vs. to the key with your pencil*), and comparative structures (which of the following sentences is correct: *A fly is bigger than an elephant. An elephant is bigger than a fly*), as well as the understanding of inversions (*Kolya was struck by Vanya — who is the hot-head?*) Understanding logical and grammatical structures is a hard process of analysis and synthesis. A person's activities and motivating area of consciousness including needs, interests and emotions is a necessary condition for the full understanding of speech (Semenovich, 2007).



**Figure 3.** Results of performance of test for understanding logical and grammatical structures

In the course of this technique performance, the empirical group showed certain problems with the explanation and/or verbalization of the observed data. Within the empirical group, six persons only performed the task correctly with the experimenter's help and after mistakes were indicated. An additional eight people were registered to make single errors with subsequent self-correction at the beginning of this task's performance. In general, the empirical group can be characterized as needing more latent time for understanding inverted structures (the oilcloth is covered with a tablecloth, the boy is saved by a girl — who saved whom?; the car is transported by the tractor, etc.). Semantically simple structures and one-word sentences prevailed in their speech. They often use slang. When they face problems with verbalization, the persons in the study actively use gestures to help themselves. They often say it would be easier for them to write it than to say it aloud.

An understanding of the statistically significant data obtained regarding differences in logical-grammatical structures leads to the conclusion that a reduction of communication activities in real life (which is substituted with Internet communication) results in a loss of non-verbal elements of communication perception and a general worsening of communicative skills. Since virtual reality distances an Internet-addicted person from his/her friends and relatives, over the course of time it impedes professional activity and gradually starts imposing its requirements and 'standards of behaviour'.

Such standards emerge from the peculiarities of the Internet: its extremely expressed dynamic properties. The Internet is subject to quick changes and constant progress and it provides people with a diverse means of communication. Furthermore, its range of informational tools is rather wide and it may cover not only professional activity but also interpersonal relations, which are separate from work-related relationships.

It is rather difficult to imagine modern society without technical devices in its constant pursuit of higher efficiency. Besides, the need for information stimulates the creation of new interpersonal ties. However, the rapid accumulation of information may result in a loss of its reliability as well as its value. The great demand for multimedia technologies may be related to this fact. They are aimed at the creation of emotionally rich products which are capable of attracting the customer's interest. All of this in turn finds its reflection on a psycho-physiological level. People absorb information holistically and accept it at face value without understanding and analysing it or verifying its timeliness and whether or not it's up to date (this applies especially to reference literature). It leaves one with the feeling that many command information while remaining more or less unknowledgeable. From this point of view, dextro-cerebral thinking starts to dominate, which is prone to engaging in a sensorial perception of reality and interaction with it but pushes objective facts to the background. Consequences can be obviously seen in modern Russian society, where the perceived trustworthiness of religious dogmata is increasing day to day. All of the information stated above is confirmed by the results obtained when using the time semantic differential technique. Such results clearly indicate a prevailing pessimistic and apathetic attitude to the present time. It expresses itself not only in addicts' reduced ability to manage their time but also in a general de-prioritization of any attempt to re-organize their lives or improve them in any way. The only way which allows Internet addicts to accept the imperceptible course of time is their hope for a bright and well-ordered future. But, unfortunately, "tomorrow never comes" and a positive attitude to their future time transforms into blind faith.

However, resources which can assist in professional activity and relieve "stress" in spare time require a significant energy cost. An Internet surfer is engaged in a multitasking mode which gradually drains the user. Additionally, information obtained in such a mode is often simplified. This is rather obviously reflected in Internet communication. Active Internet users are inclined to shorten their words and expressions or substitute them with special slang when trying to convey information to their "conversation partners". Moreover, a significant number of their thoughts are conveyed visually through symbols and represented with pre-established graphical elements or patterns. Therefore, Internet-based communication is filled with special signs and symbolic forms.

When a person is excessively engrossed in the Internet, this form of communication becomes "natural" and socially accepted; speech lacking such auxiliary means is pushed out to the background. As a result, such persons gradually lose their communication skills and may have significant difficulties when facing real conditions where they have to convey meaning. Such activity may have very diverse consequences and maladaptive forms of interpersonal behaviour may manifest themselves as artificial autism (Kerdellant & Gresillon, 2006). These communication problems could disturb the functioning of the tertiary parietal-temporal-



occipital area on the right hemisphere of the brain, which is responsible for one's awareness of spatial variations and reflects "the time perspective principle".

Our statistically reliable data on our subjects' differences in understanding logic and grammatical structures leads us to conclude that the replacement of real-life communication activity with Internet communication results in a poor understanding of nonverbal speech and a general worsening of communication skills. Additionally, researchers note that "Internet-dwellers" are inclined to simplify their language and have artificial autism (Kerdellant & Gresillon, 2006). The whole scope of these factors could cause certain deviations of the TPO area on the right, which is responsible for the ability to feel spatial variations and reflects "the principle of time perspective".

The analysis of tests for arithmetic operations has shown that the EG respondents have significantly better results ( $P < 0.05$ ). The better results obtained by Internet addicts when carrying out arithmetic operations prove that they have well-formed symbolic images, controlled by intra-parietal sulcus.

The analysis of the results of time perception study using semantic differentials has shown that there are statistically significant differences in present time perception. Internet addicts have poorer present time evaluation results with respect to its emotional colouring and sense ( $p < 0.05$ ). The lower figures (as compared with the CG respondents) may indicate that Internet-addicted teenagers have a more pessimistic attitude towards their time and life activity. When they encounter obstacles, their behavioural performance and incentives to overcome barriers may be limited. Moreover, we have found significantly lower figures with respect to time sense in the EG respondents, indicating their poorer ability to be conscious of self in time, or be able to feel events taking place around them and feel involved in them. This description also implies the ability to manage time in accordance with socially established standards. The absence of a clear pattern of their roles in real life may often result in internal psychological conflict and self-aggression. In turn, it may result in impulsion, confusion, and certain problems in explaining their personal actions, wishes and motives. We have not found any significant differences between the respondents in the sample when evaluating their perceptions regarding the future. That allows us to suppose that the future is perceived by both groups as a resource. And while there is a negative component in perceiving the present by Internet addicts, accompanied with a loss of sensing what is going on, they are hopeful that they will overcome their negative feelings in future.

As a whole, the past is perceived by Internet addicts more positively than the present. However, as compared with the CG respondents, significant differences have been found ( $p < 0.05$ ) in time-sensing figures. Difficulties in organising their own behaviour and awareness of roles in the present events may result in dissatisfaction with their lives that is reflected in a negative emotional colouring of the present.

Thus, in the course of the study, we have found the following peculiarities of higher mental functions in Internet-addicted teenagers:

1. Shorter attention span, manifesting in a longer period of time needed for performing a test at the end of the research;
2. Impaired spatial awareness;

3. A poorer understanding of logical and grammatical structures;
4. Better mathematical computational abilities.

Also, time perception in Internet addicts has certain peculiarities:

1. A poorer ability to be conscious of themselves in time, or be able to feel attached to events taking place around them and feel involved in them.
2. As a whole, the past is perceived by Internet addicts more positively than the present.
3. Perception of the present has a more negative colouring.

The results obtained are preliminary and the peculiarities of time perception and higher mental functions in Internet-addicted teenagers require extensive further study. Such a study must be based on a broader sample, which will allow us to improve our understanding of how the excessive use of information technology warps one's perception of reality in the mind and reduces adaptive skills. Additionally, the obtained results indicate that internet addicts suffer certain difficulties perceiving space and "body image". The details of this problem could be illuminated through further research. A qualitative analysis of this fact will make it possible to detect an underlying neuropsychological factor behind the defect and determine primary and secondary disturbances. That will facilitate understanding if somatognosis and space perception disturbances result in reduction of spatial awareness and, consequently, a worsening ability to immerse one's self in the digital world, or if Internet addiction changes space perception.

Moreover, it is necessary to differentiate specific types of network activities and the personality and psychophysiological changes associated with them.

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