

Features of voluntary attention of adult Internet users

Abstract

The article is devoted to a general problem of digital technologies' influence on cognitive processes, viz. long-term changes in selective attention of adult Internet users. The study is based on two postulates of a psychologist, Lev Vygotsky: the idea of an indirect structure of cultural functions and a genetic law that determines its decay as a comeback to a simpler organizational level. The study was carried out through a comparative analysis of the voluntary attention of adults who prefer different code systems: traditional printed or modern digital. Conventionally, we divided the participants into 2 groups: the readers ($n=50$, aged 46.18 ± 6.71 , 21 males and 29 females) and the Internet users ($n=50$, aged 45.38 ± 5.86 , 21 males and 29 females). The parameters were estimated via "The arrangement of the numbers" test. As starting points, we took the average results established in the pre-digital era, on one hand; and the indicators of attention of young, active Internet users (to clarify the results of the study, an additional group was comprised), on the other hand. The revealed empirical facts showed that the voluntary attention is significantly better in the group of the readers ($p\leq 0.01$). Their indicators are close to the norm of the "pre-digital" people. The indicators of the Internet users are closer to the one of young Internet users, both in accuracy ($p\leq 0.05$) and distribution ($p> 0.05$). We suggest positing a significant deterioration of selective attention as a cognitive deformation phenomenon, which is expressed in the regression of higher mental functions to its more primitive levels.

Keywords: higher mental function, mediation, cultural sign, voluntary attention, adult Internet users, adult readers, cognitive deformation

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Introduction

More than 5 decades ago, a Canadian sociologist Marshall McLuhan designated a modern stage of human evolution as a transition period from the Gutenberg galaxy to a digital civilization.¹ The invention of the Internet in the late 20th century completely corresponds to this periodization. The influence of the Internet spreads on different aspects of human life, gradually transforming traditional practices (cognition, communication, leisure, etc.) and, therefore, changing the person himself, including his cognitive functions.

The object of this study is "attention" as an integrative cognitive function which provides some focused activity of a human. There are 2 main areas of interest for scientists in the sphere of "digital technologies influence on attention functioning". The first one is concentrating on media multitasking (predominantly polling-correlation type), the second one studies a state of attention of students during the study process with the use of gadgets (mostly studied in experimental design).

Media multitasking, known as a "juggling multiple media streams"² or "Julius Caesar effect",³ is a widespread phenomenon. According to various studies, 77% Russian children and adolescents possess this feature³. The data of empirical studies is quite controversial, which is fair enough, as even a term multitasking has a few understandings (succession, simultaneity, resourcefulness), which lead to different methodologies and research approaches.^{4,5} However, a few years ago, based on already obtained empirical data, a hypothesis that a permanent switch between the tasks in the digital sphere trains attention was disapproved.⁶ Moreover, it appears that media multitasking (among the respondents aged from 15 to 24) doesn't lead to multitasking in real life.⁷ Meta analysis of 41 works of media multitasking proves that a functioning in a multitasking regime significantly correlates with a lower index of cognitive activity, especially in the tasks that require concentrated attention.⁸

Another major problem related to media multitasking is the challenges in the learning process students face to. Studies on this topic are not as numerous as the first one, but the results are quite unambiguous. Basically, they say that easy access to the gadgets during the class distracts the students easily, especially while facing hard learning tasks. Consequently, students show worse understanding and memorization of the material.⁹⁻¹¹

This brief overview allows to draw several conclusions. First, the scientists focus primarily on the peers of the Internet (from children to adolescents). Second, the main object of interest is the short-term effects of the Internet exposure. Third, the results reveal predominantly negative assessment ("do not train, "do not tolerate", "decreases" etc.), but do not record the formation of new qualities in the cognition of the Internet users of a young age (their formation is only expected in an unclear future). This phenomenon corresponds to a McLuhan understanding of the essence of technologies as "self-amputation" of human qualities.¹

It makes sense to study the influence of the Internet on the adults' cognitive abilities in long-term conditions to specify the nature of the ongoing transformations caused by digital technologies. It is important to mention, since digital technologies are a fairly new phenomenon, its influence on human life is huge in many ways, that makes study challenging from a scientific point of view and we are talking about an attempt only. Despite the obstacles, this works has a great potential and meaning during an ongoing transitional period. The importance of this work is clear: as the Internet use increases levels of the Internet addiction and different types of cyber addicted behavior, it's essential to find out the nature of this power and find the ways to either control it or use it.

A hypothesis in this study is based on cultural-historical psychology and a genetic law formulated by its founder, Lev Vygotsky: "...an evolution goes from bottom to top, a decay goes from top to bottom"¹².

^{p.173}. The most important features of cultural and higher mental functions are mediation of the structure and voluntary functioning. Thus, the state of voluntary attention of adult Internet users will let us determine the direction of transformations: either it moves up, toward the complication or it moves down, toward the simplifying.

Referential points to build up a coordinate scale are a “pre-digital” person on one hand and young adults on another hand. We consider a “pre-digital” person as the highest cultural representative of a previous evolutionary stage,^{1,13} whose formation happened due to writing skill, while the attention of young people we consider as scattered and incapable of prolonged concentration.^{5,814}

Research method

We may assume that the Internet becomes another cultural tool, like a word that was a predominant cultural sign in the pre-digital era. Keeping the Internet neutral as a technology, the present study checks 2 controversial hypotheses:

- I. The voluntary attention of the readers has better indicators than that of the Internet users.
- II. The voluntary attention of the readers has worse indicators than that of the Internet users.

Sample

The research involved 386 respondents. The respondents possess characteristics that allow us to assume that their initial level of voluntary attention is high:

- the age is over 37 years. Thus, cognitive formation completed in a pre - digital era;
- they all have a higher education;
- professional activity is in the sphere of intellectual labor (teachers, engineers, economists, librarians etc.);
- professional duties relate to the receipt, processing and transmission of information in various forms: either paper or digital.

It was extremely challenging to set up the criteria of division of the respondents as now hardly anyone is not using the Internet. The most obvious criteria were the time spent online and online actions. In terms of mixed reality, markers mentioned above were not unambiguous enough. That’s why we considered them as additional parameters. As the main parameter for a differentiation, we used a personal choice of a sign system of the respondents: traditional printed media or modern digital media.

We differentiated the respondents into the groups through a survey. It contained questions about the consistency and frequency of referring to different media. For example: “You have 1 hour of spare time. You have an interesting book and a laptop/smart phone with an Internet access. What would you choose and why?”

If an answer was indefinite, e.g. “depends on mood”, “prefer both reading and the Internet”, “can’t choose”, etc., we excluded it from the following sample, which appeared to be 35%. Thus, according to answers, one third of all the respondents used both printed and digital media in the same proportions.

Apart from a determination in choice, there were a few more aspects taken into consideration:

- I. 1. Consciousness of choice. It means the respondent could explain his choice, for example, regarding the traditional

reading: “I like to hold a book, feel the paper, turn the pages”, “I like I can stop at any moment to think about just read”, “It’s easy to make bookmarks and return to the reading later” etc. Answers in favor of the Internet were: “The information is well packed”, “Saves time”, “I feel tired of reading” etc. Answers like “I don’t know”, “Never thought about that”, “I better go for a walk”, “I prefer Tv” were excluded from the analysis.

- II. The coincidence of a choice and a real situation. Respondents were to indicate the average time per day spent reading paper sources and spent on the Internet. If the answers didn’t correlate with reality (the respondent chooses printed media, whereas he spends 20 minutes reading and 3 hours on the Internet), the answers were excluded from the sample.
- III. To check the content of reading and the Internet activity, there were a series of questions about preferred genres of paper sources (reference, fiction, etc.) and types of online activity (web search, work correspondence in messengers, chatting in social media, cyber games, etc.). This helped to single out those who preferred audio- and electronic books and, thereby, to differentiate them from those who preferred traditional printed.¹⁵

Finally, we formed 2 groups of 50 people each. The readers group comprised people who keep reading paper sources. Average age was 46.18±6,71, 21 male and 29 female. This group was the smallest and was only 13% from the whole sample. The Internet users group involved people who did not use paper media at all (34% from the sample). From 131 respondents who prefer the Internet, we chose those who fit age and gender of the readers group (age 45.38±5.86, 21 male и 29 female).

For a more accurate assessment, we comprised a control group. It included 50 students (age 18,86±1,55) and it as young Internet users. We formed the control group via the same survey.

Participation in the study was voluntary, anonymous and free of charge. The diagnostic procedure was carried out as part of the psychology classroom (with adults in advanced training courses, with students in lectures) at the end of the standard 1 hour 20min pair without a break. In all cases, classes were carried out in a traditional form, without the use of digital technologies, in order to exclude the short-term effect of their influence. Screening method from the general data array (for adults, n=386; for students, n=52), threeequally numericalgroups have been formed: adult readers, adult Internet users, young Internet users.

Diagnostic technique

We conducted the research throughout 2021. Participation was anonymous, voluntary, gratuitous.

The research was run in a group form, on refresher courses for adults and on lectures to students, at the end of 80-minute classes. Neither adult participants nor students used the devices during classes. That allowed, to a certain extent, to exclude short-term Internet impact.

Voluntary attention was measured by “The arrangement of the numbers” test. Even though an author is unknown, the technique is well known in psychological community. It is represented in the most authoritative collections of psychodiagnostic tools and is widely spread among psychologists to solve various problems. Another advantage of this tool is that it is convenient for a group research.¹⁶

The hardware required for the test is one sheet with 2 5x5 cell tables (Table 1). The first table is filled with numbers from 1 to 100

in random order, the second table is empty and to be filled in by the participants.

Table 1 Material for “the arrangement of number” test

16	37	98	29	54
80	92	46	59	35
43	21	8	40	2
65	84	99	7	77
13	67	60	34	18

Instruction: “In 2 minutes a participant must fill in empty cells with numbers in ascending order from the table where the numbers are in random order”.

The results of the test allow us to assess 2 parameters of voluntary attention: accuracy and distribution.

An accuracy is estimated by the quantity of missed numbers and corrected mistakes.

A distribution of attention is calculated by the formula: the number of errors is subtracted from the total number of figures entered in the table; the difference is divided by two, i.e., two minutes of the technique.

The norm of a “pre-digital person” (from adolescence to adulthood) is 22 correctly entered numbers, and, accordingly, 11 points for the distribution of attention.

Statistical processing methods

The “raw” scores of accuracy and distribution of attention in the three groups (adult readers, adult Internet users, young Internet users) were compared using the Mann-Whitney U test. Appeal to this non-

parametric criterion is primarily due to the qualitative characteristics of the samples - the intellectual type of work of adults and the higher education of young people. These characteristics make it possible to designate the general group of study participants as “intellectually trained” persons, which is fundamentally important for testing the hypotheses put forward, but is clearly unrepresentative in relation to the population. Therefore, the procedure for checking the normality of the distribution was not carried out. These measurements were consistently compared using the Mann-Whitney test in different pairs of samples.

To recheck the non-randomness of the identified differences, we applied a psychometric method of splitting the sample in half (even/odd numbers in the groups).

Results

Table 2 shows averaged results of assessment of indicators of voluntary attention ($M \pm \sigma$).

Table 2 Evaluation of voluntary attention

Evaluation parameters	Group		
	Adult readers	Adult Internet users	Young Internet users
Accuracy	0.62±0.75	2.5±2.35	3.22±2.13
Distribution	9.8±1.61	8.15±2.25	8.52±2.04

According to the figures in table 2, adult readers have a statistically higher indicators than the Internet users, both adult and young. The values of the Mann-Whitney U test for general samples are shown in Table 3.

Table 3 Evaluation of statistical differences between the samples

Parameters of voluntary attention	Accuracy			
	Groups	Adult readers	Adult Internet users	Young Internet users
Distribution	Adult readers	—	557.5**	328**
	Adult Internet users	685.5**	—	982*
	Young Internet users	768 **	1159	—

Note: a sign * indicates the level of statistical significance of the criterion: – $p \leq 0,05$ and ** – $p \leq 0,01$.

From Table 3, it is clear that indicators of accuracy and distribution of adult readers differ significantly from the ones of the Internet users, both adult and young.

However, adult Internet users made fewer mistakes compared to the young ones. Splitting the samples indicated differences in the same level of significance (for $n=25$ critical values, the Mann-Whitney U test: $U=227$ for $p \leq 0,05$ and $U=192$ for $p \leq 0,01$).

Specifically, for the number of mistakes:

- between adults $U=131$ and $U=114$, $p \leq 0.01$;
- between Internet users of different age: $U=224$ и $U=202$, $p \leq 0.05$;
- between adult readers and young Internet users: $U=122$ и $U=109$; $p \leq 0.01$.

There are no significant differences in the distribution of attention between Internet users of different ages. The splitting of the samples repeats the differences presented in Table 2:

- between adults $U=154$ and $U=141.5$, $p \leq 0.01$;
- between Internet users of different age: $U=324$ and $U=390$, $p > 0.05$;
- between adult readers and young Internet users: $U=98$ and $U=114$, $p \leq 0.01$.

Thus, the analysis of voluntary attention in terms of scale “pre-digital man - modern young man” shows that indicators of adult readers and adult Internet users are closer to “pre-digital” pole, whereas the parameters of young Internet users are approaching to the pole of “young man”.

Discussion

We can state that a hypothesis on a higher result of voluntary attention of adult readers is confirmed (even though this group does not reach the norm of “pre-digital man”). This allows us to suggest a theoretical explanation of a transition from one information coding system to another. While in a traditional culture a leading sign was a word, in the digital era a leading sign is a technically designed image/media image. Historically, it has the following evolution: photo, cinema, TV, the Internet, web 2.0. The advent of the mobile Internet quickly ousted the desktop Internet from the daily life of people from different countries, including Republic of Belarus.¹⁷ Due to the mobile Internet, all processes are accelerating so much that there is a threat to not notice one’s personal and cultural transformations at all.

A written word and a media image, as an information coding sign, are the results of long cultural and historical evolution. They are cultural signs, artificial stimuli that are supposed to lead to the improvement of mental organization. Being more complex (at least because a media image includes a word), media image is supposed to stimulate more significant changes in the mental system towards complexity. However, the current study does not detect this kind of effect.

In Table 4, we compared the differences between 2 coding systems to explain the contradiction mentioned above.^{1,12,18–20}

Table 4 General comparative characteristics of cultural tools

№	Parameters	Cultural tool	
		Written word	Media image
1	Way of production	various (both technical and manual)	technical
2	Speed	various (is regulated by a reader/writer)	high, set up on a device
3	Type of information	propositional	representative, iconic
4	Form of information	stable	unstable
5	Brain activity mode	Beta wave	Alpha wave (TV); Theta wave (cyber games)
6	Leading mental function to process information	thinking(selective choice of the material, analysis, etc.)	perception (recognition of patterns)

Even a brief analysis of table 4 shows that written speech allows the reader to be more proactive. Differences of the parameters 1-4 are clear enough and do not need additional comment. Regarding brain activity (5), there is not much information so far, but results of existing studies are quite apparent: “digital fog”,²¹ “digital dementia”,²² etc. Arguments regarding a leading mental function in processing of information (6), are more a hypothesis and need further verification. Nonetheless, there are already detected differences in the thinking processes of adults and adolescents, especially in categorization and classification.^{23,24}

According to Lev Vygotsky, a word is the leading mediator, in other words, a cultural sign that allows a subject to “master” his natural functions. It is the word that breaks the unity between perception and action, which is inherent in the primitive structures of the psyche. It is the gap that makes transformation, complication, and cultivation of functions possible. From this point of view, we consider the predominance of the figurative code system as a regression. Moreover, it is a regression both on a social scale (because humanity

has outgrown rock art, pictographic writing, etc. long ago), and on an individual one. This return to phylo- and ontogenetically earlier ways of operating with information can be designated as a cognitive deformation caused by the pressure of media images. Regarding the object of current research, the deformation in the voluntary attention may be designated as deterioration.

Conclusion

According to the results of the current research, the samples are arranged in order of deterioration of voluntary attention indicators (accuracy and distribution):

Adult readers

Adult Internet users

Young Internet users

In appliance with a genetic law of Lev Vygotsky, a certain “decay” of voluntary attention of adult Internet users has been revealed.

From a cultural-historical psychology point of view, detected differences in the voluntary attention of the readers and the Internet users are explained through features of media image as the main sign in digital communication. Despite an obvious technological superiority over the written word, the media image appears to be a weaker cultural sign in terms of its features. So, the predominance of a media image in communication practice of an adult leads to a specific cognitive deformation, viz, a regression to earlier levels of the genetic organization of higher mental functions.

There are no proved boosting effects of different online activities, and, to maintain already existing cultural level, traditional activities like reading paper sources, handwriting, playing the music, DIY etc., may be considered as more effective practices.

The limitations of the present study stem from its comparative design. Conducting an experimental or longitudinal study of the influence of the Internet on adult cognition is virtually impossible in a mixed reality environment. Therefore, further testing of the hypothesis about the deforming effect of technology on the attention of its users is possible in a kind of experiment in reverse, in which adult active web users deliberately increased the practice of reading traditional paper texts.

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Conflict of interests

The author declares no conflict of interest.

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