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# SPECIFIC FEATURES OF THE COMPREHENSION OF TEXTS AND STORY PICTURES BY ADOLESCENTS WITH INTELLECTUAL DISTURBANCES

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## SUMMARY

### Background:

The present article addresses the peculiarities of comprehending visual stimuli by adolescents with intellectual disturbances. We have studied the ability of school students to analyse and synthesise the meaning of the text and a series of story pictures, to successively retell their content, and distinguish the main semantic constructs.

### Material/ Methods:

We examined 60 adolescents: 20 normatively developing students from secondary school, 20 students with learning disabilities and 20 children with a clinical diagnosis of “intellectual disturbances”. The age of the students ranged from 15 to 19 years old (the average age was 16 years 1 month old). The age range was due to the presence of adolescents with intellectual disturbances. The examination involved 25 girls and 35 boys. The main method of research is authorial questionnaire. A small excerpt from the Russian folk tale “The Wolf and the Seven Young Goats” is used as a verbal stimulus, and Bidstrup comic cartoons – as a non-verbal stimulus. The technique of eye-tracking is used as a research method that allows registering the number of fixations, duration of gaze and length of saccades.

### Results:

The differences in the comprehension of text and picture visual stimuli in students with different levels of intelligence have been determined. In the case of intellectual disturbances, the duration of fixations significantly increases when perceiving the texts. The level of intelligence affects the parameters of the recognition and decoding of the visual information significantly. It was found that the specifics of understanding texts and subject pictures by adolescents with intellectual disturbances are due to thinking passivity and different formats of information.

### Conclusions:

**Keywords:** oculography method, eye-tracking, learning disabilities, intellectual disturbances.

## INTRODUCTION

Comprehension is the most important category that enables the child to interpret objects and events making up a certain picture of the world [1]. The most of studies are devoted to the analysis of the child's comprehension of texts or visual images [2]. In the empirical works, experts identify and describe the specific features of decoding verbal stimuli by children with learning disabilities [3,4]. However, there are almost no works comparing children's comprehension of multi-format information perceived by them both in the school lessons and various gadgets. There is much controversy about differences in the interpretation of the content of visually perceived texts and images. Scientists have obtained modern data on innate strategies related to a better processing of the verbal and nonverbal content by children. In this case, the mental model of analysis forms first, and then it adapts to the methods of the transmission and presentation of information. It implies the presence of the innate nature of orientation to the processing of text or images [5]. Moreover, in case of the simultaneous processing of images and text, participants of experiments do not see any inconsistency between them often [6]. It points to some peculiarities of the simultaneous processing of information when it is presented in the different formats.

Much attention is paid to the problem of the comprehension of texts and images by children with intellectual disturbances. Their number is constantly rising. Statistical data indicate five main reasons for that growing decrease in the level of the cognitive development of students: (1) the increase in the number of risk factors leading to problems in development; (2) the individual resistance of the child to them; (3) the role of the family in the formation of his/her adaptive potential; (4) the specific nature of school education and stay in the educational environment of students with intellectual disturbances; (5) cultural factors stipulating the acceptance or rejection of such children in the society [7,8].

The incomprehension of the text may be due to the lack or poor development of skills of decoding the text. That misunderstanding may be because of the deficit of sensitivity to the structure of the text. The text has an internal structure that reflects the sequence of the text ideas. In some texts, there are signal words denoting this structure, for example: "first" and "therefore". But there is a great number of texts that do not have such reference words, and they are particularly difficult for children with intellectual disturbances [9]. One of the possible problems of the child with intellectual disturbances is an incorrect interpretation of the perceived information, hence misunderstanding and, as a result, an incorrect behaviour. Different authors see the reasons of the incorrect interpretation in the different phenomena. First of all, it is a limited vocabulary which makes it difficult to directly understand words and decreases abilities to improve knowledge [10]. There is a hypothesis that children with intellectual disturbances find the deficit of phonological working memory and usage of metacognitive strategies [11].

They suggest different methods to better the comprehension including the additional information about the text, or asking the questions that contain certain

intermediate conclusions. It has turned out that only additional information influences the comprehension of the text [12]. A clear instruction specifying the actions for a better comprehension of the text is very useful [13]. A positive reinforcement of the desired behaviour is proposed to reduce the consequences of the difficult behaviour [14]. Sometimes, some characters are entered into the text, but this does not change the low level of perception of the text by children with intellectual disturbances [9]. At any rate, any external support for such children improves their understanding of speech flow [15].

A part of the works employ the technology of eye-tracking which allows you understanding how the child explores the object (a drawing or a text). In turn, it allows understanding the causes of the errors of comprehension. However, such works use devices with different degrees of resolution [16] which makes it difficult to compare the results. At the same time, these works indicate that the incomprehension is often due to the peculiarities of perception but not of the analysis of the text [17].

All of that prompted us to perform the comparative analysis of the comprehension of the text and visual images in children with intellectual disturbances using the method of oculography in the present study.

## **MATERIALS AND METHODS**

Schoolchildren of four educational institutions with the different levels of intelligence were examined. The sample of the study consisted of 60 adolescents in the 9th form. 20 normatively developing students from secondary school, 20 students with learning disabilities and 20 children with a clinical diagnosis of “intellectual disturbances” were examined. The age of the students ranged from 15 to 19 years old (the average age was 16 years 1 month old). The age range was due to the presence of the adolescents with intellectual disturbances. The examination involved 25 girls and 35 boys.

A small excerpt from the Russian folk tale “The Wolf and the Seven Young Goats” was used as a verbal stimulus. Its volume included about 700 characters. This tale was chosen as a verbal stimulus as the result of the analysis of the curriculum. Students learned Russian folk tales, that is why it was expedient to use that text material which they were familiar with. And the adolescents would be more likely to show interest in it. For the same reason, the empirical survey took place during this training period for three months, from October to December.

***Text.** Once upon a time there lived an old mother goat. And she had seven little goats. Six were white, and the seventh one was black. They lived together and funny in a small, beautiful cottage and loved one another. Once the old mother goat was going to the market and told all her kids: “Stay inside the house, and don’t open the door to anybody! I heard there was a wolf about in the forest. You would know him by his huge paws, sharp claws and rough and angry voice!*

*If you open the door, he will surely gobble you all up!" As soon as she stepped out of the house, the wolf was right there. He quietly crept to the door and howled. They were afraid of the wolf's voice and hid under the benches and behind the stove. They sat and trembled trying not to stick out. The wolf stood at the door, shuffled his feet and decided to leave. The little goats did not open the door. But hunger torments. I have to do something else to deceive the goats.*

The comic book by Herluf Bidstrup, a Danish cartoonist, was used as a non-verbal stimulus. The comic was the sequence of eight black-and-white elements – story pictures (Fig. 1). The comic was also selected as the closest to the curriculum of children with intellectual disturbances [18].

The study took place directly at the school in a separate class and with each student individually. On the computer screen, the verbal and nonverbal stimuli were successively presented to the adolescents. The average duration of the examination of the adolescents was about 20 minutes. On viewing each stimulus, they were asked to fill in a short questionnaire whose questions were about the comprehension of the presented text and picture. In case when the examinee found it difficult to fill out the questionnaire on his own, the psychologist asked leading questions invidually.



Fig. 1. Black-and-white elements – story pictures

Due to difficulties in formulating written replies, during the examination of the adolescents with intellectual disturbances, data collection was fulfilled by means of standardized individual interview. The first question was about the child and the personal information. Further, the psychologist asked the question aimed at detecting difficulties in gazing at the visual stimulus or in reading the text. The pupil was asked to tell about main characters and events in the tale and its semantic content. In addition, it was clarified whether the child had known the presented fairy tale or not. The psychologist had the conversation with the child about the content of the text immediately after reading the fairy tale or while viewing the picture. It turned out to be difficult to reproduce the content of the comic without any visual support in case of intellectual disturbances at the age of 9-11 years old.

The study of the parameters of perception was performed by means of the eye tracker of the iView XRed 250 system (SMI, Germany) with the resolution frequency of 250 Hz. This system provided fully automated image processing based on the non-contact eye tracking and the compensation of the head movement. It automatically traced the dynamics of oculomotor reactions and compensated for head movements in a wide range, providing accurate data on the direction of look and pupil [19]. Data processing was done by means of the SPSS-21 program.

## **RESULTS**

The method of oculography made it possible to study the process of the visual perception of stimulus material by the school students, to detect the trajectories of eye movement when gazing at the picture, to determine the duration and quantity of oculomotor reactions (saccades). It made it possible also to establish the zones of interest of the school students and compare them with the verbal content obtained by the results of the survey of the school students of the groups under study. The data obtained by the method of oculography allowed separating the speech context from the visual perception and revealing significant semantic constructs for the comprehension of texts and pictures. The interpretation of the results analysed the ability of the adolescents to determine the consequences of the actions of the characters of the plot. That could be observed in the verbal comments in the process of the visual perception. As a result of the cognitive processing of information, the characters' actions could provoke emotional response even and interest fixed by means of survey method.

When reading the text, the adolescents with normative development found the least number of fixations and duration of gaze and the highest average length of saccades in comparison with adolescents with the lower intelligence (Table 1). When perceiving visual stimuli, they gazed at them wholly and distinguished the most significant parts of the visual stimulus. The adolescents with learning disabilities had higher values of duration and the quantity of fixations. The adolescents with intellectual disturbances had the highest values of fixations and

Table 1. Average values of oculomotor activity in the group of the schoolchildren

Visual stimulus	Intelligence level	Average value of the parameters		
		Quantity of fixations	Duration of gaze (milliseconds)	Average duration of one fixation (milliseconds)
Picture	Normative group	119.52	51,718.25	271.33
	Intellectual disturbances	166.75	66,582	310.49
	Learning disabilities	115.05	46,674.5	257.15
Text	Norm	150.7	48,862.75	371.67
	Intellectual disturbances	206.45	72,502.3	349.09
	Learning disabilities	222.85	89,957.5	331.86

duration of gaze and the least average length of saccades in comparison with the normatively developing schoolchildren.

When gazing at a series of pictures, the normatively developing adolescents had average indices. The adolescents with intellectual disturbances gazed at the picture longest and had more fixations. The low intelligence caused increase in the length of saccades. Finally, the schoolchildren with learning disabilities used fixations least and gazed at the picture fastest. However, the judgments of such children were very superficial.

According to the results of the empirical study, the features of the comprehension of the text and image by the normally developing adolescent schoolchildren were analysed. When gazing at the picture, they paid much attention to the sports design and the changes taking place in it but not the actions of the main character of the plot. The semantic emphasis was stressed in the final element of the picture in order to confirm the right understanding of the situation. In the process of gazing, the child with normative intelligence comprehends the basic content of the comics. The conclusion accuracy was checked whether the athlete succeeded in his jump. And, it was important to concentrate on the last picture of the results of the actions of the central character of the visual stimulus to confirm the thoughts. When answering the question: "What did you like and remember?", the school students with the normatively developing intelligence commented on the correct act of a boy who helped a fallen male athlete.

The high school students with intellectual disturbances paid more attention to the person's face and those parts of the body with which people made the most intense movements. That fact was also confirmed by the statements of the schoolchildren. In their content, it was possible to identify the certain key words: "failed jump" (50% of the examined students), "fall" (50%), "runners" (10%), "repetition after an adult" (5%), "athlete" (5%) and "swing on the rope" (5%). Their interpretation of the image was primarily due to the introduction of their own experience in regard to the events in the plot. Besides, their statements were characterized by significant characters in the comic book and their actions: "an adult" (30%), "boy" (40%), "athletes" (35%), "a boy pulls a man" (45%), "pull-up on the

bar” (30%) and “failed jump” (35%).

The group of the school students with learning disabilities was characterized by the display of the procedural component of cognitive activity. It was represented in the children’s interest to the actions of the characters and the plot. They often find fragmentary thinking characterized by a partial comprehension of the text and the inability to analyse and generalize its meaning. The patterns of the recognition and comprehension of text and picture visual stimuli were identified. They displayed in the fragmentary comprehension of the texts and inconsistency of the cognitive processes functioning. Shorter oral comments on the content of the text and pictures were typical of them against the background of a slight decrease in intelligence and learning difficulties. They avoided listing a considerable amount of details of the analysed plot and sought to formulate simple conclusions. It pointed out their certain ability for generalisation.

In the normally developing adolescent students, the cognitive interest is aimed at comprehending the basic meaning of the text that indicates a higher level of cognitive development. This reveal itself in the holistic perception, and the abilities to generalise the information perceived, to retell the content in detail and sequence and to identify the main semantic construct in a series of story pictures. Difficulties in the perception and comprehension of the content of the text and pictures are identified. In the adolescents with learning disabilities and intellectual disturbances, the number of difficulties in recognizing the content of visual information increases due to difficulties in perception.

The significant number of difficulties occurs in the adolescents with intellectual disturbances in comparison with the school students with learning disabilities. The school students with learning disabilities show sequence when working with the text information that is expressed in their abilities to call all the characters of the plot by means of the proposed stimuli and to superficially retell the content of the texts and pictures. The emotional-evaluation component display is typical of the schoolchildren with intellectual disturbances in the process of understanding visual information. It is in the usage of adjectives to describe the characteristics of the characters and in the evaluation of their actions.

The peculiarity of the perception and recognition of information by means of text and picture stimuli is identified. The adolescents with intellectual disturbances are engaged in reading and analysing the picture more than the other peers that reveal itself in the largest number of eye fixations. They need more time to comprehend the content of the comic. During the perception of the pictures, they gaze at the face and movements of the characters and assess their emotional state. The processing of the verbal and nonverbal visual information by means of physiological patterns is performed in different ways in the children with different levels of intelligence. In case of intellectual disturbances, when perceiving the text, the duration of fixations increases significantly.

Thus, the level of intelligence significantly affects the parameters of the perception of texts. It reveals itself in the increase of the number of fixations and the average length of saccades. For all the schoolchildren regardless of the level

of intelligence, the efficiency of the perception and comprehension of visual information increases during their work with non-verbal (picture) stimuli in comparison with visual stimuli with written speech. One may suppose that both the level of intelligence and the quality of perception are determined by the maturity of brain structures [20], which is different in adolescents with different degrees of intellectual deficiency. No statistically significant influence of sexual differences on the processes of perception and comprehension of the text and a series of plot pictures was found.

## **DISCUSSION**

In the normatively developing adolescent students, the cognitive interest is aimed at comprehending the basic meaning of the text that indicates a higher level of cognitive development. This reveals itself in the holistic perception, and the abilities to generalise the information perceived, to retell the content in detail and sequence and to identify the main semantic construct in a series of story pictures.

Adolescents with intellectual disturbances are more successful in viewing and understanding the content of pictures than reading text. They attract their life experience, knowledge of the world around them to tell about the events in the drawings. Much attention is paid to non-verbal manifestations of man. Teenagers with intellectual disturbances are interested in interpreting facial expressions, characters' locomotion that characterize the emotive component of social communication. Upon reading the text, the duration of viewing the story pictures in this group of respondents does not significantly vary from the duration the text was viewed. Equal to them is the fragmentation of mental operations – analysis, synthesis, comparison and generalization – which limits a holistic and detailed understanding of visually perceived content.

In adolescents with learning disabilities, significant differences were found in the number of fixations, the duration of viewing, and the average duration of one fixation upon reading texts compared to viewing story pictures. In the process of completing assignments, they displayed greater interest compared to students with intellectual disturbances. They tend to desire to understand the meaning of what they read. However, they also experienced difficulties due to the limitation of cognitive resources against the background of unformed learning activities. The instability of voluntary attention prevented them from achieving better results in understanding text and pictures. This group of teenagers manages to use verbal formulations to describe pictures and the main content of what they read in more detail and more accurately. In their speech, teenagers with learning disabilities convey more detail that reflects the meaning of text and picture content.

The obtained results can be explained by microgenetic theory. It is in the cortex that perception and action reach the level of conscious decision. The brain forms articulated pictures or representations of what is out there in the world, and of what has been out there in the world, and the play of these images constitutes conscious perception. What is more – and this has only recently begun



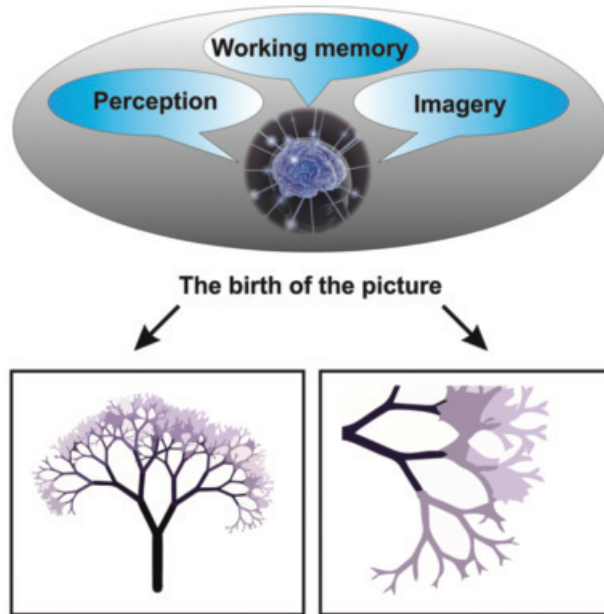


Fig. 2. The direction of brain and organism evolution, in full exteriorization, detachment and modulation of the process of perception\

Source: Pachalska, MacQueen & Cielebak [22], with permission

to be a subject of interest for neuropsychology [21,22] – the cortex is capable of forming pictures and/or images (see: Fig. 2) of what might be or could be out there, or could have been, or should have been, and was not.

It is not that hard to form a coherent theory of how the brain forms an image of something the eyes are seeing or have seen, but it is quite another thing to explain how the “mind’s eye” works in terms of brain structure and function.

For the present purposes, however, the most important fact about the cerebral cortex is that both perception and action at this stage are characterized by detail, discrimination, and analysis. The reptilian brain sees a large moving object, to be avoided, or seized, or ignored; the paleomammalian brain sees a human figure, producing an affect, positive or negative; the cortex sees features, details, a face, and can put a name to it, or not. The complexity of perception results from the fact that these three images come into existence independently and sequentially, though there is only one perceiver and one object, and the entire process takes milliseconds to complete. The conscious mind, then, typically experiences its perception as a single, simple act of seeing. According to microgenetic theory, however, this single act is a multi-layered actualization, the tip of an iceberg that floats to the surface and then subsides, containing within itself the traces of all that has gone before, in phylogeny, ontogeny, and microgeny [21].

Because of various medical causes of intellectual disturbances (infections and brain damage) in persons with intellectual disabilities, different patterns of neural connections have been formed that change brain function in milliseconds. This

mode of operation of the working brain changes the formation of the mental state, and thus the mutual, synchronous action of working memory, perception, and imagery, and so thinking and action (including speech). This is one of the important reasons for slowing down the process of realizing reality [22, 23]. Thus, the specifics of understanding texts and subject pictures by adolescents with intellectual disturbances is due to thinking passivity and different formats of information.

## CONCLUSIONS

It was found that the specifics of understanding texts and subject pictures by adolescents with intellectual disturbances are due to thinking passivity and different formats of information.

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