

## The Effect of Perceptual-Semantic Blindness in Solving Semantic Problems with Visual Means Containing the Solution

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### Abstract

*In the light of the Cultural-Historical Theory (L.S. Vygotsky) and the Theory of Transcendental Psychology of Perception (A.I. Mirakyan), the author considers the position and functional role of the perceptual process in the development of the mind of an adult. The hypothesis is that the functional role of perception in the mind of the person at the end of its period of maturation is subordinate to the higher mental functions, in particular, the process of thinking, which is based on the search for a person available memory capacity and the possibility of finding knowledge in the relevant external sources. Therefore, in semantic terms, visual perception can be excluded from a conscious process of finding semantic solutions. This suggests the subordinate function of visual perception in cognitive adult life and the virtually automatic nature of the process that serves the knowledge-based development opportunities. In this context, we presented and experimentally tested on 30 students the effect of perceptual-semantic blindness, which shows that the mental process of solving semantic tasks is in the main ignoring additional visual stimuli containing the solution in the general visual field. In contrast to inattentive blindness, these stimuli are constantly presented in the field of vision and perceptual blindness was due not so much to inattention, but semantic processes. The presented effect of perceptual-semantic blindness is clearly expressed in more than 60% of cases (up to 100% for graphical variants). This situation can be regarded as the result of a kind of sociocultural development, formed in the conditions of modern information technology society. It also points to the need for special and purposeful perceptual-cognitive training as one of the effective means of using unclaimed perceptual possibilities to avoid the phenomena of perceptual-semantic blindness. These means are especially important for the educational process.*

**Keywords:** cognitive psychology, visual perception, cultural-historical theory, transcendental psychology of perception, inattentive blindness, perceptual blindness, perceptual-semantic blindness, semantic task

### Introduction

Modern education in secondary and higher school, characterized by the extensive use of technical and auxiliary means, is often aimed at solving semantic problems that require the development of corresponding intellectual functions. In this case, it is assumed that all the auxiliary mental processes necessary for this are already developed and they work in many ways automatically. In particular, this can be said about perceptual processes. It is known that they play an essential role in the life of a person and fully provide both the possibilities of perceiving the world and actions in it, as well as communicative and cognitive interactions between people in the learning processes.

Meanwhile, focusing on semantic processes and problems can lead to an underestimation of the possibilities of perception and a bias of teaching towards the use of intellectual mental functions by students to the detriment of the possibilities of perception. More-

over, we assume that while solving semantic problems, subjects after understanding the task will be mostly using their thinking and memory (or external computer sources) and will not take into account the additional stimuli available in the visual field.

Observation of the relevant practical situations in the learning process showed that this phenomenon takes place. It is to some extent similar to inattention blindness or perceptual blindness, which appears as the inability of an individual to see a stimulus that suddenly appears in the field of vision [1]. This phenomenon has been studied extensively and is mostly explained by a lack of visual attention rather than by any vision defects or deficits [2]. Inattention blindness is modulated by various parameters, including stimulus attributes, the observer's cognitive resources, and the observer's attentional set regarding the primary task [3]. At the same time, the available experimental results are somewhat contradictory. On the one hand, significant manipulations with stimuli, such

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as putting the specific color concept in the main focus of the primary task, did not lead to reduced inattention blindness [3]. On the other hand, there is evidence that despite inattention blindness, our mind still has access to something as refined as meaning [4].

In contrast to inattention blindness, in our case, stimuli are constantly present in the field of vision and perceptual blindness is due not so much to inattention, but semantic processes. Therefore, the phenomenon under consideration and the corresponding effect are called perceptual-semantic blindness [5].

The hypothesis about the effect of perceptual-semantic blindness was formulated based on the provisions of the Cultural-Historical Theory (L.S.Vygotsky and his followers) and the Theory of Transcendental Psychology of Perception (A.I. Mirakyan and his school) taking into account the functional role of the perception process in the developed psyche of an adult person [6-10].

It can be stated that perception matures and develops even in infancy before other mental processes and is a prerequisite for their development [11,6]. Acting as the primary dominant function, the processes of perception in infancy become fundamental processes, which are then built into almost all further functional processes. At the same time, perceptual processes develop imperceptibly in many respects, in fact, in the shadow of numerous other functions.

In the course of psychological development, not only individual psychological functions change and grow, but mainly the relationships between these functions change so that at each age stage there is a system of relationships between functions specific for a given age. With the transition from age to age, this system of relationships between functions changes, first of all, and the development of each function depends on the system in which it develops [6].

Perception is a fundamental function of the psyche in the development process, and in one way or another takes a direct part in leading activities at all stages of a child's development. At the same time, the functional role of the systemic center of perception changes at each stage of growing up [12]. With the transition from age to age, the relations between the centers change so much that by the end of development they change to the opposite. In the beginning, everything depends on the lower center, and in the end, the lower center depends entirely on the higher centers. This change in intercentral relations as the main fact in the development of the nervous system and a change in inter-functional relationships as the main fact of psychological development represent two sides of the same developmental process closely related to each other [6].

In general, in the process of development, perception is increasingly subject to higher mental functions and is largely automated, which objectively can contribute to the gradual loss of perceptual function from the direct control of the developing conceptual-semantic or semantic sphere, which is under the jurisdiction of mind and consciousness. The results of perception become easily accessible to consciousness in the form of corresponding images, concepts, names of objects, and their various properties. At the same time, in many cases, the solution of various problems is carried out by people at the semantic level of understanding using think-

ing, which, first of all, relies on the available powers of a person's memory and the ability to search for relevant knowledge in the necessary external sources.

On this basis, it can be predicted that the development of a child in modern culture as a whole can lead to the fact that the procedural aspect of perception and a number of its actual effective capabilities may fall out of the area of awareness. In particular, in the activity of an adult, which is associated with the solution of semantic problems, the function of perception (primarily vision and hearing) can mainly consist in servicing the processes of understanding the problem and searching for the necessary information in third-party sources.

This conclusion allows us to put forward a hypothesis that when solving semantic tasks, adults who are unprepared for the conscious use of perception should not, first of all, take into account the possibility of finding a solution in the situational field of their direct visual perception, as an invisibly intermediate and being in a purely subordinate position to the process of thinking. In general social terms, such a state of affairs can be considered a kind of result of the cultural development of a person, formed in the conditions of a modern information technology society and often representing knowledge as a kind of information located on one or another memory medium.

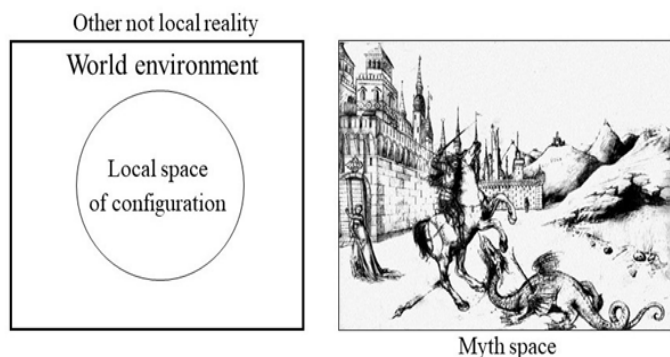
The purpose of the experimental study was to verify the truth of the above assumption about the subordinate and poorly understood role of situational processing of visual information in solving semantic problems.

### Research Assignments and Procedure

The idea of the study was that, together with the semantic task, present the subject with an answer to it, so that it would be located in the general visual field with the question being asked and other explanatory materials (on one sheet of paper or a slide), and check how much easily this answer will be noticed and used to answer the task. The experimental research procedure included two types of tasks (graphical and textual), which required the subject to answer a certain semantic question related to a particular system of concepts that is correct (coinciding) in meaning.

Thus, the task was a certain conceptual or semantic task, combined with the answer available to it in the general field of view. Together with the printed question, the subjects were simultaneously shown the corresponding images with text or only text containing the answer to the proposed question. This answer was the solution to the semantic problem related to the material, which in general was familiar to the subjects.

The first type of task was a question related to the picture attached below this question. The picture, along with graphic and written explanations to it, included a fairly explicit answer to the question asked. An example of graphical task #1 is shown in Figure 1 below. The question is: *What three classes can the space of myth be divided into in the picture below?* The picture shown in Figure 1 on the right is borrowed from the work of J. Peterson [13]. The answer to the question asked is the diagram on the left in Figure 1, where all three classes are indicated by words.



**Figure 1:** An Example of A Picture (Right) and A Diagram with an Answer (Left) For the First Type of Tasks

The second type of task, in addition to a question on a psychological topic, includes from 4 to 7 sentences, which in their meaning were related to the question or otherwise explained it. Among these phrases was one that was a short answer to the question asked. Subjects' answers were recorded in writing.

An example of the task with a question on the theory of L.S. Vygotsky: *Why is developmental defectology the key to understanding higher mental functions?* As additional explanatory sentences were used quotes from the work of Vygotsky "The history of the development of higher mental functions" [7]:

- *we hope to find the key to comprehending the development of higher mental functions in the history of the development of the so-called defective, that is, biologically defective, child;*
- *normal development does not demonstrate its mechanisms;*
- *defectological practice, the so-called curative pedagogy, is built on a still unrecognized most important principle, which we could define as the creation of detours for the cultural development of an abnormal child;*
- *divergence and plexus mutually illuminate and explain each other in the comparative study;*
- *this is a general proposition that is valid to all cultural development in general;*
- *following it, we will study the history of the cultural development of a normal and abnormal child as a process uniform in nature and different in form of flow.*

The correct answer to the question was to consider the fact that "normal development does not demonstrate its mechanisms".

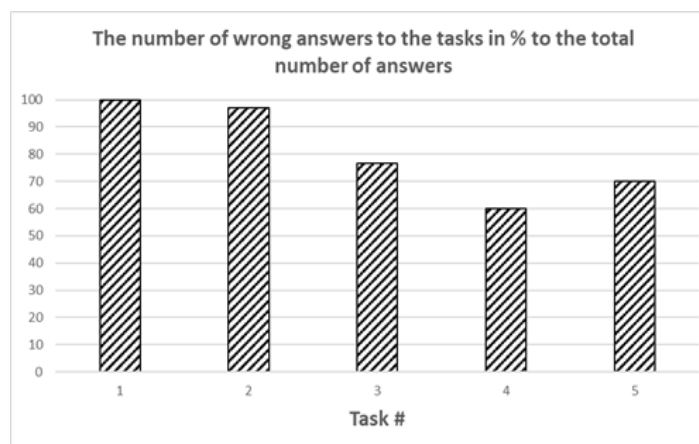
The test participants were 30 students of MSUPE aged 21-25 years. In total, they were presented with five tasks: two - of the first type (1 and 2) and three - of the second type (3-5). Naturally, the subjects were not informed about the presence of answers in the field of visual perception, and they, in principle, could not expect this. Tasks 1 and 2 were given first. Tasks 3-5 were given with some time break.

The specific objective of the study was to find out how well the subject's answer agrees with the answer proposed in the task to the question asked. The numerical results of the experiment included the calculation of the percentage of correct and incorrect answers

of the subjects to each of the tasks divided by the total number of answers of the subjects. Incorrect answers (with appropriate control over the subject's line of reasoning) testified to the effect of perceptual-semantic blindness.

### Research results

The results of the research are shown in Figure 2, where for five tasks a diagram of the number of incorrect answers is shown as a percentage of the total number of answers to tasks (equal to the number of subjects). A large number of incorrect answers here is because, when answering the semantic question posed in the task, regardless of the conditions and the actual presence of visual attention, the subjects, first of all, began to look for the corresponding ideas and concepts necessary to answer the question in their memory and reflection or an external source such as a gadget. In the vast majority of cases, they were not able to see (pay attention to) a sufficiently obvious answer in the stable field of vision in front of them.



**Figure 2:** Percentage of Incorrect Answers to Tasks of the First (1, 2) and Second (3-5) Type

This experimental phenomenon, which can be called the effect of perceptual-semantic blindness when performing a semantic task, was presented at the conference and briefly substantiated theoretically [5,10,14]. According to Figure 2, the effect is more pronounced for graphic tasks 1 and 2 and to a lesser extent for three text tasks 3-5 with additional sentences. The latter can be explained by the fact that the subjects read the presented sentences and could use them in the formulation of their semantic answers, without even realizing that the answer is in front of them in a ready-made form. Almost immediately, only one person from the entire sample drew active attention to the fact that the answer in tasks 3-5 had already been given. Task 4 turned out to be the easiest, perhaps because the answer was presented in a simple one-line sentence, located at the end of the general list of sentences.

### Discussion

Experimental results show that the distinction between perception (external presence) and conscious control (internal presence) during the solution of a cognitive task is extremely stable. The presented effect of perceptual-semantic blindness shows that the mental process of solving semantic tasks is in the main ignoring additional visual stimuli containing the solution in the general vi-

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sual field. The effect is quite observable and also clearly expressed when the tasks are presented to the subjects on the screen in the form of slides.

As hypothesized earlier, most likely, it is associated with the fact that in a given cultural-age situation for people, the external field of their perception at the procedural-semantic level is not included in the mandatory area of conscious control and search for solutions. Teaching practice also shows that students poorly track the results of perception over time and prefer to consider each new question as new in meaning, although it is often associated with a general context of perception, in which the answer to the question posed can be found.

From the point of view of analyzing thinking, the difficulty of finding an answer in a type of task, which is presented in Figure 1, can also be explained by the fact that students are accustomed to solving convergent rather than divergent tasks, and therefore seek the answer relying only on a drawing showing myth space without going beyond its boundaries. In several individual cases, the analysis of the solution process with the help of leading questions showed that some of the subjects had just such a convergent search. At the same time, many answers show that expanding the search area for an answer to the diagram attached in Figure 1 and beyond does not necessarily lead to an easy answer to the question posed. These and other pieces of evidence allow us to assert that the problem here lies not so much in thinking but in the peculiarities of the work of consciousness, which does not include the processes of perception and attention in its orbit when performing semantic tasks.

Naturally, when the subjects were drawn to the possibility of finding a solution in the area of direct perception, in most cases they could quickly find the correct solution to the problem in the presented material and even wondered why they had not noticed this solution earlier. Such a special subordination of the function of visual perception concerning the work of mind and consciousness in solving semantic problems is characteristic in general for the work of higher mental functions that are formed by adulthood.

This result, which is consistent with the provisions of the cultural-historical theory, is a consequence of the socio-cultural development of a person in the conditions of a modern information technology society, in which semantic knowledge belongs to a person's memory or is in the form of information on artificial external media, and the task of perception is only in automatic recognition this information [6]. The sociocultural dominant, consisting in the fact that knowledge belongs to a very specific intellectual world that limits the functions of perception, is combined here with the fact that the perceptual processes themselves are mostly poorly accessible for comprehension and are largely automated.

According to the Transcendental Psychology Approach (A.I. Mirakyan and his school), this is explained by the special form-generating nature of the processes of direct perception [8,9]. The concept of form generation in general terms is associated with the concept of a class of structure-generating processes that characterize transitions from one level of hierarchies of system-forming structures to another, and these levels themselves are usually

associated with processes studied by different sciences [14]. The system providing the processes of form generation can have a complex organization, and the mechanisms of the structure-generating process have nothing to do with the properties of the products involved in it. This significantly complicates their study, since here it is impossible to use the so-called "product basis approach", in which the study of the mechanisms of natural processes is carried out based on the properties of the products of these processes [8]. This issue is also relevant because of the trends in cognitive psychology to consider perception as a simplified initial part of the cognitive processes.

Form generation in perception provides a variety of functionally flexible mental functions and is formed in the process of ontogenesis in such a way that this process is inaccessible for awareness. At the same time, its self-obtained results do not seem to require special attention and comprehension and do not belong so much to perception itself but memory and thinking, with which a person works when solving intellectual problems at the conceptual and semantic level of thought. In this regard, although conscious perception, in principle, has functional capabilities with some access to the procedural side of the interconnected flow of feelings, including in the form of concomitantly generated and co-represented sensory products it, largely due to its socially determined selectivity, maybe underdeveloped even in adults [15].

## Conclusion

The conducted experimental study of the peculiarities of using the possibilities of visual perception by students in the process of solving semantic problems confirms the above assumption about the subordinate and unconscious role of situational processing of visual information in solving semantic problems. In the behavior of the subjects, the effect of perceptual-semantic blindness is observed. It shows the natural absence of the inclusion of the procedural-semantic component of visual perception in the conscious cognitive process associated with semantic tasks, while, in principle, it is possible to carry out this inclusion.

In fact, in the cognitive activity of an adult, perception is often in such a subordinate position that, in the procedural-semantic plane, the functional capabilities of visual perception are poorly understood and are not taken into account by the subjects. This can be considered one of the results of the socio-cultural development of a person, formed in the conditions of a modern information technology society.

The presented results allow us to draw a practical conclusion about the need for additional educational work aimed at understanding the cognitive role of the perceptual process and forming conscious attitudes to its procedural component and sensory capabilities. On the one hand, this involves a semantic work with the foundations of normative scientific models used in education and social practice [15]. On the other hand, it is necessary to use special practices and classes for the further development of perception and activation of conscious control of its functions (expansion of the space and connectivity of the field of perceptual presence, increase in the duration of perceptual memory, etc.), for better inclusion of these processes in the general conscious activity. In particular, the

importance of special and purposeful perceptual-cognitive training as one of the effective means of achieving high results at the elite level is quite clearly understood by researchers of giftedness [16]. These means are especially important for the educational process. To eliminate the effect of perceptual-semantic blindness, it is necessary to develop unclaimed possibilities of perception and consciousness.

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