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FEATURES OF VISUAL ILLUSIONS PERCEPTION BY 1st, 5th AND 9th GRADE STUDENTS OF SECONDARY SCHOOL

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ABSTRACT

This article examines some of the mechanisms of perception of visual illusions, shows how such perception develops in the process of learning and development of a child using the example of visual illusions. It is emphasized that the perception of visual illusions is associated with the accumulation of perceptual experience, which in the process of natural development and schooling is the main factor in the development of perception. It is in school that perceptual experience becomes more and more mediated by knowledge about the properties of external objects. Thanks to the development of school disciplines, the formation of the image of perception is more intertwined with the processes of thinking, memory, attention, which can lead to the appearance of illusory effects. This leads, as a rule, to the development of observation and value judgments in relation to certain objects according to certain parameters. With the development of the child, the illusory effect on the perception of certain illusions may well be different due to familiarity with certain illusions, or due to the level of education. The author introduces the results of his research conducted with students in grades 1, 5, 9 of a comprehensive school on the subject of perception of visual illusions depending on the year of schooling and age. The study used both classic and relatively new size illusions. A classical psychophysical method was applied in a modern interpretation, the essence of which was to modify the selected stimulus material. Based on the results, it was noted that the perception of visual illusions can change with age due to objective and subjective factors.

Keywords: Perception of visual illusions, illusory effect, perceptual learning, perceptual experience, age.

INTRODUCTION

It is known that the peak of the development of mental processes falls on such an institution of socialization as a school. In particular, perception in the process of general education does not stop its development; it continues to develop throughout a person's life. Accordingly, the school as an institution of socialization is one of the factors influencing the life-long development of perception and other mental processes.

In the last decade, interest in the visual illusions study has increased dramatically. One of the methodological aspects of the visual illusions study is to use them as a stimulating material for various types of diagnostics, for example, diagnosing the degree of development and formation of thinking and perception in the process of general education and mental development.

The aim of the study is to reveal the perception peculiarities of visual illusions at different age-specific stages, in particular, among 1st, 5th and 9th grade students of a secondary school.
Research object: visual illusions perception.

Research Subject: features of the visual illusions perception at different age-specific stages.

Hypothesis: we assume that there are differences in the severity of the illusory effect among pupils from different classes of a general education school due to the peculiarities of teaching in various classes.

LITERATURE REVIEW

Implying foreign and domestic studies devoted to the study of this kind of perception, it can be noted that there are studies in which the development of perception is studied in various aspects: the relationship between the perception development and the activity development (Zaporozhets, 1966), enrichment and differentiation in the course of perceptual learning (Gibson, 1956), the perception development with inverted vision (Logvinenko, 1981), etc. In particular, Zaporozhets A.V., considering the perception development in conjunction with the development of the child's practical activities, emphasizes that "the development of the activity in general and the perceptual processes included in it is determined by the conditions of life and learning, during which the child learns the social experience accumulated by previous generations". Developing this idea, he notes that the sensory and perceptual skills development involves not only the adaptation of perceptual processes to life situations and conditions that are individual for each person, but also the acceptance and use of sensory systems and perceptual samples created and formed by the society (Zaporozhets, 1966). Gibson J. provides an analysis of the development of perception from a slightly different angle - within the framework of theories of enrichment and differentiation. According to the first theory, the perception development is seen as a perceptual experience enrichment by increasing associative connections and modifying perceptual images in the process of life. According to the second theory, the development of perception occurs through "a gradual clarification of the qualities, properties and types of images movement," which leads to a change in these images (Gibson, 1956). Stratton showed that with prolonged inversion of retinal images using special glasses, the testee gradually becomes able to see the world in the correct orientation.

It should be noted that there exist also a large number of studies concerning the visual illusions perception (Gregory, 1970, Luria, 1982, Ames, 1946, Rock, 1989, Segall, 1966, etc.). In these studies, various reasons for the perception of certain illusions were clarified. Consequently, for example, Gregory R. paid attention to the study of the illusions of size, as well as the cultural conditioning of these illusions perception, Leaper R. - the influence of attitudes in perception, Ames A., the influence of experience on the perception of illusions. However, in these studies, adults took part as testees.

An attempt to conduct a study on the visual illusions perception in children was undertaken by I. Vlachos, K. Panos and others. This study was conducted with 10-14 year old children, who were presented with the illusions of Müller-Lyer, Ponzo, Poggendorf, Goering and others. The schoolchildren had to give an answer to the presented illusions, and after receiving the correct answer, try to explain the reason for their "wrong" perception. Younger children (10-11) years old could not explain the reason for the illusory perception or noted that "the picture was drawn with the aim of confusing or deceiving us." Elder children participating in this experiment (13-14 years old) gave explanations, referring to the structural features of the visual system, or explanations with elements of science (Vlachos & etc, 2007).

This study shows at what age children can explain their feelings when exposed to visual illusions, but it does not show at what age children start to experience visual illusions and how the illusory effect changes during the development and children's learning.

The accumulation of perceptual experience during natural development and schooling are the main factors in the perception development. As already noted, it is at school that knowledge about the properties of external objects becomes more and more mediated. Owing to the school disciplines development, the formation of the image perception is more intertwined with the processes of thinking, memory, attention, which can lead to the appearance of illusory effects. This leads, as a rule, to the development of observation and value judgments in relation to certain objects according to certain parameters (color, shape, size, etc.).
Visual assessment of the perceived object takes place in 3 stages (Tolansky, 1967):
1) fixing an object in the field of view, examining it (“see”);
2) object identification (to recognize, recognize, correlate with past experience);
3) assessment (assess the size and shape of the object in relation to surrounding objects, determine the distance to the object, etc.).

Based on this, it is possible to associate the development of perception with these stages. Thus, a child first learns to see a variety of objects with which he or she meets for the first time. With repeated acts of perception, he/she is already able to recognize familiar objects. When teaching various general subjects at school, he/she learns to measure the dimensions of the object itself and the distance to it. This staging is very similar to the stages of perceptual actions development considered by A.V. Zaporozhets. (Zaporozhets, 1999).

With regard to the visual illusions perception, such a picture can be observed. If the image of the illusion corresponds to a real object that has ever been perceived by a child, then he is likely to be strongly affected by this illusion. This conclusion is based on the results of cross-cultural studies, where it was emphasized that people who did not encounter objects that are "prototypes" of visual illusions in their experience were less susceptible to these illusions (Gregory, 1970). Strong susceptibility can be explained in terms of the above three stages in the development of visual assessment. At the first meeting with an image containing an illusory effect, a strong susceptibility to this effect is quite possible due to the fact that orientation actions, correlation with past experience, recognition of the object occur, and only after that evaluative actions take place (if they are formed and developed in the child during this period). Therefore, with the child development, the illusory effect on the certain illusions perception may be quite different due to familiarity with certain illusions, or due to the level of education. Therefore, we will try to trace in our empirical study how the degree of illusory effect changes depending on age and educational level.

METHODOLOGY

The experiment is carried out using the method of constants (presentation of stimuli of varying intensity in a random order), the method of conversation and measurement are used as well. The constants method (constant stimuli method, true and false cases method) enjoys a reputation for being the most accurate and reliable, since the procedure of the method itself provides for such an organization of stimulation that excludes errors of habituation and expectations (since stimuli are presented in a random order). The possibility of accumulating large statistics of responses associated with limiting the number of constant stimuli used in the measurement increases the reliability of the threshold measurement by this method. Stimuli have constant fixed values and cannot be changed during the experiment.

In our study, we used the following visual illusions: Muller-Lyer illusion, Ponzo illusion, road illusion, wall illusion, skyscraper illusion, and minaret illusion. For convenience and simplicity, we have introduced symbols for each illusion: the Mueller-Lyer illusion - ML, the Ponzo illusion - IP, the illusion of roads - ID, the wall illusion - IS, the illusion of a skyscraper - IN, the illusion of the minaret - IM. Note that all illusions are illusions of perspective, i.e. reflect the spatial characteristics of objects in space (size of objects, angles, linear perspective, etc.). In fact, they are all illusions of size, since when they are perceived an overestimation of objectively identical elements of the picture (in particular, size) occurs. Nevertheless, we consider it necessary (for research purposes) to divide them into groups according to the degree of abstractness:

1. Abstract illusions are simplified, schematic images represented by several lines. Of the illusions used in our study, we included the Mueller-Lyer illusion and the Ponzo illusion into this group.

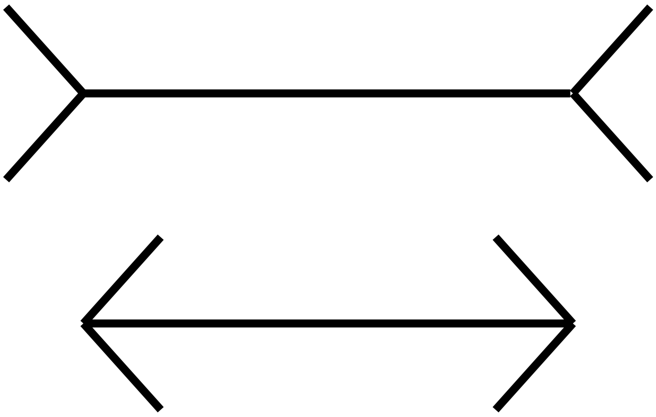

Fig. 1. Mueller-Lyer illusion (ML).

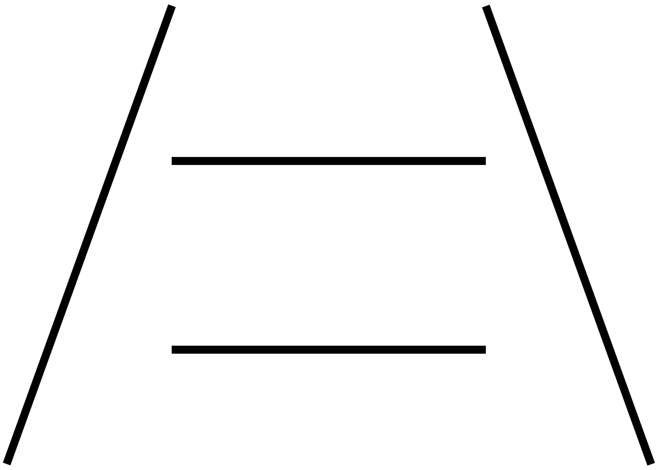

Fig. 2. Ponzo's Illusion (PI).

2. Semi-abstract illusions (illusions with a medium degree of abstraction) are fragmentary photographs or schematic drawings of real objects, in which, with the help of some additional elements (for example, lines), visual signs of perspective are introduced. Here we include the illusion of roads (the author's name) and the illusion of the wall (the author's name).

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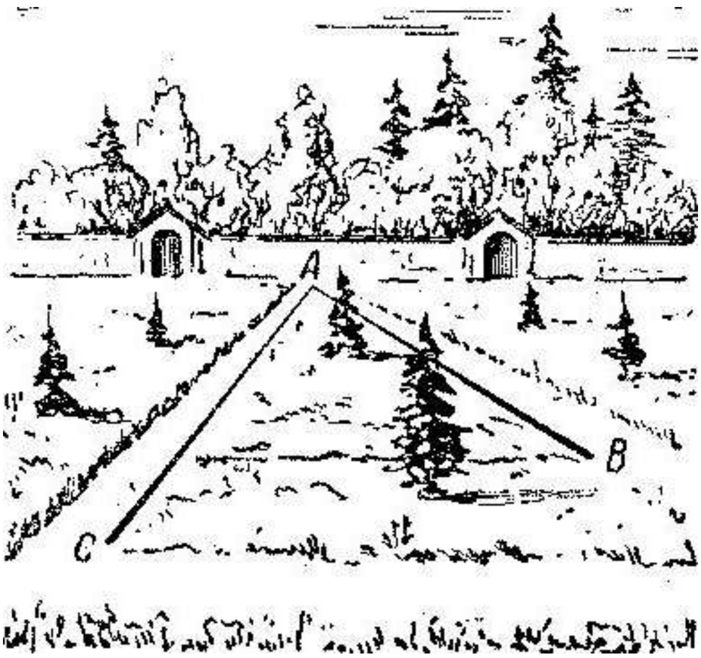

Fig. 3. Illusion of roads (IR).

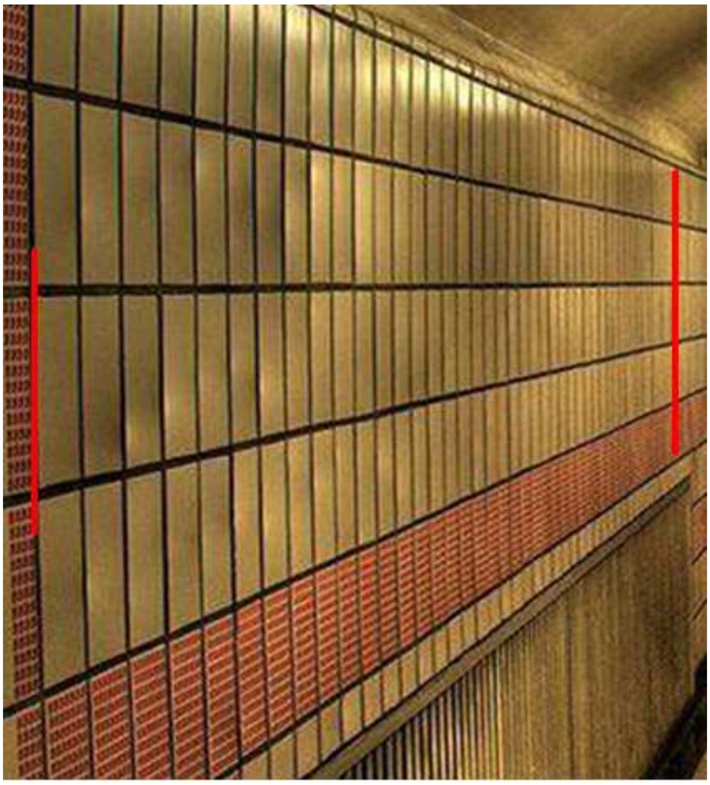
Fig. 4. Wall illusion (WI).

3. Visual illusions - photographic (as a rule) images of real objects, the illusionary effect is provided by the objects themselves, without introducing any additional elements (lines, abstract figures, etc.). This group includes the illusion of inclined buildings - the illusion of a skyscraper and the illusion of a minaret.

Fig. 5. The illusion of a skyscraper.

The illusion of a skyscraper (Fig. 5) and the illusion of a minaret (Fig. 6) reflect the peculiarities of perception of two tall objects moving upward from us. As you know, with linear perspective, the impression is created that parallel lines converge at some distant point, and it is quite normal for perception that the distance between parallel lines visually decreases with distance from the observer. This regularity of linear perspective works in the perception of objects not only "in length and width", but also in "height", which is reflected in the perception of high-rise buildings. Therefore, according to linear perspective, the distance between the central axes (and not just between the outer walls) also visually decreases with distance from the observer. The central axis of a building is a more reliable indicator, since the outer walls of buildings are not always vertical due to engineering solutions (such as a minaret), and the visual system can make certain corrections for this if there is a perceptual experience of perceiving such buildings. Accordingly, when perceiving such images, the observer has the impression that the building on the right is “falling over” to the right relative to the left. The illusory effect is achieved due to the fact that the figure shows two identical buildings, at the same angle, respectively, their central axes are parallel to each other, and do not form an angle typical for linear perspective.


Fig. 6. Minaret illusion.

We will use this classification when organizing, conducting an experiment, as well as analyzing and interpreting the results.

The experimental technique was developed independently, based on the method of constants. To conduct an experimental study, we chose from a large variety of illusions 2 abstract (ML, PI), 2 semi-abstract (IR, WI) and 2 visual illusions (illusion of inclined buildings). We made the last two illusions ourselves, guided by the article on the illusions of slanted buildings (Kingdom, 2007).
Each illusion has been modified to enhance or weaken the illusion effect. As a result, 8 modifications were prepared for each visual illusion. Modifications were made in Paint and Photoshop CS 8.0.
The Mueller-Lyer illusion (ML) and the Ponzo illusion (PI) were modified as follows: the upper segment was unchanged; the lower segment was changed in the range from 95% to 130% of the original value. So, if the original segment was 6 cm, then in each modification, 3 mm was added (or decreased). As a result, 8 variants of illusions were distributed as follows:
A) 95 %
B) 100 % (original)
C) 105 %
D) 110 %
E) 115 %
F) 120 %
G) 125 %
H) 130 %
Accordingly, modification A enhances the illusory effect, while modifications from C to H decrease it in succession with the same step.
In the illusion of roads (IR), the AB segment was modified, while the AC segment remained unchanged. The range of modifications in percentage is the same as in the previous illusions.

In the wall illusion (WI), the left vertical segment of the red color was modified; the right segment of the same color remained unchanged. The range of modifications in percentage is the same as in the previous illusions.
The illusions of inclined buildings were processed as follows: the left building (with the image of the inclined building) remained unchanged, and the right (the same) building was rotated clockwise and counterclockwise. Clockwise rotation was reached up to 5 degrees, and counterclockwise up to 30 degrees from the original position of the object in the drawing. As a result, 8 variants of each illusion were distributed as follows:
A) 5 degrees clockwise
B) Original (unmodified)
B) 5 degrees counterclock-wise
D) 10 degrees counterclock-wise
D) 15 degrees counterclock-wise
E) 20 degrees counterclock-wise
G) 25 degrees counterclock-wise
H) 30 degrees counterclock-wise
Since 8 modifications were made for each illusion, and there were 6 used illusions, we received 48 images of illusions with varying degrees of severity of the illusory effect.
The method of constants was used to determine the severity of the illusory effect. It requires the presentation of each image 10-20 times. Due to the limited time of the study, we decided to reduce the number of repetitions to 5. As a result, each participant had to evaluate the severity of 240 images. A form was developed to register the participants' answers.
Testees (groups "schoolchildren"):
- 1st grade students of secondary school No. 225 in Tashkent (60 people) at the age of 6-8 years (28 boys and 32 girls);
- 5th grade students of secondary schools No. 225, 27 in Tashkent (60 people) at the age of 10-12 years (30 boys and 30 girls);
- 9th grade students of secondary schools No. 187, 225 in Tashkent (60 people) at the age of 14-16 years (32 boys and 28 girls).
The control group (in which it would be possible to separate the level of education from natural development) is not provided due to the fact that it seems impossible for us to select children of the same age, but not enrolled in school, into similar age groups.

Results Processing

1. Summation and averaging of answers for each illusion for each participant.
2. Construction of a psychometric curve for each illusion for each participant.
3. For each psychometric curve, the calculation of the point of subjective equality (PSE), corresponding to the 50% probability of answering "yes";
4. Calculation of the difference between TCP and the value of the standard (E) according to the formula: Δ = PSE - E, where E is the value of the segment or the angle of inclination according to the reference image;
5. Calculation of the severity of the illusory effect (B) according to the formula: $B = \Delta / E * 100\%$.

The B values obtained for each illusion and for each testee as a result of initial processing are entered into the Excel program, after which these data can be processed using the SPSS 15.0 statistical program.
There were used:
1. Descriptive statistics
2. distribution normality verification (according to the Kolmogorov-Smirnov test).
3. Mann-Whitney test (nonparametric method)

4. Kruskal-Wallis test (nonparametric method, analogue of one-way analysis of variance)

RESULTS

Based on the results of testing the normal distribution of data among the groups of "schoolchildren", we see that for each illusion there is an abnormal distribution for one sample or another or for all samples at once. This indicates that in the subsequent testing of the hypotheses put forward, it is necessary to use nonparametric methods of statistical processing. Since the data for the “schoolchildren” groups showed us an abnormal distribution, we can further test the hypothesis using the Kruskal-Wallis test, the Mann-Whitney U-test, as well as the results of descriptive statistics.

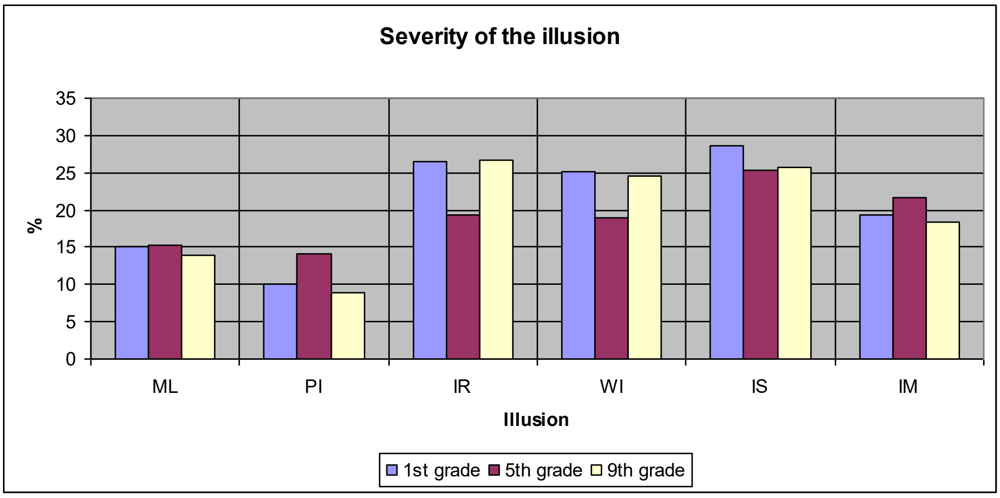

Fig. 7. The severity of illusions in the "schoolchildren" group

According to the graph shown in Fig. 7, you can see that in 5 cases out of 6 9th grade students are less susceptible to visual illusions than 1st grade students. In the case of abstract illusions, an interesting tendency can be seen - 5th grade students are more susceptible to them, and in the case of semi-abstract illusions, on the contrary, 5th grade learners were less susceptible to them. From visual illusions, we can notice somewhat contradictory results - 1st grade learners are more susceptible to illusions of a skyscraper, and 5th grade students are more susceptible to the illusion of a minaret.

These results can be examined in more detail.

Table 1. Results on the methods of mathematical processing on the illusion ML in the groups "schoolchildren"

Index	1st grade	5th grade	9th grade
Mean	14,9813	15,2595	13,9897
Std. Deviation	7,01230	5,85852	7,83269
Average rank (Kruskal-Wallis test)	92,10	94,37	85,03

The Kruskal-Wallis test showed that there were no significant differences between all three samples ($p = 0.597$). To compare the results pairwise between samples, we used the Mann-Whitney U-test, according to which there are also no significant differences between all samples ($p = 0.792$, $p = 0.442$ and $p = 0.339$, respectively). If we analyze the results shown in Table 1 (by average values and average ranks), then we can see that 5th grade students are slightly more susceptible to the Mueller-Lyer illusion than others, and 9th grade students are slightly less than others. The average value of the illusory effect on the ML illusion for 1st grade students can be taken as 15%, for 5th grade students - for 15.3%, for 9th grade students - for 14%. Differences in severity were found to be insignificant.

Table 2. Results on the methods of mathematical processing on the illusion PI in the groups "schoolchildren"

Index	1st grade	5th grade	9th grade
Mean	9,9895	14,0732	8,8505
Std. Deviation	4,82456	5,39312	5,74281
Average rank (Kruskal-Wallis test)	81,83	120,46	69,22

The Kruskal-Wallis test showed that the results were significantly different between all three samples (p = 0.000). To compare the results pairwise between samples, we used the Mann-Whitney U-test, according to which there are no significant differences between samples of 1st and 9th grade students (p = 0.107), while between samples of 1st and 5th grade students There are such differences between the samples of 5th and 9th grade students (p = 0.000 in both cases). If we analyze the results shown in Table 9 (by average values and average ranks), then we can see that 5th grade students are more susceptible to Ponzo's illusion than others, and 9th grade students are less likely than others. These results are to some extent similar to the results for the ML illusion, which allows us to conclude that there is a similar trend in abstract illusions (which include ML and PI illusions). The average value of the illusory effect on the PI illusion for 1st grade students can be taken as 10%, for 5th grade students - for 14.1%, for 9th grade students - for 8.9%.

Table 3. Results on the methods of mathematical processing on the illusion IR in the groups "schoolchildren"

Index	1st grade	5th grade	9th grade
Mean	26,4588	19,3620	26,7477
Std. Deviation	4,17553	5,32280	5,99734
Average rank (Kruskal-Wallis test)	106,85	47,82	116,83

The Kruskal-Wallis test showed that the results were significantly different between all three samples (p = 0.000). To compare the results pairwise between the samples, we applied the Mann-Whitney U-test, according to which there are differences at the tendency level (p = 0.095) between the samples of 1st and 9th grade students, while between samples of 1st and 5th grade, as well as between the samples of students in the 5th and 9th grade, there are significant differences (p = 0.000 in both cases). If we analyze the results shown in Table 10 (by average values and average ranks), we can see that 5th grade students are less susceptible to the illusion of roads than others, and 9th grade students are more than others. The average value of the illusory effect on the illusion of IR for 1st grade students can be taken as 26.5%, for 5th grade students - for 19.4%, for 9th grade students - for 26.7%.

Table 4. Results on the methods of mathematical processing on the illusion WI in the groups "schoolchildren"

Index	1st grade	5th grade	9th grade
Mean	25,1715	18,9980	24,4920
Std. Deviation	7,32154	5,96990	8,02581
Average rank (Kruskal-Wallis test)	105,98	61,58	103,95

The Kruskal-Wallis test showed that the results were significantly different between all three samples (p = 0.000). To compare the results pairwise between samples, we applied the Mann-

Whitney U-test, according to which there are no significant differences between samples of 1st and 9th grade students (p = 0.967), while between samples of 1st and 5th grade students There are such differences between the samples of 5th and 9th grade students (p = 0.000 in both cases). If we analyze the results shown in Table 11 (by average values and average ranks), we can see that 5th grade students are less susceptible to the wall illusion than others, and 1st grade students are more prone to others. These results are to some extent similar to the results for the illusion of IR, which allows us to conclude that there is a similar trend for semi-abstract illusions (which include the illusions of IR and WI). The average value of the illusory effect on the illusion of WI for 1st grade students can be taken as 25.2%, for 5th grade students - for 19%, for 9th grade students - for 24.5%.

Table 5. Results on the methods of mathematical processing on the illusion IS in the groups "schoolchildren"

Index	1st grade	5th grade	9th grade
Mean	28,6662	25,3960	25,6682
Std. Deviation	9,34297	8,34219	11,76067
Average rank (Kruskal-Wallis test)	101,61	82,33	87,57

The Kruskal-Wallis test showed that there were no significant differences between all three samples (p = 0.110). To compare the results pairwise between samples, we applied the Mann-Whitney U-test, according to which there are no significant differences between samples of 1st and 9th grade students, as well as between samples of 5th and 9th grade students (p = 0.256 and p = 0.835, respectively), while there are such differences between the samples of 1st and 5th grade students (p = 0.017). If we analyze the results shown in Table 12 (by average values and average ranks), we can see that 5th grade students are less susceptible to the illusion of a skyscraper than others, and 1st grade students are more than others. The average value of the illusory effect on the illusion of IS in 1st grade students can be taken as 28.7%, for 5th grade students - 25.4%, for 9th grade students - 25.7%.

Table 6. Results on the methods of mathematical processing on the illusion IM in the groups "schoolchildren"

Index	1st grade	5th grade	9th grade
Mean	19,3658	21,6480	18,2855
Std. Deviation	5,95083	5,34583	5,74485
Average rank (Kruskal-Wallis test)	86,20	110,78	74,53

The Kruskal-Wallis test showed that there were no significant differences between all three samples (p = 0.110). To compare the results pairwise between the samples, we applied the Mann-Whitney U-test, according to which there are no significant differences between the samples of 1st and 9th grade students (p = 0.193), while between the samples of 1st and 5th grade students there are such differences between the samples of 5th and 9th grade students (p = 0.008 and p = 0.000, respectively). If we analyze the results shown in Table 13 (by average values and average ranks), we can see that 5th grade students are more susceptible to the illusion of the minaret than others, and 9th grade students are less likely than others. A rather contradictory tendency is already visible here (if we compare the results for the illusions of IS and IM). When discussing the results, we will try to analyze the possible reasons that could influence such "inconsistent" results. The average value of the illusory effect for the MI illusion in 1st grade students can be taken as 19.4%, for 5th grade students - for 21.6%, for 9th grade students - for 18.3%.

DISCUSSION

In fig. 7, as well as from tables 1-6, one can see the dynamics of the illusory effect among students in grades 1, 5, 9 of a secondary school. It should be noted that these were different groups of testees (and not longitude), so the dynamics of the illusory effect is somewhat conditional. Nevertheless, the data obtained allow us to trace the peculiarities of the visual illusions perception depending on the age and grade of schooling.

Let us analyze the results for abstract illusions (ML and PI). As indicated, 5th grade students are more susceptible to them and 9th grade students are less susceptible to them. Obviously, according to the ML illusion, we did not get significant differences between the samples of students in the 1st, 5th and 9th grades, but according to the PI illusion, there are such differences. It is noteworthy that a similar dynamics is observed for these illusions - the degree of exposure increases from the 1st to the 5th grade, and decreases from the 5th to the 9th grade. Differences in the results for these two illusions can be ascertained not only in terms of significant differences, but also in the severity of the illusory effect - the graph shows that the degree of susceptibility to the illusion of PI is less in 1st and 9th grade students.

This similar dynamics can be explained as follows: students from the 1st to the 5th grade have an increase in perceptual experience, thanks to teaching in elementary school, in particular, elementary school subjects, introducing students to the world around them, expand the boundaries of the space available for perception. This can be natural history, fine arts (drawing, modeling, appliqué, etc.), mathematics, reading, rhythm, etc. This, in turn, contributes to the fact that spatial representations in children are accumulated, processed and can be used for subsequent assimilation of knowledge. Thus, by the 5th grade, the number of objects that were perceived both in reality and on a plane in the form of images or drawings increases. But the assessment and accuracy of perception in relation to such objects is not yet sufficiently formed, moreover, the 5th grade learners have quite little experience of interacting with abstract figures. If you look at the textbooks from the 1st to the 5th grade, you will notice that there are many illustrative drawings, but abstract shapes are very rarely used for illustrations. Differences in the results on illusions of ML and PI can be explained by the fact that the experience of perception of converging lines in the future (for example, railways, roads) in children from the 1st to the 5th grade is much less than rectangular objects (for example, rooms, buildings etc.). The fact of familiarity with the ML illusion cannot be ruled out, since this is one of the most common illusions. The same can be said for the PI illusion, which is less common but may still be familiar to these groups of subjects.

Learners from the 5th to the 9th grade have an increase in perceptual experience also due to the development of knowledge about subjects; however, the content of knowledge during this period is somewhat different. This is due to the fact that during this period of study (secondary school), schoolchildren study subjects that suggest a higher level of abstraction. This is physics, chemistry, more abstract mathematics, which is represented in the 7th grade by the sections of algebra and geometry, drawing. Mastering these subjects, schoolchildren acquire more knowledge, skills, skills in the perception and assessment of mainly flat figures (with three-dimensional figures, they are mainly dealing with drawing), which are presented in textbooks rather abstractly. Teenagers develop the ability to solve geometric problems by combining calculations and building drawings, diagrams, graphs. This requires students to develop observation, perception of spatial relationships depicted on a plane (on a board or in a textbook). This explains the decrease in the illusory effect of abstract illusions by the 9th grade.

A somewhat different picture is observed with semi-abstract illusions. The 5th grade students turned out to be less susceptible to them than the others, both in the case of the ID illusion and in the case of the WI illusion, and this difference was significant. We can see an insignificant difference in the results between the 1st and the 9th grades and a somewhat contradictory situation - according to the illusion of IR, the illusionary effect on the sample of the 9th grade is slightly greater than for the sample of the 1st grade, and on the illusion WI, the opposite is true. But this difference is insignificant, so we can take it for random. The difference in results between the 1st and the 5th grades, as well as between the 5th and the 9th grades, is statistically significant; moreover, a similar dynamic attracts attention. So, from the 1st grade to the 5th one can see a decrease in the degree of susceptibility to illusions of IR and WI, and from the 5th grade to the 9th grade one can state an increase in susceptibility to these illusions.

As mentioned above, the semi-abstractness of illusions is achieved due to the fact that the clarity of images is artificially reduced by transforming them into a drawing, somewhat schematic form with a loss of color, or by isolating some separate fragment of the whole object. In fact, the illusory effect of semi-abstract illusions is achieved by the fact that drawings (or fragments of objects) act as a context, a background, and it is necessary to evaluate the segments artificially introduced into them. In abstract illusions, there is practically no such background and it is necessary to evaluate it based on a comparison of the segments with each other, which are the main forming elements of such illusions. A decrease in susceptibility to such illusions in students of the 5th grade compared to the 1st grade is possible because they have little experience in perceiving such images. In contrast to the perception of abstract illusions, where the testees have experience of perception of real objects and their images on paper, but little experience of perception of abstract images, in the case of perception of semi-abstract illusions, the subjects have relatively little experience of perception of such images. This demonstrates once again that the development of the perception of illusions proceeds in leaps and bounds due to the accumulation of perceptual experience and its representation for the perception of new objects. The higher susceptibility to semi-abstract illusions in 1st grade students can be explained by the fact that they have less experience of perceiving flat, drawing images compared to 5th grade students, but these perceptual skills are enough to be sufficiently susceptible to this type of illusion. In addition, 1st and 5th grade students deal with more colorful and visual images than was presented in the stimulus material.

The increase in the illusory effect from the 5th grade to the 9th grade can be explained by the fact that in adolescents, due to the teaching of these subjects in secondary school, the influence of abstract and verbal-logical thinking begins to prevail in comparison with the influence of sensory-perceptual processes. This makes it possible to better evaluate abstract figures rather than visual ones. Although in semi-abstract illusions it was necessary to evaluate segments that are to a certain extent abstractions, the presence of a background (which is more visual) can be new material for 9th grade students, since in textbooks on geometry and drawing, a background other than white is quite seldom. Of course, about the results of the 1st and the 5th grade subjects, we can also say that the presence of such a background for evaluating abstract objects is new in their perceptual experience. Nevertheless here you need to distinguish between the characteristics of perception at different ages. The fact is that in the perception of children studying in the 1st and the 5th grades, there are more holistic mechanisms of perception, the essence of which is that the image is perceived as a whole, and their attention will most likely be dispersed throughout picture. The pupils of the 9th grade, on the other hand, have formed analytical mechanisms of perception, which make it possible to isolate the necessary elements from the whole. Hence, the experience of perceiving schematic drawings among 9th grade students, of course, is greater, but to a certain extent it is subordinated to the perception of abstract figures and the operation of abstract concepts in thinking. Therefore, they perceive and evaluate abstract figures against the background of the drawing, in contrast to 5th grade students, who, apparently, perceive and evaluate the whole image first, and only after that they try to estimate the sizes of the segments if they have enough exposure time.

Compared to abstract illusions, the degree of susceptibility to semi-abstract illusions is higher in all groups of subjects. This can be explained, on the one hand, by the different perceptual experiences of the subjects, on the other hand, by the relatively novelty of these illusions, on the third hand, by the combination of visual and abstract elements in the image, which is somewhat unusual for perception. It is more usual for schoolchildren to perceive visual images, illustrations, drawings, photographs of real objects, or abstract figures, lines, drawings on a uniform background. High school textbooks are provided with such illustrations and drawings. And there are much fewer drawings in which both visual and abstract components are combined.

According to the results of inclined buildings, a contradictory situation is observed, both in the severity of the illusory effect and in the dynamics of perception. In the case of the illusion IS, we see less susceptibility among of 5th grade students and more susceptibility among 1st grade students, while the severity of the illusory effect decreases from the 1st to the 5th grade, and from the 5th to the 9th grade increases slightly. In the case of the IM illusion, a completely different trend is visible: 5th grade students are most susceptible to it, and the least of all - 9th grade students, and the severity of the illusory effect increases from the 1st grade to the 5th grade, while from the 5th grade. From the 1st grade to the 9th grade it decreases. The differences in the degree of susceptibility between the samples and the dynamics of the illusory effect of the IN illusion makes it similar to semi-abstract illusions; the same with regard to the IM illusion resembles the tendencies associated with abstract illusions. Therefore, it is worth considering in more detail and comparing the features of these illusions.

We attributed the illusions of IS and IM to visual illusions, since the illusory effect is caused by the images themselves, which are duplicated and shifted by a certain distance without introducing additional distinctive elements, preserving the relative integrity of the depicted object (without isolating individual fragments, as was the case with the WI illusion).

If we consider the illusion of IS, we can see that the image of the skyscraper is not consistent, quite highly detailed (due to the many parallel, perpendicular and diagonal lines of different thickness), a large number of windows. This, to some extent, "makes this illusion related" with semi-abstract illusions, where there are a fairly large number of details of different sizes and shapes. In the IR illusion, image detail is provided by the textured surface between the roads, the presence of buildings in the background, and the presence of trees both between the roads and in the background. In the illusion WI, this detailing is provided by tiles of objectively the same size, but the sizes of the tiles visually decrease as they "move away" from the observer.
With a similar consideration of the IM illusion, it can be noted that the image of the minaret is much more homogeneous and the detail is an order of magnitude less (which is presented mainly in the upper part of the minaret). This feature allows us to draw some analogy (but not a sign of identity!) with abstract illusions.

Continuing the comparative analysis of the IS and IM illusions, one can point out the fact that the illusory effect of the IS illusion is comparable to the illusory effect of the semi-abstract illusions, while the illusory effect of the IM illusion is lower than that of the IS illusion, but nevertheless it is significantly higher than illusions of ML and PI. Such a difference in the severity of the illusory effect in the illusions IS and IM can be explained not only from the point of view of detail (as indicated above), but also from the point of view of isolating the central axis of the building. In the illusion of IS, it seems to us a difficult operation to isolate the central axis in a short exposure time (2 seconds) due to the presence of several parallel lines converging in height on the lateral sides and different areas of the lateral sides themselves (illuminated and shadowed), and orientation to the lateral visible edge of the building not the most reliable sign. In the IM illusion, the central axis is much easier to isolate due to the cylindrical shape of the tower and the almost equal distribution of light and shadow on the side surface. In other words, lighting "divides" the side surface of the tower into illuminated and shaded ones almost in half, and the border of such division serves as a more reliable indicator for highlighting the central axis of the building.

Thus, we can conclude that the perception of visual illusions can change depending on the class of study in a secondary school and has a similar dynamics in the severity of the illusory effect, both in the case of abstract and semi-abstract illusions. Despite the fact that some comparisons between the samples showed insignificant differences, it is the similarity in the dynamic aspect that allows us to conclude that there are differences in the severity of the illusory effect between the samples of the 1st, the 5th and the 9th grade. These differences were obtained by virtue of different perceptual experiences, conditioned to a greater extent by the content of the curriculum, which partly confirms both general and particular hypotheses. Consequently, the degree of susceptibility to abstract illusions increases from the 1st grade to the 5th and decreases from the 5th grade to the 9th, while the degree of susceptibility to semi-abstract illusions decreases from 1st grade to 5th and increases from the 5^{th} grade to the 9th.

If we connect the obtained data with the theories of perceptual learning, then we can point out that in schoolchildren the development of perception is largely due to the accumulation of perceptual experience, an increase in the number of images, a change in their qualities, but the distinctive skills are still at the stage of formation.

CONCLUSION

Based on our research, we have established that the illusory effect can depend on the following factors:
- perceptual experience as an integral part of the experience of interacting with real objects;
- perception of two-dimensional and three-dimensional objects;
- formed perceptual skills for assessing the spatial characteristics of objects and associated operations of analysis and synthesis, abstraction and concretization;
- the degree of concentration of attention on the presented images;
- the presence of visual and abstract elements in the image;
- detailing the background and the elements themselves, creating an illusory effect.

Thus, it was shown that the perception of visual illusions depends on subjective and objective factors.

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