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VIOLATION OF THE TEENAGERS-COMPUTER USERS' BINOCULAR VISION AND PECULARITIES OF ITS RESTORATION

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Abstract

According to WHO experts, vision is vulnerable to computer loads. Computer users have complaints, combined by the terms «visual fatigue», «computer vision syndrome», which include a complex of violations in the system of refraction-accommodation. We did not find any research on the peculiarities of senior students' binocular vision with emmetropia when they are working with a personal computer, and therefore we decided to study this issue. 63 healthy school age senior students were examined, those with emmetropic refraction but without ophthalmic, somatic and psychological abnormalities. Chromatic angle of view and chromatic stereoscopy were studied with the help of special computer techniques. The survey was conducted in three stages. At the first stage, we studied the effect of a one-hour nonstop work in front of the computer monitor on the visual functions, at the second one – their state after a 15 minute passive rest. The third stage involved implementing our own program «Saving and Restoration of Vision» and determining the investigated parameters. The «Saving and Restoration of Vision» program contains special eye exercises, as well as those for the shoulder and neck with breath-holding elements. It is ascertained that high school students' one-hour work at the computer leads to deteriorating chromatic angle of view as well as chromatic stereoscopy. Herewith, the perfect match frequency of test objects decreased by 14,5 and 24,2 % respectively. Applying a set of rehabilitation exercises after a one-hour computer work allowed to restore the binocular vision to the original state, while a passive fifteen-minute rest after the computer visual load did not give such results. Thus, the study of senior students' binocular vision with emmetropic refraction, after one hour of work, showed its violation, which can be eliminated by a complex of rehabilitation exercises from the authors' program «Saving and Restoration of Vision».

Key words: computer influence, teenagers, chromatic angle of view, chromatic stereoscopy, restoration measures.

Наталія Ульяницька, Степан Вадзюк, [1]Наталія Бєлікова, Світлана Індика, Оксана Усова. Порушення бінокулярного зору та особливості його відновлення в підлітків-комп'ютерокористувачів. Як стверджують експерти ВООЗ, зір вразливий до комп'ютерних навантажень. У користувачів комп'ютерів виникають скарги, об'єднані термінами «зорова втома», «комп'ютерний зоровий синдром», які включають комплекс порушень у системі рефракція-акомодація. Досліджень особливості бінокулярного зору в старшокласників з еметропією під час роботи з персональним комп'ютером ми не виявили й тому вирішили вивчити це питання. Обстежено 63 здорові особи старшого шкільного віку з еметропічною рефракцією без офтальмологічних, соматичних та психічних відхилень. Хроматичний кут зору й хроматичну стереоскопію вивчали з використанням спеціальних комп'ютерних методик. Обстеження проводили за три етапи. На першому вивчали вплив годинної безперервної роботи за монітором комп'ютера на зорові функції, на другому – їх стан після 15-хвилинного пасивного відпочинку. Третій етап уключав застосування авторської програми «Збереження та відновлення зору» з наступним установленням досліджуваних параметрів. Програма «Збереження та відновлення зору» містить спеціальні вправи для очей, а також для плечового пояса й шиї з елементами затримки дихання. Установлено, що одногодинна робота старшокласників за комп'ютером призводить до погіршення як хроматичного кута зору, так і хроматичної стереоскопії. При цьому частота ідеальних зіставлень тест-об'єктів зменшувалася на 14,5 і 24,2 % відповідно. Застосування комплексу відновлювальних вправ після одногодинної роботи за комп'ютером дало змогу повернути бінокулярний зір до вихідного стану, тоді як пасивний п'ятнадцятихвилинний відпочинок після зорового комп'ютерного навантаження не привів до відновлення цього показника. Отже, дослідження бінокулярного зору в старшокласників з еметропічною рефракцією після одногодинного навантаження засвідчило його порушення, яке можна усунути комплексом відновлювальних вправ з авторської програми «Збереження та відновлення зору».

Ключові слова: вплив комп'ютера, підлітки, хроматичний кут зору, хроматична стереоскопія, відновлювальні заходи.

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Наталья Ульяницкая, Степан Вадзюк, Наталия Беликова, Светлана Индыка, Оксана Усова. Нарушение бинокулярного зрения и особенности его восстановления в подростков-компьютеропользователей. Как утверждают эксперты ВОЗ, зрение является уязвимым к компьютерным нагрузкам. У пользователей компьютеров возникают жалобы, объединенные терминами «зрительная усталость», «компьютерный зрительный синдром», что включает комплекс нарушений в системе рефракция−аккомодация. Исследований особенности бинокулярного зрения у старшеклассников с эмметропией при работе с персональным компьютером мы не обнаружили и поэтому решили изучить этот вопрос. Обследовали 63 представителя здоровых лиц старшего школьного возраста с эметропической рефракцией без офтальмологических, соматических и психических отклонений. Хроматический угол зрения и хроматическую стереоскопию изучали с использованием специальных компьютерных методик. Осследование проводили в три этапа. На первом изучали влияние часовой непрерывной работы за монитором компьютера на зрительные функции, на втором – их состояние после 15-минутного пассивного отдыха. Третий этап включал применение авторской программы «Сохранение и восстановление зрения» с последующим установлением исследуемых параметров. Программа «Сохранение и восстановление зрения» содержит специальные упражнения для глаз, а также для плечевого пояса и шеи с элементами задержки дыхания. Установлено, что одночасовая работа старшеклассников за компьютером ведет к ухудшению как хроматического угла зрения, так и хроматической стереоскопии. При этом частота идеальных сопоставлений тест-объектов уменьшалась на 14,5 и 24,2 % соответственно. Применение комплекса восстановительных упражнений после одночасовой работы за компьютером позволило вернуть бинокулярное зрение к исходному состоянию, тогда как пассивный пятнадцатиминутный отдых после зрительной компьютерной нагрузки не привел к восстановлению этого показателя. Таким образом, проведенное исследование бинокулярного зрения у старшеклассников с эметропичной рефракцией после часовой нагрузки показало его нарушение, которое можно устранить комплексом восстановительных упражнений с авторской программы «Сохранение и восстановление зрения».

Ключевые слова: влияние компьютера, подростки, хроматический угол зрения, хроматический стереоскопом, восстановительные мероприятия.

Introduction. Overall informatization of society as a global process and multifaceted changes in the organization of work motivates many people to use various means of computer technology (Bolshakova V. A., 2006; Akhmadiev P. P., 2010; Trubylin V. N., etc., 2010).

The computer has become common not only in scientific laboratories, offices, banks and production halls, but also in school classrooms. Therewhile, the introduction of computers in all spheres of human life has revealed not only positive but also the negative effects of their use. According to World Health Organization (WHO) experts Vision, psyche, autonomic nervous system and musculoskeletal system are the most vulnerable. The teaching of high school students is characterized by the widespread use of computers. The work at the computer display is characterized by a significant load on the visual analyzer, therefore, such professional activity is considered to be a visual-intensive work. Visual fatigue and visual efficiency are closely related to the state of the accommodation convergent system [1]. The process of intensive computerization causes many medical and social problems. Up to 40–60 % of users suffer from a computer vision syndrome [10].

The emergence of young people with refraction abnormality, the number of whom grows every year and the emergence of late-acquired short-sightedness among the computer users at video display terminals (VDT) is a problem [13].

In Ukraine the influence of the computer on sight has been studied recently (L. V. Kochin, M. I. Kovtun, 2008), but the influence of work at the computer monitor on visual functions of senior school students has not been defined yet [8]. Some researches have shown that the ergonomic organization of the workplace of a person at a computer provides visual comfort [9]. However, even if these requirements are hold, there are complaints caused by changes in the functional state of the visual analyzer under the influence of the peculiarities of work with the PC [10]. Existent measures and the search for new non-pharmacological physiological recommendations for a complex of recovering exercises require further improvement; implementation will reduce the negative impact of computer technology and protect vision.

The goal of the research is to study the chromatic angle of view and chromatic stereoscopy of senior school students working at a computer monitor, and to propose effective correction of revealed deviations.

The Materials and Methods of the Research. 63 healthy students of the senior school age with hemitropic refraction without ophthalmological, somatic and psychical deviations have been inspected. The conditions of the carrying out of the research met all the sanitary and – hygienic demands [7]. The chromatic angle of view and chromatic stereoscopy were studied with the employment of special computer methods [5; 6].

The research was carried out by the standard light conditions. The inspected person was offered to sit down with his face to the monitor of a personal computer so that his eyes were on the mid-level of a tested

field. The chromatic angle of view and chromatic stereoscopy indices conditioned by such physical phenomenon as chromatic dispersion of the refracted eye mediums were established. The chromatic angle of view is a result of the chromatic diversity of the foci, and the chromatic stereoscopy is a result of the chromatic diversity of the enlargement. The stereoscopic effect that reflects the state of the binocular vision is quantitatively determined at the binocular fixation.

The research of the chromatic angle of view was carried out at a distance of 0,5 m from the monitor. In the process of the inspection it was necessary to combine the blue stripe with the yellow one up to the appearance of a white one. On the basis of this the degree of the divergence in grades was determined.

During the studying of the chromatic stereoscopy it was necessary to combine vertical lines of red and blue test-objects, that alternated with each other, in one line on a computer monitor. The result was obtained owing to the automatic calculation of the angular distance between the axis of blue and red circles in grades at the distance of 0,5 m from the monitor.

The inspection was carried out at three stages. At the first stage the influence of one-hour continuous work in front of the monitor over visual functions was studied.

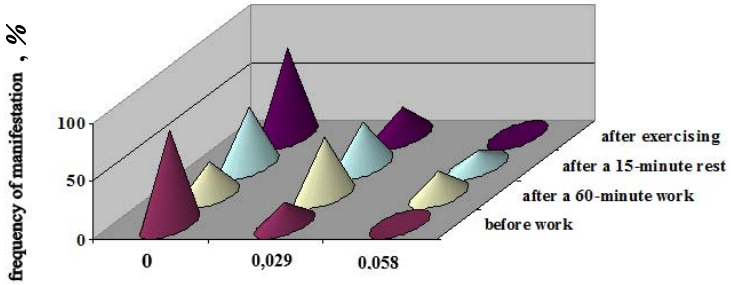
At the second stage after an hour computer load and the following 15-minutes break (shutting eyes or looking aside of the monitor) the chromatic visual angle and the chromatic stereoscopy were estimated.

The third stage foresaw the studying of the researched visual functions after the work in front of a computer and the complex of renewing exercises with the elements of respiratory gymnastics of the author's program.

The results were worked out on a PC with the usage of a software applied package Statistica 6,0 (Statsoft, USA). The results are given as a average meaning +– standard deviation (M+–0). At the normal distribution of the variable quantities the t–test Student for independent categories was used. To compare independent mean quantities the non–parametrical Wilkokson-Mann-Witney-Mann-Witney criterion was used [3].

Research Results. Discussion. Determination of high-school students with emitropic refraction of the chromatic angle of view in the initial state showed (fig. 1) that of 32 people the perfect comparison of the vertical blue band with the yellow one demonstrated only 26. Only 6 students demonstrated the difference in 0,029 degrees.

One-hour work of the 24 examined students by the computer monitor, caused significant changes in the chromatic angle (fig. 4,1). Almost 70 % of high school students, after hour of visual load, could not match the blue and yellow strips on the monitor without deviation. Moreover, 1/5 of schoolchildren assumed a mistake of 0,058 degrees. Thus, 60 minutes visual computer load of high school students significantly degrades the state of binocular vision.



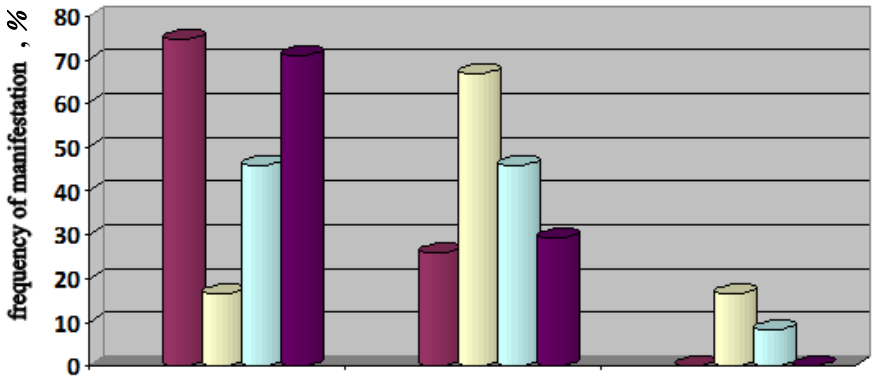
	The magnitude of the chromatic angle of view (in degrees)		
	0	0,029	0,058
before work	81,25	18,75	0
after a 60-minute work	29,17	50	20,83
after a 15-minute rest	50	37,5	12,5
after exercising	75	25	0

Fig. 1. *Chromatic Angle of View Before and After Work in Front of the Computer Monitor*

15 minute rest from the visual computer load caused certain changes in the ability of the surveyed high school students to match the colored stripes on the monitor. We found that 50 % of the students could not complete the test perfectly. That is the rest from the visual computer load improved the researched senior pupils indicator in 20 %. However, this short rest failed to achieve the initial state of binocular vision.

A set of exercises, after hour of visual computer loading of senior pupils, caused significant changes (see figure 1). It was found that inaccuracy in the performance of the test in the comparison of colored stripes was observed only in 0,029 degrees in 1/4 of the surveyed. Thus, the implementation of a complex of exercises, after 60 minutes visual computer load has significantly improved the index of the chromatic angle of view.

Research of chromatic stereoscopy of senior students with emmetropic refraction (fig. 2) in the initial state showed that of 31 persons the perfect combination of the vertical rows of red and blue test–objects was observed in 23 persons. The divergence in 0,029 degrees was observed in 8 students.



	The magnitude of the chromatic angle of view (in degrees)		
	0	0,029	0,058
before work	74,72	25,8	0
after a 60-minute work	16,67	66,67	16,67
after a 15-minute rest	45,83	45,83	8,33
after exercising	70,83	29,17	0

Fig. 2. *Chromatic Stereoscopy Before and After Work in Front of the Computer Monitor*

One-hour work in front of the computer monitor of 24 surveyed students caused significant changes in the parameters of chromatic stereoscopy.

Almost 83 % of senior students after the computer visual load were unable to match the vertical rows of red and blue test-objects on the monitor without deviation. Moreover 1/6 students made mistakes in 0,058 degrees. Thus, the study of chromatic stereoscopy has once again proved that a 60-minute visual computer load of senior students significantly worsens binocular vision.

A 15-minute rest of eyes from one–hour work in front of the computer monitor caused certain changes in the ability of surveyed students to match the vertical rows of red and blue circles on the monitor (see fig. 2). As it turned out, almost 54 % of the surveyed could not do the test perfectly. That is, applied passive rest from the visual computer load improved chromatic stereoscopy of 7 senior students. However, this event failed to achieve the initial state of binocular vision.

Performing a set of exercises after one-hour computer visual load by school age senior students has brought about significant changes. It was found that inaccuracy in doing the test on comparing the vertical rows of red and blue circles on the monitor was observed only at 0,029 degrees in 29 % of the surveyed. Thus, the implementation of a complex of exercises after a 60-minute computer visual load has significantly improved chromatic stereoscopy.

It must be mentioned, that an hour's work of high school students in front of the computer display results in blurred binocular vision. This statement is based on determination of chromatic angle of view and chromatic stereoscopy. Binocular vision is known to be related with the activity of cortical vision centres. Thus it is possible to claim about changes in cortical neurons functioning. This complies with literature data [9] about the suppression of activity of the cortex area of visual analyser after 60-minute computer activity of schoolchildren aged 11–14 years. To some extent, a 15-minute rest from computer load renewed binocular vision. However, a complex of exercises with breathing component turned out to be the most effective way

for vision improvement, which must improve blood and oxygen supply of the brain and prompts substantial renewal of its neuron functions.

Conclusions and Perspectives of Further Studies. Thus, the study of chromatic angle of view and chromatic stereoscopy revealed their more than tripled blurring after 60–minute load. Proposed data signify a positive dynamics of visual functions during the author's programme sessions of the complex of exercises: «Preservation and renewal of vision», which supports its effectiveness. That is why it is advisable to be used in educational establishments and other spheres of our life for prevention of vision fatigue and renewal of vision functions.

Binocular vision is known to be related with the activity of cortical vision centres, so the next step of our studies is seen as determining the functional state of higher reasoning activity.

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