

Editorial

The structure of the eye is marvelous. Through the perfect design and composite of this little window, we can see the shape, color and activity of surroundings, which are essential in our daily living and learning. Therefore it is crucial to protect our eyes. If we have refractive errors such as short-sightedness, long-sightedness, we could correct it effectively with spectacles. We then become more observant and see more clearly. However, there is no medical treatment for color deficiency and color blindness. The feature article of this issue of Bridge, "Color Perception of Color Deficiency", talks about color deficiency. The optometrist introduces to us how the eyes distinguish colors, how color deficiency differs from color blindness, and what the features, types and causes of color deficiency are. More importantly, we could learn that people with color deficiency have their color perception, and, color deficiency and color blindness are not harmful to health.

Let me tell you what color deficiency and color deficiency are!



Actually, people with color deficiency can make adjustments in various aspects in their daily living. This helps to solve problems related to color deficiency and makes living and learning easier. After all, gaining more knowledge in this topic permits a better understanding in how to help out ourselves and others to face the problem, giving another kind of color to life.

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Color Perception of Color Deficiency

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The firework performance over the Victoria Harbour is so fascinating and wonderful! It not only heightens the festive air of Chinese New Year, but also symbolizes a prosperous and lively new start. Having the pleasure to watch such a colorful firework is the result of our eyes being able to distinguish different colors. If our eyes do not have this ability, what do you think would happen?

Light rays shining on the colorful world

Talking about the colorful world, we must know about color vision of our eyes. The ability of our eyes to perceive different colors is called color vision. It is a kind of sense resulting from light rays of different wavelength stimulating our eyes. Light is a basic requirement for us to see. As early as in 1666, the British Scientist Isaac Newton had already discovered that sunlight is a combination of light rays of different wavelengths. He used a prism to separate sunlight into seven visible lights. The seven color light spectrum is made up of seven colors: red, orange, yellow, green, light green, blue and violet. He also found that colors of all objects were not generated by themselves, they were colors of light rays reflected from the object when a light source shone on it.



Light with different wavelengths reflected from objects gives the color of objects. Light goes through the cornea and crystalline lens of our eyes and the refraction of light projects onto the retina. On the retina, there are three kinds of light sensitive cells called "cone cells". When different kind of cone cells receive light of different wavelengths (red, green, blue light), they generate signal which will be transmitted to the brain through the optic nerve located behind the eye ball. The brain analyses the signals to give the perception of the three colors. The brain also combines the three colors in different proportions to create different colors in the world. If there is defect in the retina cone cells or in the signal transmission path, our color distinguishing ability would be affected and we became color deficient or color blind.

Another type of color perception

Color deficiency is different from color blindness. Color deficiency means that the color differentiating ability is lower than normal. People with color deficiency can still recognize most colors. However, if several colors mix together, they may have difficulty in differentiating them and the colors look almost the same. If the illumination is inadequate or if the colors are light, the problem becomes more obvious. Nevertheless, the visual acuity is not affected. Color blindness, on the other hand, is a rare congenital problem. People suffering from color blindness totally lose the ability to distinguish colors. They can only rely on "rod cells" of the eyes to perceive brightness of light and distinguish white, black and grey. In their eyes, the colorful world is just like black and white movie. Color deficiency would not become color blindness.



The two common types of color deficiency are red color deficiency and green color deficiency. Blue-yellow color deficiency is less common. What does the world look like in the eyes of people with color deficiency? They easily mix up colors with similar hues (such as red and orange) and similar brightness (such as yellow and white). People with green color deficiency or red color deficiency vary in their extent of color differentiation problem.



There could be no problem at all, or, there may be problems in daily living and learning. People with red color deficiency would mix up red, yellow, green, white-green and violet-blue. People with green color deficiency would mix up red, yellow, green and white-green. In a situation of crossing the road with traffic lights, people with red color deficiency would have more difficulty than people with green color deficiency because in the eyes of people with red color deficiency, the "red" light appeared to be a dark color only. People with blue-yellow color deficiency cannot distinguish blue, blue-green and green color, and could not tell the difference between white and yellow color.

The mystery behind the chromosomes

Color vision abnormality can be classified into congenital or acquired. Most color deficiency is congenital and inherited. However, some eye diseases can cause color deficiencies, such as optic nerve diseases, retinal diseases and yellow spot abnormalities. Color deficiency is a common problem; it is much more common in males than in females. About 8% of males and 0.5% of females suffer from congenital color deficiency. That is to say, one in 12 males and one in 200 females has the problem. The reason why it is much more common in males is because the color vision gene is located in the X chromosome and color deficiency is an x-linked recessive problem. In human, there are 23 pairs of chromosomes in the cells. The 23rd pair determines the gender of human beings. Males inherit their X chromosome from the mother and the Y chromosome from the father. The

23rd pair of chromosome is XY in males. Females inherit one X chromosome from the mother and one X chromosome from the father and the 23rd pair of chromosome is XX. As the color vision gene is located in the X chromosome, if the only X chromosome in males carries the color deficiency gene, the male will have color deficiency or color blindness. For females, if one of the X chromosomes carries the color deficiency gene while the other X chromosome carries the normal gene, the female will not have color deficiency but she will be a carrier of the color deficient gene. In fact, one out of sixteen females carries color deficiency gene but perceives color normally. Only when both X chromosomes in a female carry color deficiency genes, she will suffer from color deficiency. The most common pattern of inheritance is a boy inherited the color deficient gene from the mother who in turn inherited the gene from her father.

Color vision abnormality can be classified into congenital (due to inheritance) or acquired (due to diseases)



What to do if suspect color deficiency?

People usually could not recognize their color deficiency problem because they have

accustomed to the situation as they grow, or they have developed their own method to recognize color. Usually they get to know their color deficiency problem only when they go through a screening test, or accidentally during the primary school years. There are different types of color deficiency screening test. The one being used by the Student Health Service of the Department of Health is called the "Ishihara" chart. The plates in the chart make use of dots of easily mixed colors. Some of the dots are arranged to form a pattern. If the student can distinguish the pattern from the background, he/she passes the test. It should be noted that the test result could not be considered as accurate if students

had poor visual acuity, the testing distance is incorrect, the illumination is inadequate or if the student does not understand the testing instruction. For students who failed in the test, they would be referred to the Special Assessment Centre to see the Optometrist for a detailed color test called "Farnsworth D-15" test. If the diagnosis comes out to be color deficiency or color blindness, the optometrist would explain in detail about the problem and provide appropriate counselling. Parents may also consult optometrists in private practice.

The adjustment in daily life

Most people with color deficiency would not have major problem in daily life, although some of them may have inconvenience or troubles. The extent of problem on daily living and learning would depend on the severity of color deficiency. It may be very minimal or it may lead to inconvenience or misunderstanding in matters related to color differentiation, for example, choosing a ripe fruit, choosing a color tie to fit a color shirt, pairing up of 2 socks, selecting a snooker ball. When people with color deficiency learn in a subject that is based on color appreciation, they may mix up the colors, for example, choosing a wrong color pencil or



wrongly identify a colored part on the geography map. However, the eyesight and the ability in gaining knowledge are not affected. People with color deficiency may find difficulty if they are engaged in jobs that demand the ability to distinguish color, for example, disciplinary forces, pilot, chemistry worker, quality control worker (color verification).

Today, there is still no effective medical treatment for congenital color deficiency or color blindness. Nevertheless, adjustment in daily life could help minimize the extent of impact. Family members and friends could offer help by organizing clothing and accessories, stationery and articles for daily use according to colors and adding labels of color names, so that people with color deficiency find it easier to identify the color objects correctly. They could also distinguish objects successfully by noting the orders of different objects. On the

traffic light, the red light is on the top while the green light is at the bottom and the yellow light is in the middle. According to the position, the three light could be recognized. If children have color deficiency, parents have to encourage them to face the problem positively and guide them through. Coordination with schools and communication with teachers are also essential for teachers to understand these students' situation and find ways to facilitate their learning. The ultimate aim is to help students develop or sustain self-confidence, appreciate that they could choose their subject streams and career according to their qualifications, potentials and knowledge. Many academic subjects and jobs do not place restrictions on applications whether one is color deficient or not. In fact, every person has strengths and weaknesses, and will not be capable all round.

So long as one could accept oneself, take advantage of potentials and do the best in one's role, one could always lead a colorful life and gain respect and admiration.



Conclusion

Although color blindness could lead to inconvenience and mixing up of certain colors, it will not endanger the general health. With adequate understanding of the problem, adjustments in daily living, making use of aids and being patient, people with color deficiency could gradually adapt to the situation. No matter in daily life or in festive celebrations, everyday is delightful, prosperous and lively.

References:

The Hong Kong Polytechnic University

<http://www.polyu.edu.hk/so/patients.php?lang=en&pageid=374&dispmode=1&lang=en>



We have the privilege to appreciate the wonderful colors of the world because our eyes are able to recognize colors. If the cells on the retina got damaged, or message transmission through the optic nerve became problematic, our ability to differentiate colors would be affected and color deficiency or color blindness would be resulted.

We collected from students some sharing about color deficiency in this issue of Bridge:

Mixing up some of the colors or cannot differentiate among them.

Some parts (e.g. cones) of our eyes suffer from congenital problem and therefore some messages about color could not be transmitted to the brain. Color perception is weaker but it is not color blind.

Not tend to use things of good-looking colors.

Have difficulty in differentiating colors when compared with others. Objects seemed to be black and white.

Color deficiency makes me unable to see the color of the world.

Color deficiency – I think it is the sensitivity to color differentiation is weaker or lessened than usual.

Color deficiency is an unhappy event, but actually, life should be abundant and full of colors.

Could not see the beautiful colors.

Although my classmate has color deficiency, I would not give up my support for him.

What I see is not as wonderful as in others.

Answer: d
For people with color deficiency, the ability to differentiate color would be decreased by inadequate illumination and light color of the object. Therefore, under the condition that illumination is adequate and color of object is dark and sharp enough, differentiation of color becomes better.

People with color deficiency may not recognize their problem in differentiation of colors. Student Health Service provides color vision screening service for all primary 6 students. After screening test and detailed examination, color deficiency could be confirmed.

We would like to share a letter on 'color deficiency' with you:

Maybe Color Deficiency?



Dear Wing,

Thank you for your letter. Our service provides color vision screening for all primary 6 students who joined the service. During the annual health visit, nurses will use color vision charts for screening. If a student could recognize the number or pattern out of a background, he/she passed the test. If a student could not read them out or did it wrongly, we shall arrange the student to attend the Special Assessment Centre where the optometrist would provide a detailed examination to confirm whether the student has color deficiency, color blindness or not. The optometrist would also explain the details and make recommendations on adjustment in learning or daily life. Students could also consult optometrists in private practice.

Wish you good health

Health Box

Dear Health Box:

Hi, I have a question. My classmate told me that when he attended Student Health Service Centre for annual health check last week, he had to read out the numbers from a book. He was told that he might have color deficiency because he did not perform well. I query whether I have this problem, should I get enrolled with your service before I could have this test?



Wing

Interesting knowledge Q&A

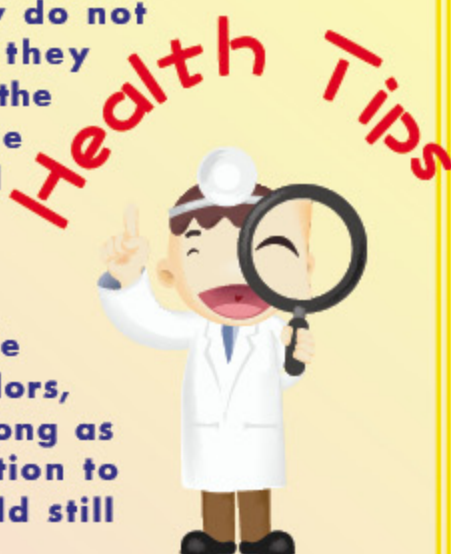


In what situation will people with color deficiency have higher ability to recognize colors?

- a. objects with dark color
- b. objects with sharp color
- c. adequate illumination
- d. all the above

(Answer: find it out from the newsletter)

People with color deficiency usually do not recognize their condition because they assumed that the colors they see are the same as others do. They often notice their problem when they attend health check up or when apply for a job. Although color deficiency is not treatable, its influence on daily life is not very large. The world of people with color deficiency is not without colors, they only mix up certain colors. So long as one could accept oneself, pay attention to adjustments in daily living, one could still live happily.



For enquiries of student's health problem, please write to "Health Box"



Please write your name & address, contact tel. no. in the letter.

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