COLOR BLINDNESS: FORENSIC PERSPECTIVE

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ABSTRACT

Color vision deficiency is a condition in which certain colors can not be distinguished, and is most commonly due to an inherited condition. Being color blind does keep one from performing certain jobs and makes other difficult. Compared to persons with normal color vision, they have some trouble differentiating between certain colors, but the severity of the color deficiency is variable. Color blindness is normally diagnosed through clinical testing- Ishihara color test is one of the most common tests used. It is mainly useful for quick screening. From a practical stand point though, many protanomalous and deteranomalous people breeze through life with very little difficulty doing tasks that require normal color vision but in some professions a normal color vision is a necessary requisite. This article focuses on the forensic perspective of abnormal color vision and future research and guidelines for assessing an individual for colour vision.

Key words: Color Blindness, color vision test, Deficiency, road traffic accident, forensic scientist.

INTRODUCTION

Colour blindness is a condition in which ability to distinguish some colors and shades is less then normal. It occurs when the colour sensitive cone cells do not properly pick up or send the proper colour signals to the brain. It is most commonly due to an inherited condition or acquired by diseases of the optic nerve or retina. These colour problems are linked to the X chromosome and are almost always passed from a mother to her son. Prevalence of impaired colour vision in males is 8% and only 0.5% in females[1].

Although it must have been existed for centuries, the first case on record was discovered in the practice of Dr Tuberville in 1684. Nearly a hundred years later an English chemist by the name of Dalton, who was colour blind himself, published the first accurate description of the condition[2].

The advent of the information age brought with it an increasing importance of colors. Colour coded computer information, colour printers, colour applications for safety, colour comparison test mechanism and other needs are driving increasing changes in the occupational requirements for colour vision.

Sweden was the first country to pass a law forbidding the employment of any man upon a rail road until he passed the color vision test.

CLASSIFICATION OF COLOUR VISION DEFICIENCY

<table>
<thead>
<tr>
<th>Type</th>
<th>Colour Deficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protanomaly</td>
<td>Red Weakness</td>
</tr>
<tr>
<td>Deuteranomaly</td>
<td>green Weakness</td>
</tr>
<tr>
<td>Tritanomaly</td>
<td>Blue Weakness</td>
</tr>
<tr>
<td>Protanopia</td>
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<td>Tritanopia</td>
<td>Blue Deficiency</td>
</tr>
<tr>
<td>Achromatopia</td>
<td>Absolute colour blindness</td>
</tr>
</tbody>
</table>

In a normal trichromat, three wavelengths are required to match a given reference wavelength. Dichromacy occurs when there are only two cones functioning. Monochromats and achromats only need one wavelength to match the reference colour.

A mild colour deficiency is present when one or more of the three cones function "poorly". A more
severe colour deficiency is present when one of the cones does not function at "all" or is missing. Red green deficiency is by far the most common form of colour blindness. The scientific basis for the same is that, DNA sequences of the red and green receptor gene are so similar, that it is easy for mistakes to occur during the development of egg and sperm, as genetic material is replicated and exchanged between chromosomes.

Those with a less common type have difficulty distinguishing blue and yellow. In very few cases, colour deficiency exists to an extent that no colors can be detected; only shades of black, white and gray are seen.

**OCCUPATIONAL REQUIREMENTS**

The use of colour extends to the work environment, and so it affects job and careers which require some degree of colour identification. These careers vary in the extent of reliance on colour vision.

Occupation requiring perfect colour vision e.g. is:
- Forensic scientist
- Driver
- Armed forces
- Color matcher in textile, paints & cosmetics.
- Electrical work
- Navigation

Occupation where good colour vision is desirable, but defective colour vision would not necessarily cause a handicap, e.g. are:
- Accountant
- Administration
- Architect
- Builder
- Draughtsman
- Metallurgist
- Physiotherapy

Occupation where defective colour vision may be an asset, e.g.:
- Camouflage detection

**OBJECTIVES OF COLOUR VISION TEST**

- As a screening test to separate those with defective colour vision from those with normal vision.
- As a qualitative diagnostic test to classify the type of colour defect (whether proton, deutron, tritan).
- As a quantitative test to indicate the extent of the colour defect (whether mild, medium or strong)

It is important to be able to determine the type and the extent of any defect for several reasons, like:
- What are the risks to the employee in performing this job if they have colour vision deficiency?
- What would the consequence be of the most serious colour judgement error?
- Can 'work around' be developed to reduce these risks to acceptable levels.
- Will these colour defects affect the overall efficiency of performance in a serious manner.
- Can the work be redesigned efficiently to eliminate colour judgement requirements?

**FORENSIC OUTLOOK**

**Defective color vision - role in accidents**

In every case of road traffic accident and railway accident, the investigation officer should be diligent for color vision of victims and accused as the driver might have circumvented the route of detection at the time of medical vision testing, or the condition might have progressed after medical examination or developed anew subsequent to recruitment.

**Importance of color vision for forensic professionals**

Forensic scientists, who are involved in crime scene investigation, collection of trace evidences, laboratory testing and interpreting results, should have good color vision as any defect will seriously hamper their functioning in the respective roles.

Forensic medicine persons who are conducting post mortem should have good color vision as various parameters like color changes in contusion, abrasion (healing of wounds) etc. are based on color changes. Most importantly histopathologists should be having good color vision as their job involves interpretation where color differentiation is imperative.

**EPILOGUE**

It would seem to be obvious that a condition of colour blindness must be very dangerous, when
it exists in persons responsible for the lives of others on railroads and air. But at the same time due care should be given to the job profile of a person while assessing him for the colour vision, as his colour vision deficiency would not necessarily cause a handicap in that particular organization.

In India Ischiara pseudoisochromatic tests are used for screening the colour vision but it is not a qualitative or quantitative test. The ideal test should provide qualitative as well as quantitative details so that extent of the colour defect is known.

References
2. Soilandhealth.org. Strengthening the eye. Chapter 1X.