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PSYCHOSENSORIAL MECHANISMS OF COLOUR PERCEPTION - APPLICATIONS IN AESTHETIC DENTISTRY

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ABSTRACT. The emergence of electronic systems for measuring the colour reduced failure rate. However, colour perception is a complex phenomenon that can be considered ultimately by the dentist. Colour choice may seem a minor thing, but aesthetic requirements have increased dramatically today. Therefore, a colour mismatch may lead to rejection of the work by the patient. Aesthetic sense is to be educated and trained in office and outside it with beneficial consequences for doctors and patients.

Keywords: colour choice, colour mismatch, aesthetic

INTRODUCTION

The concept of perception

Perception is a complex phenomenon involving organs of senses, a way of transmitting nerve impulses and a system of analysis and synthesis of data. An object can be seen only by association with other objects and the experience of the subject. An object is perceived identically by different observers, even if the same observer may have changed perceptions in different space-temporal determinations.

Colour perception

Objectively, the colours of an object are given by the wavelengths of light that reaches us from the object. The light falling on the object is reflected, absorbed, refracted and scattered by it. Colours of the visual field form an ordered system around a ruling that is enlightenment. Not only colour but also their geometric characteristics, all the sensory data together with the significance of objects form a system.

MATERIALS AND METHODS

Colour chart

Visual analyzer perceives wavelengths between 400 and 700 nm. Colour sensation depends on the chromium, saturation and brightness. There are 3 primary colours (red, yellow, blue) which can be obtained by combining other colours. There is a complementary of colours (blue-yellow, red-green, etc.; Fig. 1).

Colour harmony (Fig.2)

Harmony monochrome, analogous colours, complementary colour (harmony contrasts), double complementary, colour triads, colour family (Fig. 3).

Illusion of translucency (Fig. 4a, b)

Phenomenon Craik-O'Brien-Cornsweet

In this rectangular version of classical Craik-O'Brien-Cornsweet stimulus, the left flank appears to be darker than the right one, although they actually have the same luminance value. The brightnesses effect is caused by the central region composed of two opposite sign luminance gradients and a contrast border between them (try covering the central portion with a piece of paper to convince yourself that the flanks are actually equiluminant).

RESULTS AND DISCUSSIONS

Brightness processing in visual cortex

Luminance is a photometric quantity that represents the amount of light emitted by a surface. Brightness (that very much confused and misused term!), on the other hand, is the apparent level of light emitted by a surface and depends not only on the actual luminance but also on the context in which the surface is viewed.

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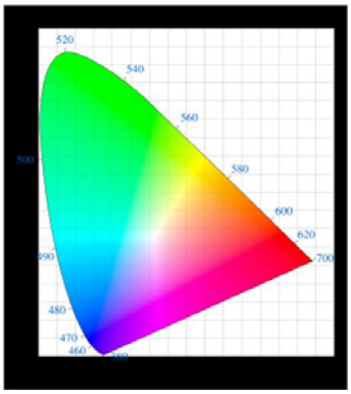


Fig. 1 Colour chart

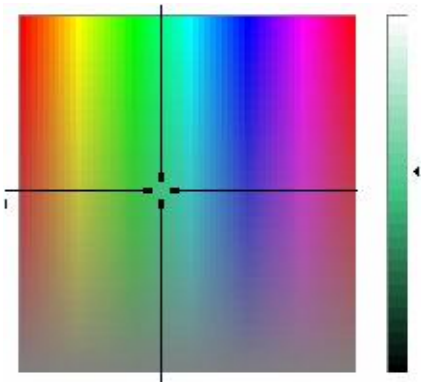


Fig. 2 Colour harmony

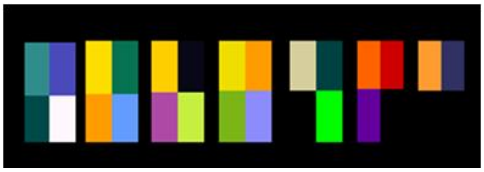


Fig. 3 Colour family

Fig. 4a The image is flat

Fig. 4b The image has depth

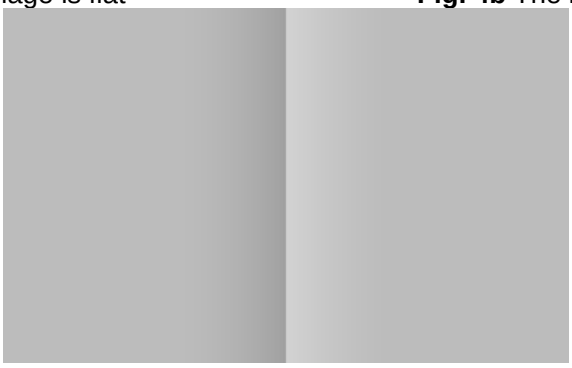
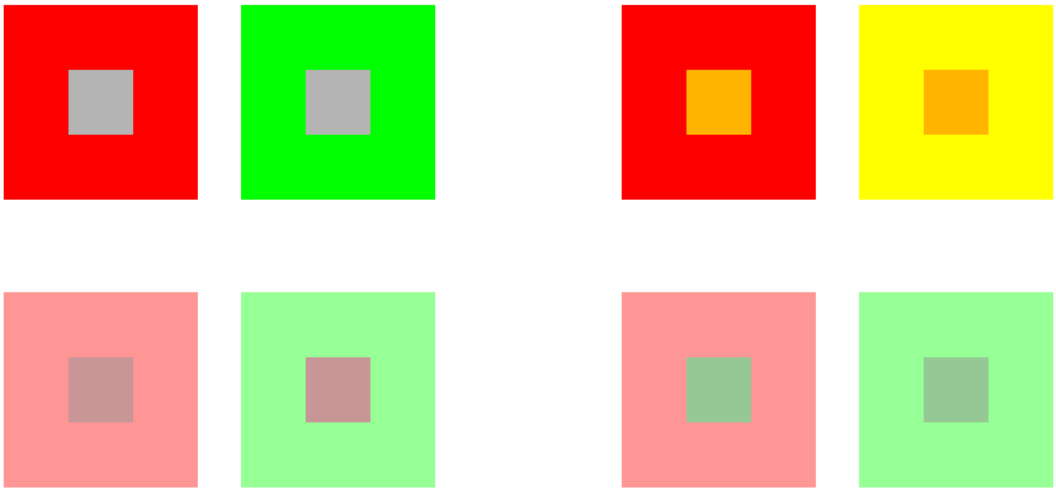


Fig. 5 Craik-O'Brien-Cornsweet phenomenon: the left flank appears to be darker than the right one, although they actually have the same luminance value



Contrast illusions

Many compelling visual illusions demonstrate the "failure" of visual system to accurately compare the raw luminance values, like the well-known Craik-O'Brien-Cornsweet stimulus shown below. Craik-O'Brien-Cornsweet stimulus is a fairly simple stimulus; in more complex scenes perceptual grouping can also influence surface brightness.

Amodal completion - when two spatially separated surfaces appear to be grouped together behind an occluder - is one of the mechanisms which can facilitate perceptual grouping, and indeed it influences the brightness

Kirschmann's (1891) formulation of colour contrast illusion

The smaller represents the test area and the larger represents the effect (Fig. 6). Colour contrast occurs even if there is a spatial gap between the two fields. The larger the gap the smaller the effect. The effect is maximum when brightness contrast is absent or weak. The larger the size of the inducer, the larger the effect and the higher the saturation of the inducer, the larger the effect.

Colour assimilation (Fig. 7)

The left (1) gray background appears to be bluish while the right (2) one to be yellowish

Remote colour assimilation:

The red close to blue appears to be magenta while the red close to yellow appears to be orange.

Munker illusion (Fig. 8)

Chromatic White's effect:

The same red appears to be orange or magenta in the upper panels and the same green appears to be yellowish green or cyan. There appear to be spirals of two different types of red. Actually, they are identical.

Chromatic scintillating illusion

Blue light appears to scintillate in white circles. Stars appear to twinkle when we fixate on the center (Fig. 9).

Determination of colour in dental medicine:

Tone
Brightness
Saturation

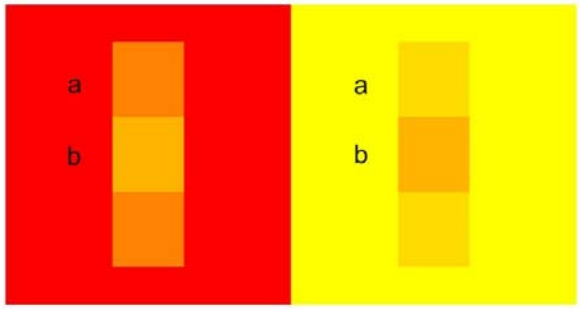


Fig. 6 Contrast illusion

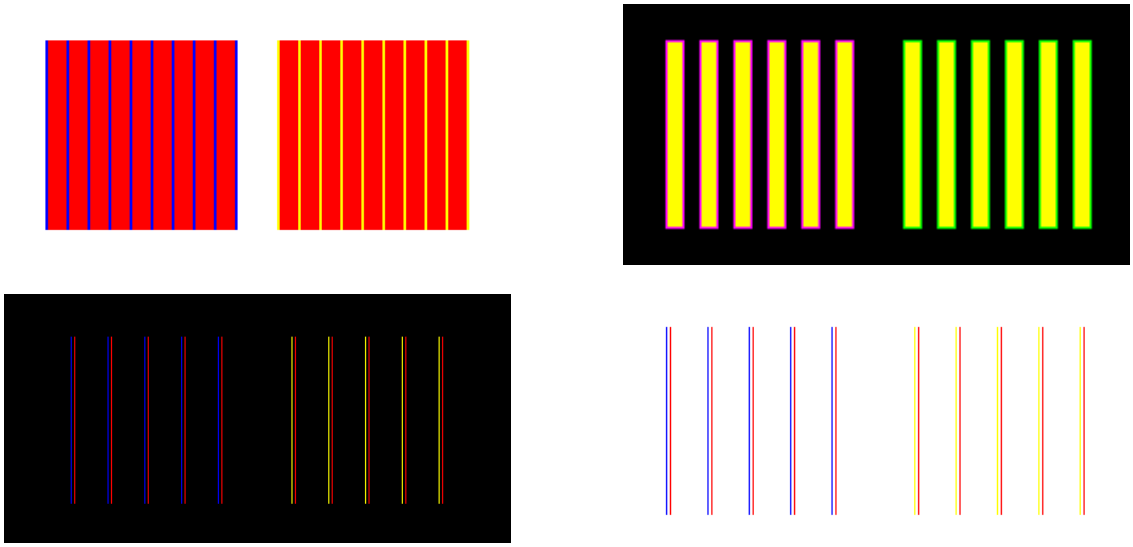


Fig. 7 Colour assimilation

Assessment of colour

The human eye perceives light reflected by teeth and the light transmitted through teeth. The perception of colour depends on the characteristics of teeth and the quality of light. Perception also depends on the objective conditions of the optical device and the observer's subjective assessment (Fig. 10).

Colour reorganization

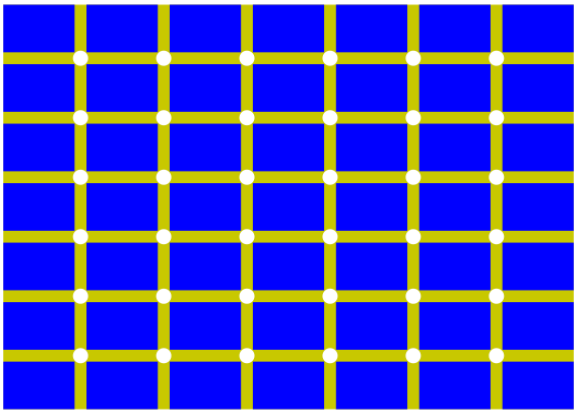
The most obvious feature is the brightness. If there are doubts concerning the choice of colour, it is better to choose a tone with lower brightness. It avoids the effect of teeth "too white". Vita Key: B1, A1, A2, D2, B2, C1, C2, D4, D3, A3, B3, A3, B4, C3, A4, C4

Instrumental colour measurement

Given the great subjectivity that predominates all during the colour measurement process in the clinic, a series of electronic instruments designed to facilitate and make more objective the process of colour measurement have recently been appearing on the market.

The practitioner thus needs only to use these devices in order to be able to indicate the tooth's colour in a more precise, reliable and repeatable way. From the point of view of the clinical information that we are provided with, we can talk about one spot reading devices, devices which indicate the colour at one spot of the tooth, and which therefore need several readings in order to be able to appreciate the regional colour variations of the tooth; and extensive reading devices, capable of capturing all of a tooth's surface each time, or even of several teeth simultaneously, and which with a computer program can draw up a chromatic map of the tooth.

Fig. 8 Munker illusion



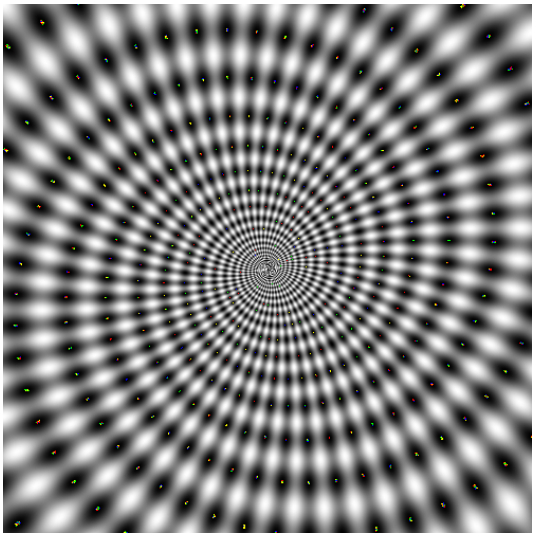


Fig. 9 Chromatic scintillating illusion

Fig. 10 Dental colour chart

Chromatic maps obtained with these devices are usually very detailed, and it is sometimes feasible to choose the colour guide in which the annotation method is preferred; some of these devices even allow for the personalization of the guides, which can be made up with specific combinations of restorative materials.

This opens the door for allowing their intra-operating use in direct restoration with composite or with CAD-CAM manufacturing systems for in-clinic restorations (CEREC-3D, Sirona). One of the most interesting applications for these devices is the objective measurement of the results obtained in vital whitening treatments, making it possible to clearly verify the degree of effectiveness obtained.

Electronic Colourimeters

The advantages are the elimination of subjectivity in the colour measuring process, and a great improvement in being able to reproduce the colour (Paul S. et al.), the elimination of the environmental factor in colour measurement due to the utilization of constant light sources that are calibrated each time they are used.

Another very important element is that if the laboratory is working with the same system, the control of the desired chromatic reproduction is total.

CONCLUSIONS

Colour choice may seem a minor thing, but aesthetic requirements have increased dramatically today. Therefore, a colour mismatch may lead to rejection of the work by the patient. The emergence of electronic systems for measuring the colour reduced failure rate. However, colour perception is a complex phenomenon that can be considered ultimately by the dentist. Aesthetic sense needs to be educated and trained in office and outside it, with beneficial consequences for doctors and patients.

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