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Mini Review

***Corresponding author**
Jaikishan Jayakumar, PhD
Department of Optometry and Vision Sciences and Melbourne Brain Centre
The University of Melbourne
Melbourne, Victoria 3010
Australia
E-mail: jja@unimelb.edu.au

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Visual Perception: Scientific Lessons Learned From "The Dress" Phenomenon

Jaikishan Jayakumar, PhD*

Department of Optometry and Vision Sciences and Melbourne Brain Centre, The University of Melbourne, Melbourne, Victoria 3010, Australia

ABSTRACT

Our visual percept across the population is relatively similar with little or no ambiguity in what we perceive. A red flower on a green plant is still perceived as red flower by everyone. So when social media threw up a picture of a dress which was not agreed by everyone about the colour, it created an exception to our general perceptual stability and created an enigma for visual scientists to explain this apparent contradiction to relatively stable percept. This mini review aims to explain "the dress" phenomenon and provide theories explaining this illusion that has confounded many vision scientists.

KEYWORDS: Colour; Illusion; Visual perception.

INTRODUCTION

Our perception of colour is not a property of the visualised object, rather the consequence of the distribution of reflected light that the visual system interprets and assigns as a colour of the object. However, our percept of colour is remarkably stable, given the wide variation in luminance conditions. This phenomenon is called colour constancy[1] and is attributed to adaptation mechanisms within the visual system. This phenomenon is also the reason why the interpretation of the dress as interpreted through social media during a Scottish party became somewhat of a surprise when people started reporting the dress as being of two separate colours blue-black or white and gold. So how can the perception of a relatively simple coloured object be so different among members of the human population or in other words how the brain can get it so wrong? This mini review aims to review and explain this phenomenon.

How different is the perception of the dress amongst the general population. In an online experiment by Lafer-Sousa et al[2] conducted in 1401 subjects. The authors reported that 57% perceived the dress as blue-black, 30% saw white-gold, 10% brown-gold and the rest could switch between any combinations. However, when the same experiment was conducted in laboratory condition on calibrated monitor and the subjects were asked to match the colours of the dress to calibrated Maunsell chips, it was found that the percept is actually a continuum rather than just blue-black or yellow gold.[3] This leads us to our first question: are there fundamental differences in the make-up of our visual system that could result in this varied perception. The first stage of our perception of colour starts from the cone photoreceptors at the back of the eye. There are three types of cones: each selective for specific wavelengths and are names as red, blue and green cone photoreceptors. The numbers and the distribution of these photoreceptors vary between each individual,[4] however our perception of the colour is the same across the population as our brain weights the inputs coming from the photoreceptors and allocates them for a constant perception of colour. These differences are unlikely to provide an explanation for the dress phenomenon as there are rarely any differences in our perception of naturally coloured objects even though there are small variations in colour naming[5] amongst human population.

The second theory is based on how our sense of colour is influenced by other factors

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in particular the background. The picture of the dress is somewhat different from natural images. Our vision is calibrated to view within a very narrow band of wavelengths across the entire electromagnetic spectrum (approximately 380- 740 nm) available to us. Everything we view is within this spectrum. Our first clue about the percept comes from the image itself, the image in question is not from natural surroundings. It was taken using camera phone and appears to be a bleached image as evident from the background which is exceptionally bright. What does the background mean for our perception. Winkler et al[6] conducted experiments with photographs and what people perceived when the background information was filtered and overlayed onto the image. It is worthwhile noting that by applying a blue background, the percept shifted completely to white-gold in a majority of observers (95%) and to blue-black when the background was shifted to yellowish hues. This result points to the most likely explanation on why people perceive such a different colour.

Our visual system is designed to maintain a fair degree of consistency in its perception of colour, despite the myriad of change in the reflectance and illumination properties for e.g. we perceive a red apple as red whether it is a sunny day, cloudy day, inside or outside. This is achieved by factoring in the background illumination and the reflectance from the object. In the dress phenomenon, the unusually bright and ambiguous background means some people's brains allocate as the dress being viewed from a bluish background and hence a percept of white and gold, while others perceive it has blue-black as a result of the brain interpreting the background being from a bright day.

Although this seems like a valid explanation of the reported phenomenon, there are some unanswered questions that still remain. If the way we perceive is determined by how we interpret the background why should there be a continuum of percepts rather than a bimodal distribution of extreme case responses. More recently, there has been of MRI study[7] looking at brain activation regions with the dress phenomenon and asking if the varying percept is a direct result of activation of different networks within the brain. The yellow-gold responders had more activation in their middle frontal gyrus, inferior and superior parietal lobules and inferior frontal gyrus suggesting that there is significant involvement of top-down networks in the perception of this illusion. These networks are also involved in attentional mechanisms.

The dress phenomenon provides a rare case of discovery on how the human brain works as a result of viral social media observations. More scientific studies are warranted to determine how the brain interprets the background information and what the neurophysiological basis of such a phenomenon is.

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