DOCUMENT SUMMARY

This review by Elliot and Maier examines the link between color perception and psychological functioning in humans, moving beyond simple aesthetics. The article provides a historical context, overviews recent theoretical and methodological advances, and details empirical findings on how colors like **red** influence outcomes in achievement and attraction contexts. The review concludes that while color clearly carries meaning and impacts affect, cognition, and behavior, the research is still nascent and requires more investigation into boundary conditions before strong real-world applications can be recommended.

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FORMATTED CONTENT

Elliot_&_Maier_2014_Color_Psychology_Effects_of_Perceiving_Color_on_Psychological_Functioning_in_Humans

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Abstract

Color is a ubiquitous perceptual stimulus that is often considered in terms of aesthetics. Here we review theoretical and empirical work that looks beyond color aesthetics to the link between **color** and psychological functioning in humans. We begin by setting a historical context for research in this area, particularly highlighting methodological issues that hampered earlier empirical work. We proceed to overview theoretical and methodological advances during the past decade and conduct a review of emerging empirical findings. Our empirical review focuses especially on **color** in **achievement** and **affiliation/attraction contexts**, but it also covers work on consumer behavior as well as food and beverage evaluation and consumption.

The review clearly shows that **color** can carry important meaning and can have an important impact on people's affect, cognition, and behavior.

The literature remains at a nascent stage of development, however, and we note that considerable work on boundary conditions, moderators, and real-world generalizability is needed before strong conceptual statements and recommendations for application are warranted. We provide suggestions for future research and conclude by emphasizing the broad promise of research in this area.

Keywords: hue, **achievement**, **attraction**, **consumer**, **food**

INTRODUCTION

Humans encounter the world as a colorful place. **Color** is perceived on essentially every object that we view in daily life; it is even present in our dreams (Rechtschaffen & Buchignani 1992). Those with normal color vision experience a vast and rich chromatic palette, with estimates reaching up to 2.3 million discernable colors (Linhares et al. 2008) that may be seen together in an “almost infinite" number of possible combinations (Hård & Sivik 2001, p. 4). **Color** considerations emerge regularly in our decision making and conversation, as we choose which color clothes to wear, pick a color for our new car or computer, and comment on the color of our friend's skin, hair, or makeup. Popular opinions abound on the nature of color associations and on presumed influences of **color** on our feelings, aesthetic judgments, and beyond.

A considerable amount of scientific research has been conducted on many aspects of **color**. There are robust, well-developed literatures focused on the way that **color** is defined and modeled (i.e., color physics), on the way that the eye and brain process color stimuli (i.e., color physiology and neuroscience), on the way that color terms are represented in language (i.e., color linguistics and categorization), and on various practical issues such as color reproduction, color deficiency, and color appearance phenomena (e.g., illusions, synesthesia). Surprisingly, there is no comparably robust, well-developed literature on the effects of **color** perception on psychological functioning in humans. However, research activity in this area has surged in the past decade, and a number of noteworthy theoretical ideas and empirical findings have emerged. The time is right for a review of this research.

Our focus in the present review is on a subset of **color psychology**, namely, the influence of perceiving **color** on psychological functioning in humans. Even this subset of **color psychology** is too broad for a single review; thus, we focus primarily on effects of **color** perception on downstream affective, cognitive, and behavioral responding in two fundamentally important domains of daily life: **achievement contexts** and **affiliation/attraction contexts**.

HISTORICAL CONTEXT (PRE-TWENTY-FIRST CENTURY)

Theoretical Work

Scholarly interest in the link between **color** and psychological functioning may be traced back to the German poet and polymath **Johann Wolfgang von Goethe**. In his classic work “Theory of Colors," Goethe (1810/1967) offered intuition-based speculation on the influence of **color** perception on emotional experience. Colors were categorized as “plus colors” or “minus colors." Plus colors, namely, yellow, red-yellow, and yellow-red, were thought to induce positive feelings such as lively, aspiring, and warm, whereas minus colors, namely blue, red-blue, and blue-red, were said to induce negative feelings such as restless, anxious, and cold.

Goethe's speculations were expanded on in the twentieth century by psychiatrist **Kurt Goldstein**. Goldstein (1942) integrated Goethe's ideas with his own clinical observations in proposing that **color** perception produces physiological reactions in the body that are overtly manifest in people's emotions, cognitive focus, and motor behavior. **Red** and yellow were posited to be stimulating, to prompt an outward focus, and to produce forceful action, whereas green and blue were posited to be relaxing, to encourage an inward focus, and to produce calm and stable action. Goldstein's ideas were vaguely formulated, and subsequent researchers have tended to read his ideas through the lens of wavelength and arousal. Specifically, longer wavelength colors such as **red** and orange are thought to be experienced as arousing or warm, whereas shorter wavelength colors such as green and blue are thought to be experienced as relaxing or cool (Nakashian 1964).

Methodological Issues

Conducting scientific research on **color** requires attending to the fact that **color** varies on multiple attributes. In most experimental research, the most important of these attributes to attend to are **hue**, **lightness**, and **chroma** (Fairchild 2005). **Hue** is wavelength and is what most people think of when they hear the word “color.” **Lightness** is similar to brightness and is essentially the white-to-black property of the color. **Chroma** is similar to saturation and is essentially the intensity or vividness of the color (Fairchild 2005). Each of these **color** attributes may have an influence on psychological functioning (Camgöz et al. 2004), so only one of them should be allowed to vary in a well-controlled experiment. Failure to control for nonfocal **color** attributes leads to a confounded design and results that are essentially impossible to interpret (Valdez & Mehrabian 1994).

Unfortunately, the majority of the extant research on **color** and psychological functioning conducted pre-twenty-first century failed to systematically attend to the multidimensionality (and perceived typicality) of **color** stimuli.

RECENT THEORETICAL ADVANCES AND METHODOLOGICAL CONSIDERATIONS

Theoretical Advances

In the past decade, the primary theoretical advances in the area of **color** and psychological functioning have shared a common feature: They have sought to ground

color effects in biology, drawing on parallels between human and nonhuman responding to color stimuli.

Hill & Barton (2005) highlighted the signal function of **red** in competitive interactions in human and nonhuman animals. In many animals, including primates, **red** coloration in aggressive encounters is a testosterone-based indictor of dominance in males; the alpha male shows the most prominent **red**.

In their **color-in-context theory**, **Elliot & Maier (2012)** focus on both biologically based and learned sources of color meanings and effects. Some **color** effects are thought to represent inherent tendencies to interpret and respond to **color** in a manner similar to that observed in our nonhuman primate relatives. Other **color** effects are thought to be rooted in the repeated pairing of **color** and particular concepts, messages, and experiences; over time, these pairings create strong and often implicit color associations such that the mere perception of the **color** evokes meaning-consistent affect, cognition, and behavior. Critically, **color** meanings and effects are posited to be context specific. The same **color** can have different and even opposite meanings and effects in different contexts. For example, **red** is hypothesized to have a negative meaning (failure) and aversive implications (avoidance motivation) in **achievement contexts**, but it is hypothesized to have a positive meaning (sexual receptivity or status) and appetitive implications (sexual desire) in mating contexts.

Methodological Considerations

As noted in the Methodological Issues section above, to avoid confounding **hue**, **lightness**, and **chroma** in an experiment, it is imperative to vary only one attribute at a time. In the past decade, researchers have begun to address this issue of color control with much greater regularity by implementing a variety of different techniques.

A third approach is to use a **spectrophotometer** to create color stimuli. A **spectrophotometer** is a device that assesses **color** at the spectral level; it provides objective numeral values for **hue**, **lightness**, and **chroma** (or similar attributes) and does so taking into account different types of environments (e.g., direct sunlight or cool white fluorescent lighting) and observer viewing angles. We think the use of a **spectrophotometer** is the optimal method for controlling **color** in research on **color** and psychological functioning.

EMPIRICAL FINDINGS: COLOR EFFECTS ON PSYCHOLOGICAL FUNCTIONING

Color in Achievement Contexts

Competitive sport performance. Hill & Barton (2005) used data from four combat sports (e.g., boxing, tae kwon do) in the 2004 Olympics to test their proposal that **red** functions as a dominance cue in human competitions and enhances performance accordingly. Their results showed that competitors randomly assigned to **red** relative to blue sportswear were more likely to win the competition.

Individual cognitive and motor performance. Elliot and colleagues (2007) proposed that viewing **red** in an **achievement context** can undermine performance on challenging tasks that require mental manipulation and flexibility. They posited that **red** is associated with failure and danger and evokes avoidance motivation in such contexts, which impedes performance attainment. Their experimental studies indicated that individuals who viewed **red** before or during anagram, analogy, and math tasks performed worse than those who viewed green or achromatic control colors.

Color in Affiliation/Attraction Contexts

Color on the skin. Stephen, Perrett, and colleagues have conducted a program of research designed to test their theoretical proposals regarding relations between various properties of facial skin color and perceived health and attractiveness. This research has revealed that faces that are redder (presumably due to blood perfusion), yellower (presumably due to carotenoids), and lighter are rated as healthier and more attractive.

Extended color stimuli. Color may not only have an influence on attraction when displayed directly on the skin, but it may also impact attraction when seen in close proximity to a person of the opposite sex. Indeed, in a series of experiments, **Elliot & Niesta (2008)** found that men rate women as more attractive and sexually desirable when the women are viewed within a **red** picture border or in **red** clothing.

BROAD CONCLUSIONS AND HIGHLIGHTS FROM OTHER RESEARCH AREAS

Broad Conclusions

The empirical work that we have reviewed clearly indicates that **color** can carry meaning and have an important influence on affect, cognition, and behavior in **achievement** and **affiliation/attraction contexts**. **Red**, especially, has been shown to be a critical **color** in this regard.

Another clear take-home message from the literature that we have reviewed is that **color** meanings and, therefore, **color** effects are context specific. The same **color** can have different meanings in different contexts, leading to different implications. For example, the extant literature shows that **red** carries negative, threatening meaning when seen on an opponent or test of ability and evokes avoidance-relevant affect, cognition, and behavior; but **red** carries positive, appetitive meaning when seen on a potential mate and facilitates approach-relevant responding.

Highlights from Other Research Areas

It is taken as an undeniable fact by marketers, advertisers, and graphic artists that **color** influences consumer behavior (Paul & Okan 2011). One line of research in this area focuses on atmospherics, addressing issues such as the influence of building, store, and website **color** on drawing consumers in, keeping them engaged, and enhancing their shopping experience.

Another active area of research focuses on the influence of **color** on our experience and intake of food and drink. One line of work in this area focuses on the link between food/beverage **color** and flavor perception, with researchers drawing an important distinction between flavor identification and flavor intensity (Spence et al. 2010).

FUTURE DIRECTIONS

Throughout our empirical review we have made ongoing mention of specific issues in need of further research attention. Here we pull back from the specifics to offer broader suggestions regarding directions for future research. We highlight three foci: the source of **color** effects, overlooked conceptual issues, and methodological considerations.

CONCLUDING REMARKS

Color is a complex construct studied in multiple ways by scholars across multiple disciplines. Theory and empirical work linking **color** to psychological functioning have been relatively slow to emerge, but the past decade has seen considerable development. Our review herein has necessarily been selective, given the breadth of research in this area, but a clear take-home message is that **color** is about more than aesthetics—it can carry important information and can have an important influence on people's affect, cognition, and behavior.

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