# *The Influence of Language on Color Cognition in Different Cultural Backgrounds*

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***Abstract:*** It has been firmly established that one's native language influences one’s worldview. This article delves into this concept through three experiments, examining the fundamentals of color perception, variations in color naming across different cultural contexts, and the relationship between language and color cognition. The first experiment revealed that Greek speakers distinguish colors faster than English speakers. In the second experiment, Mongolian language users differentiated visual search displays belonging to distinct linguistic categories more swiftly than those within the same category. These findings solidify the subtle impact of specific linguistic terms on human color perception. Numerous studies conclusively link color cognition with language, albeit the precise mechanisms vary. Furthermore, such effects can be altered, for instance, by learning to better distinguish blue from green. The article explores the underlying reasons for these differing impacts of language on color cognition and how they might be manipulated. It offers deeper insights into how language shapes our understanding of color.

***Keywords:*** Psychology, color cognition, Linguistic, different culture.

## 1. Introduction

Scholars have long disagreed about whether language affects perceptual experiences like color perception. The underlying link between language and color perception may be explored through color categorization effects, which entail quicker or more accurate color discrimination across category borders [1]. The variety of languages covered by current research allows for a compelling argument on how language and culture affect color cognition. Furthermore, evidence supporting the function of learning in color cognition may be obtained by contrasting the outcomes of ordinary persons with those of those who have received color cognition training. These results provide credence to the theory that variables other than intrinsic characteristics influence color cognition. It's important to note that, in some situations, phrases pertaining to color brightness can also affect color perception, much like terms connected to color influence hue perception. The fact that subjects label stimuli with the same degree of brightness as "light" or "dark" indicates a gap between the subjects' perceptions and the stimuli's physical characteristics, according to research findings. There is still need for research on how lightness is processed cognitively [2]. This work investigates the impact of language on color cognition from several angles through an analysis synthesising three trials. It offers a synopsis of the most important experiments conducted to date on this topic, which may be used as a guide for further research.

## 2. The Influence Mechanism of Language on Color Cognition

### 2.1. Basic Principles of Color Cognition

Some contend that the perception of color categorization is not language-specific, but rather a universal visual phenomenon governed by biological systems. Others, however, contend that it is impacted by the categories that are employed in color communication [1]. Some data support the Wolff theory about the functional arrangement of color categorization perception in the brain. Because nearly all language activities, including those involving lexical access, are largely performed by the left hemisphere of the brain, researchers have deduced that color categorization perception is highly correlated with the right visual field [3].Color categorization perception was only observed in the right visual field during lateralized visual search tasks, and not in the left, indicating that this is a linguistic phenomena [3]. Though the impact looks larger in the right visual field, suggesting a more dominating role for language, other studies demonstrated substantial color categorization perception in both visual fields, suggesting that both language and perception may affect color categorization perception [4]. Furthermore, color categorization perception was only seen in the right visual field and left hemisphere in faster responders, indicating that language prioritizes color categorization perception given the left hemisphere's function in tasks requiring lexical access [2, 5]. Furthermore, it was shown that category and metric color differences are encoded in qualitatively different ways by various brain regions. In particular, hue differences did not elicit a response from the middle frontal lobe, while category color differences did. Higher cognitive processing, including language processing, is known to occur in this area [6].All things considered, the results of this study point to a left-hemisphere dominance impact in adult color categorization perception, which suggests that language is the primary influence on adult color categorization perception.

### 2.2. Brain and Language

The capability for language processing is distinctive to humans, and our understanding of its neurobiological underpinnings has significantly advanced in recent decades. Specific areas in both the left and right hemispheres of the brain have been pinpointed as supporting various language functions. For syntactic processes, networks involving the temporal and inferior frontal cortex with a strong leftward bias have been found to be crucial. In contrast, less lateralized temporo-frontal networks are more involved in semantic processing. Both functional and structural connectivity data support these findings. Electrophysiological evidence suggests that within these networks, the construction of local structures through syntactic processes occurs before the attribution of grammatical and semantic relationships within sentences. Suprasegmental prosodic information, which is overt in the acoustic signal of language, is mainly processed in a right-hemisphere temporo-frontal network, as indicated by distinct electrophysiological markers. Research on patients with corpus callosum lesions has demonstrated that the posterior part of this structure is essential for the interplay between syntactic and prosodic information during language comprehension.[7]

### 2.3. Cultural Differences in Color Words

Color vocabulary frequently comes from a variety of linguistic contexts and languages. For instance, color names in Chinese that are particular and obvious include "blood red," "milk white," and "goose yellow." Chinese speakers usually refer to tangible items in their immediate environment when they use words to express concepts. Basic color names in English indicate the hues of objects, including red, white, black, grey, brown, and yellow. The majority of these words are single-syllabic, with roots mostly in Anglo-Saxon language. A few loanwords denoting colors are also present in English, including "azure," "auburn," and "vast," most of which have Romance etymologies. Nevertheless, compared to the Anglo-Saxon-derived color terminology, which are more widely used and valued, many of these words are lengthier and less dynamic[8].

### 2.4. Ways People Name Colors

Warm colors (yellow, red, orange, and brown) are often more uniquely named by humans across linguistic and cultural boundaries than cold colors (blue and green). It has long been recognized that, in contrast to cool hues, where "blue" may be used to represent both brighter and darker shades, people tend to use more general phrases to describe warm hues at varying brightness levels (e.g., "yellow" versus "brown"). According to this new research, there may be more variations in the patterns of brain activity in warmer colors—such as brighter and darker shades—than in colder hues. The findings suggest that, rather than being influenced by language or culture, our innate propensity to label warm hues may be related to how human brains see color [9].

### 2.5. Ways Human Brains Perceive Color

The retina is a kind of tissue found at the rear of the eye. Rods and cones are special cells found in the retina. These cells serve as the eye's watchtowers. Their job is to identify light and notify the brain when it is there. Different light colors or wavelengths cause different rods and cones to react. They use the optic nerve to send electrical messages to the brain when they come into contact with light. Nerves are like highways and roads: they carry signals from the brain to every part of the body. The thalamus is a region of the brain that is directly connected to the optic nerve. The thalamus is not only responsible for receiving signals from vision, but it also functions as a sorting station for incoming cards and packages. It combines and repackages some of these signals into new information as it processes them. The brain then forwards this information to other regions. Details about the beach ball then make their way to the visual brain. The visual cortex, a region of the occipital lobe located at the rear of the brain, is home to specialized cells that search for various kinds of visual information. For example, some cells respond to a circular item, whereas others respond to a linear one. Certain cells react to movement, while others are sensitive to color and other stimuli. Therefore, when a ball is seen, certain cells perceive every hue, while others just notice the ball's round form. An whole picture is created by combining these signals. Nerves provide information about the beach ball picture to different parts of the brain. One place to go is the prefrontal cortex, an area at the front that is located above and behind the eyes and forehead. Here, sensory data is processed by the brain and combined with other forms of information, such memories and emotions.[10]

### 2.6. How Different Languages Stimulate the Brain Differently

Even seemingly little linguistic components have a significant impact on how our subconscious minds interpret the outside environment. Russian people believe that beds are more associated with women and chairs with men since the grammar assigns a masculine noun to chairs and a feminine noun to beds. In one experiment, speakers of Spanish and German were asked to describe items in their respective languages that had the opposite gender assigned to them. There were differences in their descriptions that corresponded to the grammatical gender of the objects. For instance, German speakers were more likely to use phrases like "hard" or "heavy" when describing a "key," which is feminine in Spanish and masculine in German. In contrast, Spanish speakers were more inclined to use terms like "little" or "lovely". Spanish people favored the adjectives "big" or "strong," whereas German speakers picked adjectives like "beautiful" or "elegant" to describe a "bridge," which is feminine in German and masculine in Spanish. This was true even though English, a language lacking grammatical gender, was used for all of the tests. In non-linguistic activities, such judging the resemblance between photos, similar trends were seen.[11]

People perceive time differently in different languages. For example, when discussing time, English speakers usually use horizontal spatial metaphors (e.g., "The past is behind us," "The future lies ahead"). On the other hand, Mandarin speakers use a vertical metaphor for time; for example, they may call the month after this one the "upper month" and the month before it the "lower month." As a result, Mandarin speakers more often than English speakers cognitively perceive time vertically. Think about this simple experiment: point to a location right in front of you and say, "This point represents today." Where would you have stood yesterday? Where would you put it tomorrow, too?" When given this challenge, most English speakers use horizontal gestures. On the other hand, speakers of Mandarin indicate vertically around seven or eight times more often than speakers of English.[12]

### 2.7. Color Naming Makes a Difference in Brain Stimulation

While learning a language, people unintentionally pick up mental habits in addition to verbal habits. Language tampers not just with abstract or sophisticated realms of cognition, such space and time, but also with basic parts of visual experience, including color perception. The color spectrum is divided differently by different languages: certain languages are far more adept at differentiating between colors than others, and linguistic borders are frequently inconsistent.

The bright blue stimulus was labeled ghalazio, the dark blue stimulus was named ble, and the light and dark green stimulus was named prasino (green) by all Greek participants. This meant that native Greek speakers were able to identify these colors more rapidly than native English speakers. The blue and green stimuli in the test tasks were identical for individuals who spoke English, whereas the blue stimulus was much greater than the green stimulus for native Greek speakers. As a result, speakers of a language that lacks a term for a particular hue will discern that color more slowly or inaccurately than speakers of another language.

### 2.8. The Relationship between Language and Color Cognition

The effects of language-specific differences between the two colors on early visual processing were examined in each experiment using either the same or different techniques. The results not only showed the influence of native language on implicit color discrimination, such as electrophysiological differences occurring as early as 100 milliseconds after the stimulus was presented, a time range that correlates with activity in the primary and secondary visual cortex [13], indicating that language-specific differences between the two colors can affect early visual processing even when the color is irrelevant to the task. This provides strong support for Wolff's hypothesis that language-specific distinctions play a strategic role in differences between language speakers in the early stages of color perception. Specifically, it demonstrates that these differences go beyond the observation of higher-level classification and differentiation effects.

## 3. Specific Case Analysis

### 3.1. Greek and English Experiment

#### 3.1.1. Introduction

The study looked at how color names in various languages impact the early stages of visual processing using visual mismatch negativity (vMMN), an electrical measure of perceptual bias[14]. Of particular note, it was shown that Greek speakers distinguish between blue and green tones more clearly than English speakers do. To the best of our knowledge, this study provides groundbreaking proof that a person's mother language is associated with natural, unconscious color discrimination that goes beyond conscious, explicit color classification[15].

#### 3.1.2. Discussion

The results of the trials suggest that some color terminology found in a person's native language have a subtle effect on the early stages of color perception. They provide strong support for Wolff's theory and are the main proof that early disparities in color vision between speakers of various languages outweigh previously noted improvements in categorization and distinction. These differences are regularly correlated with classifications based on language.

### 3.2. Mongolian and Chinese Experiment

#### 3.2.1. Introduction

There were three experiments in this study, but we will just discuss the second one here because it is most pertinent to our paper [16] . Mongolian speakers should search for targets that belong to different color categories from their surroundings (a qinker among huhe, for example) more quickly than they should search for targets that belong to the same category as their surroundings (a qinker among other qinkers), if language influences color perception in a way that is specific to categories encoded by the speaker's language. Since there is only one fundamental term for green in Mongolian, nogvgan, this impact should not be noticed in the nogvgan region. In a similar vein, Chinese speakers should not exhibit disparities in speed when differentiating between light and dark hues of blue or green, as they only have two fundamental color names for blue (lan) and green (lv).

#### 3.2.2. Discussion

Chinese speakers did not differ in their reaction times when distinguishing between green and blue, as was predicted. Notably, some surprising results were observed as well: for example, green speakers showed faster response times than blue speakers, and Mongolian speakers were better at differentiating between the nogvgan color group than between qinker and huhe. These findings imply that language's impact on color perception is particular to the categories that the speaker's language encodes.

## 4. Conclusion

Extensive research has indicated the substantial impact of language on color perception, highlighting how different languages can modulate specific neural pathways, thus influencing the brain's response to color stimuli. Additionally, the origins and application of linguistic frameworks are inherently associated with this phenomenon. Speakers of languages that lack specific terms for certain colors tend to perceive and categorize those colors less accurately and more slowly. Moreover, short-term language acquisition has been shown to enhance color discrimination, allowing individuals to identify colors with greater speed and precision and to choose appropriate responses more rapidly. Furthermore, it has been established that language significantly shapes cognitive functions, illustrated by the varied methods individuals employ to quantify time using their hands or the disparate vocabulary utilized in object description. Contrary to widespread assumptions, language not only affects our perception of color but also influences cognitive processing. Future inquiries should delve deeper into these intricate relationships.

The implications of these findings are profound, suggesting that cognitive frameworks are not merely passive reflections of reality but active constructs shaped by linguistic capabilities. Such insights call for a multidisciplinary approach, combining cognitive science, linguistics, and psychology to explore the full spectrum of language's influence on perception.

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