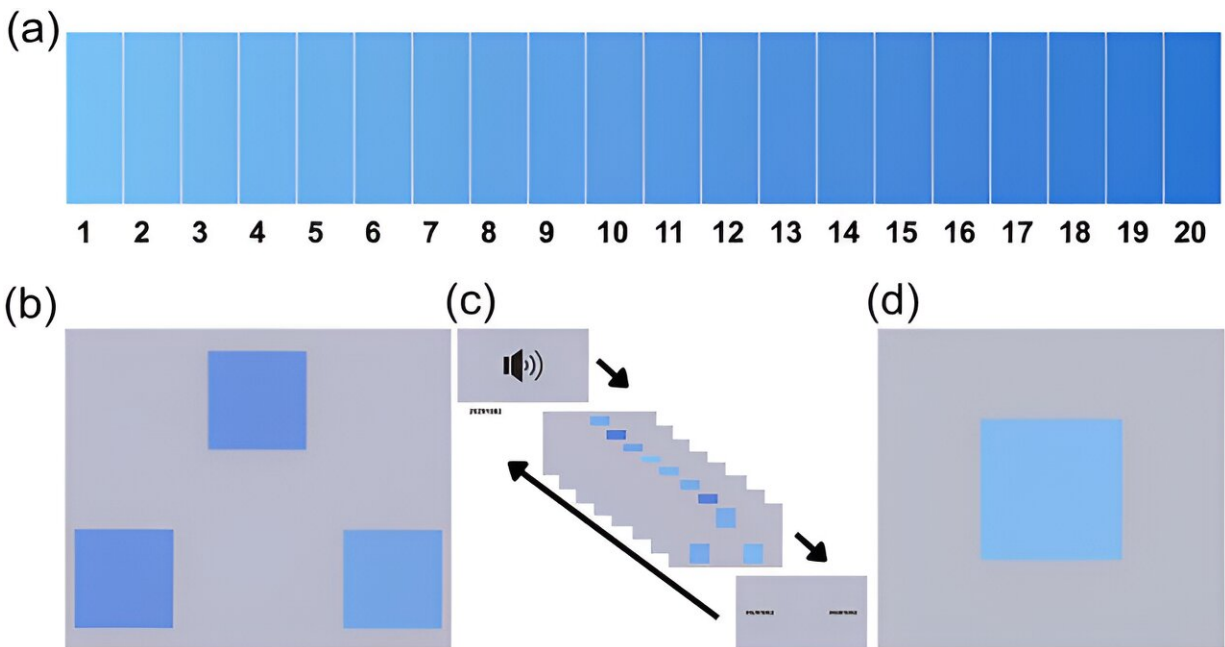


Study finds language affects how quickly we perceive shades of color

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Stimuli and tasks' procedure. (A) illustrates the linear color interpolation of the blue color used in the study. (B) outlines the procedure for the color discrimination task without verbal interference; (C) illustrates the same task with verbal interference. (D) presents the procedure for the final task—the color identification task. Credit: *Language Learning* (2024). DOI: 10.1111/lang.12645

Bees have a phenomenal ability to perceive different shades of color, and their eyes are able to see ultraviolet light. This helps them find flowers that produce nectar.

Human beings are also influenced by colors and different shades of colors. For example, we use different colors to create different moods in rooms. Colors are used on signs to send signals to the brain's ability to perceive and interpret. If a sign has a lot of red on it, you should be extra cautious; it may indicate danger if you do not follow the sign's instructions.

At sea, there are clear color codes on pennants and maritime signal flags. For example, it is a good idea to keep a certain distance from ships with a yellow flag on the mast; this is the color code for contagious disease or quarantine.

More words for blue

Researchers have long been interested in how language affects our perception of the world. A fascinating aspect of this is how we perceive colors. Researchers at NTNU and the University of Oslo (UiO) have recently investigated how language affects our perception of shades of various colors.

The human eye's perception of colors is determined by its biology and is based on the perception of light. However, the color spectrum is divided and defined differently in different languages.

For example, there are two words for blue in Russian: "siniy" for dark blue and "goluboy" for light blue, while English only has only one word: "blue." Previous studies have shown that Russian speakers can distinguish between light and dark blue faster than English speakers.

"A logical next question is to what extent does your mother tongue influence your categorization of colors, which are otherwise perceived in an objective way due to the biology of the eye," says language professor Mila Vulchanova at NTNU.

Dynamic interaction

In the new study from NTNU and UiO, researchers have further investigated this phenomenon by analyzing how bilingualism affects color perception. The researchers have studied how people who speak both Lithuanian and Norwegian defined shades of color through the two different languages.

Lithuanian, like Russian, has two completely different words for blue: "žydra" (light blue) and "mėlyna" (dark blue), while Norwegian only has one word: "blå."

"Our study revealed that the bilingual participants' ability to distinguish between shades of color was influenced by the language they used while performing the task. These findings shed light on the dynamic interaction between language and perception, i.e., our perception of sensory input," says Vulchanova.

In practical terms, this means that the brain responds quickly to the language that is activated and connects the sensory impression to that language. This phenomenon is known as 'code switching' among bilinguals. As soon as a language is activated, the entire language system is active, including words and concepts.

"Our results also refer to the dynamic link between language and cognition, i.e., the brain's ability to receive, process and express the information. Our research and research done by others show that this is a two-way process. This means that language can activate and influence cognitive categories, and vice versa, that cognitive mechanisms and categories influence language," explains Vulchanova.

Close collaboration

For many years, Vulchanova has conducted research on language, perception and brain activity, especially on phenomena related to bilingualism. Several of the research projects are conducted in collaboration with students and Ph.D. candidates she supervises.

In this study, master's degree student Akvilė Sinkevičiūtė is the lead author of the article [published](#) in *Language Learning*.

The co-authors of the article are Vulchanova and UiO professors Julien Mayor and Natalia Kartushina. All four have participated in the design of the study, the collection and analysis of the data material, and writing the scientific article.

"The research reveals that the language being actively used by bilingual individuals can significantly affect their perception of color. The findings show that the language you use can shape how you perceive the world, right down to basic color perception.

"Our research demonstrates the intricate connection between language and perception, highlighting the profound impact of linguistic context on basic cognitive processes," says Sinkevičiūtė.

Method: Defining shades of blue

Participants in the study were divided into three groups: monolingual Lithuanians, monolingual Norwegians, and people who are bilingual in Lithuanian and Norwegian. All of them performed a task in which they had to distinguish between different shades of blue on a scale of 1 to 20.

They performed the task with and without a verbal interference task, i.e., with and without the active use of language to express where on the color scale the [shade](#) of blue they were supposed to define was located. This took place in Lithuanian for the Lithuanians, in Norwegian for the

Norwegians, and in both Lithuanian and Norwegian for the bilingual participants.

The bilingual participants had started learning Norwegian sometime between the ages of 5 and 43. A total of 106 people participated in the study.

Results and conclusion

Bilingual participants: The Lithuanian–Norwegian bilinguals showed a clear color category effect when performing the task in Lithuanian, but not when using Norwegian.

This means that they distinguished between light and dark blue faster when they were thinking in Lithuanian, whereas this advantage disappeared when they were thinking in Norwegian.

Monolingual participants: The monolingual Lithuanians also had a color category effect, while the monolingual Norwegians did not. This means that the Lithuanians who have two words for blue were quicker to define the different shades of blue than the Norwegians who only have one word for blue.

"This supports the idea that the language we use can affect how we perceive colors—and that this link is very dynamic and dependent on the activation in the brain," says Vulchanova.

The study shows that the language we use can actively influence our [perception](#) of colors, also among bilingual people. When the Lithuanian–Norwegian participants were thinking in Lithuanian, they had an advantage in distinguishing different shades of blue, which was not present when they were thinking in Norwegian.

"This suggests that language not only shapes how we communicate about color, but also affects the color categories that establish themselves in the brain during childhood—and that this can directly affect how we perceive shades of color," says Vulchanova.

More information: Akvile Sinkeviciute et al, Active Language Modulates Color Perception in Bilinguals, *Language Learning* (2024). DOI: [10.1111/lang.12645](https://doi.org/10.1111/lang.12645)

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