New study reveals that prelinguistic infants can categorize colors

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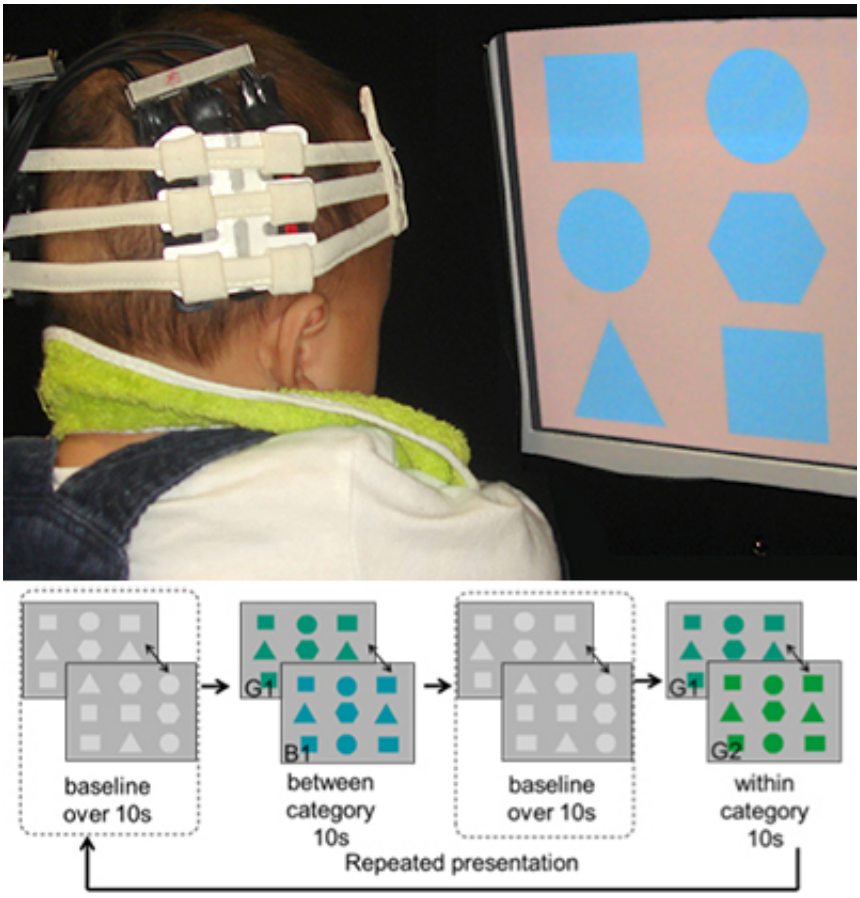


(Top) Infants watched figures whose colors alternate. NIRS probe set is fitted on an infant's head with bands. (Bottom) Sequence of color changes in the experiment. Colors alternated every 1s. B1 represents a color of blue category and G1/G2 represent two different colors of green category. Color differences between G1-B1, and G1-G2 are equated. Credit: Ichiro Kuriki

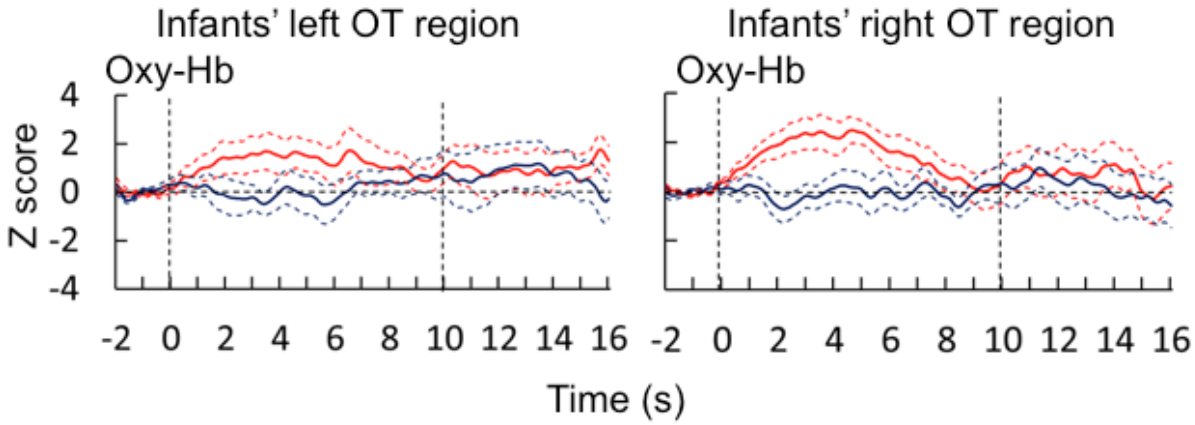
A joint group of researchers from Chuo University, Japan Women's University and Tohoku University has revealed that infants aged between 5 and 7 months hold the representation of color categories in their brain, even before the acquisition of language.

This study is published in the online journal of *Proceedings of the National Academy of Sciences.*

A long-held theory called Sapir-Wharf hypothesis claims that languages define our perceptions. This theory is widely accepted in various fields of study including psychology, linguistics and anthropology. Color perception is also considered to be subject to this theory, since colors are called by their names in daily communications.

Through numerous studies on the color lexicons of languages in the world, categorical color perception is considered to be strongly affected by language. On the other hand, the similarity of color categories across linguistic and cultural differences is also reported as strong evidence of the universality of color categories. Therefore, whether or not language affects color categories has been a central issue related to how we perceive colors.

This new study reveals that the category of colors can be independent of language, at least in the early stage of development in an infant's visual system.



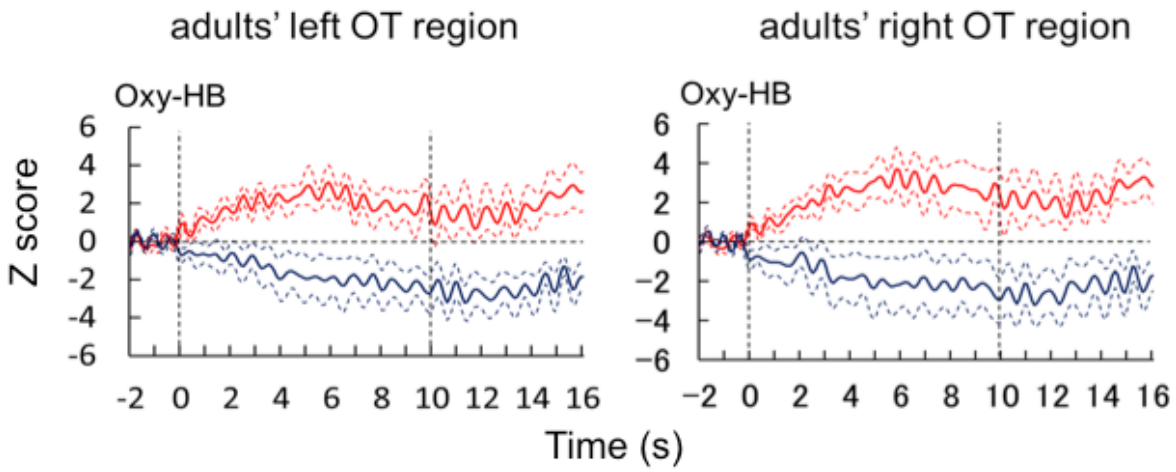
Time course of brain activity changes in infants' occipito-temporal (OT) region. Vertical axis indicates normalized concentration of oxy-hemoglobin (oxy-Hb) in Z-score. Red and blue lines indicate responses to color alternations between blue and green categories, and between different shades of green, respectively. Dashed colored lines indicate +/- 1 standard errors of mean. Vertical dotted lines at time 0s and 10s indicate onset and offset of visual stimulus, respectively. Credit: Ichiro Kuriki

Infants 5-7 months old were tested to see if brain activity is different for colors in different categories. The brain activity was measured by a near infrared specrtoscopy (NIRS; Figure 1) technique, which realizes comfortable measurement of brain activity in infants.

The study found that the brain activity increased significantly when the colors of blue and green were alternated, while there was no significant reaction to the alternation of different shades of green (Figure 2). The difference was observed in the occipito-temporal area in both left and right hemispheres.

A similar difference was found in adult participants with no significant

lateralization. Since language related cortical areas reside in the left hemisphere in most right-handed adults, the observed brain activity had no direct relation to language processing. In addition, brain activity caused by categorical color differences was not found in the occipital region, which is known to play a significant role in the early stage of visual processing.



Time course of brain activity in adults' OT regions is shown. Same visual stimuli as the infants' experiment were used. Symbols are the same as in Figure 2. Credit: Ichiro Kuriki

These results show that color information is processed through multiple cortical stages in infants, in a way similar to adults. They suggest that the brain activity in reaction to different color categories are represented differently in infants, even before the acquisition of language. They also imply that color categories can develop independent of the acquisition of relevant language.

More information: Jiale Yang et al. Cortical response to categorical