国立大学法人
豊橋技術科学大学

TOYOHASHI
UNIVERSITY OF TECHNOLOGY

PRESS RELEASE

Source: Toyohashi University of Technology, Japan, Committee for Public Relations

Release Title: Perception Depends on Whether You Are Looking Up or Down
Release Subtitle: Discovering that intensity of perceptual bias in specific views varies depending on posture

Overview

A research team led by Fumiaki Sato, a doctoral student at the Department of Computer Science and Engineering, Toyohashi University of Technology with the Japan Society for the Promotion of Science (JSPS) Research Fellowship for Young Scientists, and professors Shigeki Nakauchi and Tetsuto Minami discovered that the intensity of perceptual bias in specific views varies depending on the posture of the neck. This research investigated how changes in posture have a contextual effect on visual perception. Specifically, the experiment used the Necker cube as a visual stimulus that would potentially generate two different visual perceptions. In a virtual reality (VR) space, it placed the stimulus above and below each subject and asked them to report how it appeared in a posture that involved looking up at the stimulus and in another posture that involved looking down at it. The experiment revealed that the visual perception of the stimulus varied depending on the viewing posture.

Details

The common belief is that whenever we see something, we perceive the image as cameras do. In fact, our visual perception is flexible, changing with circumstances and context. One well-known phenomenon is the color contrast effect, or the variation in how a specific color looks depending on the colors around it. The mechanism behind these shifts in perception is still largely unknown and investigating it is considered significant to understanding how our visual experience is constructed.

The human visual system processes a tremendous volume of information according to a method that is based on practical experience acquired through learning. This is called the heuristic method, and it has been made clear by a study on the interpretation of ambiguous figures. Take the Necker cube shown in Figure 1 for example. It is possible to perceive this cube in two different ways. Observers are more likely to recognize it as an image viewed from above than from below. This tendency in perception is called perceptual bias. It is understood that this bias arises from the fact that humans have more experience seeing a cube from above than from below in everyday life. It is known that the human visual system is thus susceptible to an experience-based context. However, it was unknown whether the experiential context is linked to physical posture.

To resolve this point, the research team carried out an experiment using the Necker cube mentioned above to study changes in probability of perception. Participants were asked to how the Necker cube looked when it was placed at each of five different angles, specifically 60°, 30°, 0°, -30° and -60°, in a virtual space. The experiment was conducted not only under a vertical condition, defined as moving the neck vertically, but also under a horizontal condition, defined as moving the neck horizontally, which were provided as controlled conditions. It demonstrated that the probability of the view-from-above (VFA) interpretation is significantly higher in the state of looking vertically downwards than in the state of looking upwards. There was no significant difference observed under the horizontal condition.

Fumiaki Sato, the lead author of the research and a third-year student in the second half of the doctoral course, explains: “In daily life, there will almost certainly be differences in the frequency with which we view particular objects looking up at them or looking down at them. For example, we often see the sun, fluorescent lamps and other light sources when looking up. We rarely see them looking down. Our question was whether the difference in visual experience depending on posture leads to a difference in visual perception, and our experiment sought to answer this. This study employed a stimulus that would possibly induce two different visual interpretations despite constant input. This means that the information received on the retina is identical under any condition. However, the percentage of interpretations did vary depending on the posture. This suggests that the human visual system uses posture as a factor in determining the perception.”

The research findings show that the human visual system flexibly modulates observers’ perception according to their posture.

Future Outlook

The research team has demonstrated that the human visual system flexibly modulates observers’ perception according to their posture. This research is expected to help develop a model for the expression of human visual perception. The experiment measured the pupil diameter, believed to reflect the cognitive factor. Although details are not provided, the results suggest that the pupil size is closely related to the neck movement in the vertical direction. A future research objective will therefore be to explore the mechanism behind the links between the perception, the pupil diameter and the posture.

国立大学法人
豊橋技術科学大学

TOYOHASHI
UNIVERSITY OF TECHNOLOGY

Reference

Fumiaki Sato, Ryoya Shiomoto, Shigeki Nakauchi, Tetsuto Minami, Backward and forward neck tilt affects perceptual bias when interpreting ambiguous figures, *Scientific reports*, **12**, 7276 (2022).
https://doi.org/10.1038/s41598-022-10985-4

This research benefited from Grant-in-Aid for Scientific Research (B) for *Changing the cognitive world using pupil diameter as an indicator* (Grant Number 20H04273) and financial support for a joint research project on *Interaction with virtual reality through pupillometry* (Project Number 120219917) under the Bilateral Programs from the Ministry of Education, Culture, Sports, Science and Technology and the Japan Society for the Promotion of Science (JSPS). The lead author, Fumiaki Sato, also received a Grant-in-Aid for Scientific Research (Grant Number JP21J12947) from the JSPS.

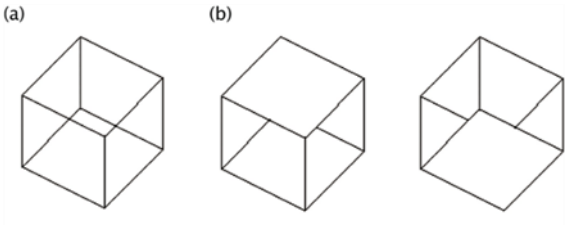
Further information

Toyohashi University of Technology
1-1 Hibarigaoka, Tempaku, Toyohashi, Aichi Prefecture, 441-8580, JAPAN
Inquiries: Committee for Public Relations
E-mail: press@office.tut.ac.jp

Toyohashi University of Technology founded in 1976 as a National University of Japan is a research institute in the fields of mechanical engineering, advanced electronics, information sciences, life sciences, and architecture.

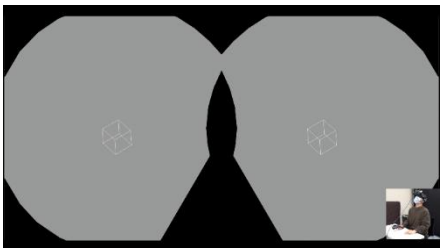
Website: https://www.tut.ac.jp/english/

Figure1:



Caption: The Necker cube stimulus (a) used in the experiment potentially induces the view-from-above interpretation (left in (b)) and the view-from-below interpretation (right in (b)).

Figure2:



Caption: A scene in which a subject observes the stimulus in the virtual reality space.
(The Figure takes the form of a two-dimensional image that depicts a three-dimensional image. It may look partly distorted in this image.)

Keywords: Visual perception, Virtual reality