LABORATORY OF NEUROPHYSIOLOGY

Associate Professor
WATANABE, Eiji

NIBB Research Fellow: *NAKAYASU, Tomohiro*

In order to interact successfully with the environment, animals must deduce their surroundings based on sensory information. The visual system plays a particularly critical role in such interactions with the environment.

"Why can we see?" This question is fundamental for a thorough understanding of vision-dependent animals, including human beings. In order to better understand the visual system of animals, we are researching animal behaviors through psychophysical and computational methods.

I. Psychophysical study of Medaka fish

One of our major subjects is the psychophysical and computational study of medaka (*Oryzias latipes*). Recently, we made progress in studies of the prey-predator interaction using medaka and zooplankton. Visual motion cues are one of the most important factors for eliciting animal behavior, including predator-prey interactions in aquatic environments. To understand the elements of motion that cause such selective predation behavior, we used a virtual plankton system where the predation behavior in response to computer-generated prey was analyzed. Virtual prey models were programmed on a computer and presented to medaka, which served as predatory fish. Medaka exhibited predation behavior against several characteristic virtual plankton movements, particularly against a swimming pattern that could be characterized as pink noise motion. Analyzing prey-predator interactions via pink noise motion will be an interesting research field in the future (Matsunaga & Watanabe, 2012).

Last and this year, we have made progress in studies of the schooling behaviors of medaka. Many fish species are known to live in groups. Visual cues have been shown to play a crucial role in the formation of shoals. Using biological motion stimuli, depicting a moving creature by means of just a few isolated points, we examined whether physical motion information is involved in the induction of shoaling behavior. We found that the presentation of biological motion could prominently induce shoaling behavior. We have shown what aspects of motion are critical in the induction of shoaling behavior. Motion or behavioral characteristics can be valuable in recognizing animal species, sex, and group members. Studies using biological motion stimuli will enhance our understanding of how non-human animals extract and process the information which is vital for their survival (Nakayasu & Watanabe, 2014).

This year, we have developed novel method for behavior analysis by using 3D computer graphics. The fine control of various features of living fish have been difficult to achieve in studies of fish behaviors. However, computer graphics allow us to manipulate morphological and motion cues systematically. Therefore, we have constructed 3D computer graphics animations of medaka based on tracking coordinate data and photo data obtained from real medaka. These virtual 3D models will allow us to represent medaka faithfully and to undertake a more detailed analysis of the properties of the visual stimuli that are critical for the induction of various behaviors.

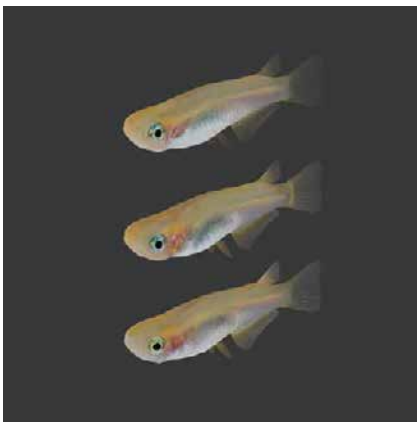

Figure 1. Virtual Medaka fish constructed of 3D polygonal models and photo textures.

II. Psychophysical study of Human vision

Another of our major subjects is the psychophysical and theoretical studies of the visual illusions of human beings (*Homo sapiens*). One recent focus of this debate is the flash-lag effect, in which a moving object is perceived to lead a flashed object when both objects are aligned in actual physical space. We developed a simple conceptual model explaining the flash-lag effect (Delta model, Watanabe *et al*., 2010). This year, we have made a more developed novel visual illusion, the shelf-shadow illusion (Figure 2).

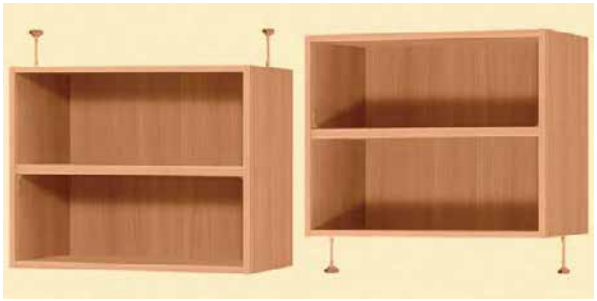

Figure 2. Shelf-Shadow Illusion (Photograph version). Upward shadows look darker than downward shadows even when the shadows are actually the same brightness. Third place award of The 5th Illusion Contest in Japan.

Publication List

〔Original paper〕

● Nakayasu, T., and Watanabe, E. (2014). Biological motion stimuli are attractive to medaka fish. Animal Cognition *17*, 559-575.