Elucidation of the Benham's Top Illusion Using Artificial Eyes

Tsuji, Yurika (School: Tamagawa Academy)
Niikura, Risa (School: Tamagawa Academy)
Uraguchi, Manasa (School: Tamagawa Academy)

Benham's top, characterized by black-and-white patterns, induces an optical illusion where colors other than black and white are perceived as it is spun. This study aims to investigate this phenomenon using an artificial eyeball. A cylindrical Benham top is proposed to generate various pattern arrangements, revealing that perceived colors correspond to the pattern layout. Based on this observation, we aim to control the subjective colors produced by the illusion successfully. The retina contains three types of cone cells, each exhibiting different sensitivities and response times. Considering these characteristics, we propose developing an artificial eyeball modeled on the human eye for quantitative analysis. To achieve this, we explored strontium aluminate, a material that emits light upon optical stimulation and designed an artificial plastic eyeball that incorporates this colloidal solution. This setup accurately replicates the sensitivities and response times of the cone cells, enabling precise modeling of the underlying mechanisms of the illusion. Our findings suggest that subjective colors are not generated from neural processes in the brain, such as those involving the thalamus, but from afterimages caused by response delays in retinal cells. Our results confirm a direct correlation between the black-and-white patterns of Benham's top and perceived colors. To further validate these results, we develop a mathematical model. Future research will focus on refining artificial eyeballs to better mimic human vision.

Awards Won: