UC San Diego
Cognitive Science

Yueying Dong' Dissertation Defense

Windows to the Goal: The Flexible Engagement of the Ocular System in Visual Working Memory

Thursday, May 28, 2026
10:00 am – 12:00pm, Cognitive Science Building, Room 180
or https://ucsd.zoom.us/j/9147150243?omn=95660485535

Abstract:

The eyes—the 'windows to the soul'—are the primary apparatus of vision. Pupils adjust to regulate light intake, while eye movements bring relevant visual information to the fovea. Recent studies indicate that the eyes also reflect internal mental content in working memory (WM). For example, during memory maintenance, pupil size reflects the brightness of a remembered item, and gaze veers toward the location it was presented. If ocular WM signals are functional to memory maintenance, they should exhibit task-adaptive flexibility. If they merely reflect cortical representations, we might expect them to be reflexive and invariant to task demands.

This dissertation examines the specificity and flexibility of ocular WM signals. Chapter 1 tests whether the ocular WM signal is flexible to behavioral priority. We manipulated relative task-relevance among the WM items, and found that the WM-ocular response scaled with task priority. Chapter 2 probes whether the WM pupillary signal generalizes to naturalistic scene stimuli, and whether it is sensitive to task demands. Here, we encouraged maintenance of precise visual details or semantic categories for the same naturalistic scenes. We found that despite comparable mental-effort across test conditions, during the memory delay, the WM pupillary response was more pronounced in the visual condition compared to semantic. Chapter 3 centers on the eye movement aspect of the ocular WM signal for the same naturalistic scene images. We tested whether fixation sequences during the delay period reinstate sequences from encoding, and whether the strength of such reinstatement varies with the visual versus semantic demands of the task. Similar to the pupil results, gaze reinstatement was most prominent when the task demands maintenance of precise visual information.

Taken together, both pupillary and oculomotor signatures not only track feature-specific WM content, but are adaptive to task goals. This work highlights the value of pupillary and other ocular signals as refined indices of mental content. It also illuminates the vastly distributed physiological networks that carry out WM. Sensorimotor recruitment for WM may extend to the most primary stages of processing, where the eyes themselves are instruments of flexible WM

Committee members:
Dr. Anastasia Kiyonaga (Chair) - UCSD Cognitive Science
Dr. Virginia de Sa - UCSD Cognitive Science
Dr. Meenakshi Khosla - UCSD Cognitive Science
Dr. John Serences - UCSD Psychology