Abstract

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During natural vision, observers shift attention and gaze over a visual scene as they serially multiplex numerous tasks and sub-tasks. This requires that observers integrate visual information about multiple objects over time as the behaviors unfold. Visual working memory (VWM) is therefore central to our ability to effectively perform most of the visually guided behaviors in which we engage. I will describe two lines of research being done in our lab on visual working memory. The first line of research looks at how observers use visual working memory in natural visuo-motor tasks. We show that in a serial motor task, in which subjects have to move objects from one place to another, they integrate information about target objects gained in previous fixations and stored in working memory with online visual information to plan hand movements. Moreover, they do so in a qualitatively optimal way – weighting information in visual working memory according to its reliability relative to online visual information. This shows that visual working memory is not merely deployed when sensory information is unavailable, but rather, the brain rationally integrates mnemonic and visual information so as to optimize task performance. In a second line of research, we have developed an ideal observer model of visual working memory based on principles from information theory. The modeling framework allows us to formalize the predictions of different models for how the limited capacity of visual working memory is organized in the brain. Applying the framework to the results of visual working memory experiments, we have found evidence that the brain does not have a fixed limit on the number of items encoded, but rather stochastically encodes variable numbers of items in a display and distributes limited memory resources across encoded items. We also show that observers adapt their encoding and decoding of information in visual working memory to the statistics of items in a scene. I will discuss the implications of this framework for future research on visual working memory.