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Deciding where and when to look: probing the neural mechanisms that govern eye movement choices

DECIDING WHERE AND WHEN TO LOOK: PROBING THE NEURAL MECHANISMS THAT GOVERN EYE MOVEMENT CHOICES

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Primates continuously resample their visual environment through a combination of slow pursuit and quick saccadic eye movements. Such frequent movements require timely choices by both pursuit and saccades about which stimulus to target next. These choices likely involve identifying the most active neurons among those representing the competing alternatives, but it is unknown how these choices are coordinated between the two eye movement systems. We have examined how the superior colliculus, a structure in the midbrain known to be important for orienting to stimuli in the environment, is involved in this process of target selection. We compared the neuronal activity at sites representing the possible choices and found that the difference in activity between the neuronal populations could predict when and where subjects looked. Our results suggest that choosing the goal for pursuit and saccades involves applying different decision criteria in parallel to a common pool of information. This simple but robust sensory-motor strategy can coordinate the outputs from different motor systems with higher-order sensory processes (such as attention), while at the same time retaining independent control over the output motor commands.

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