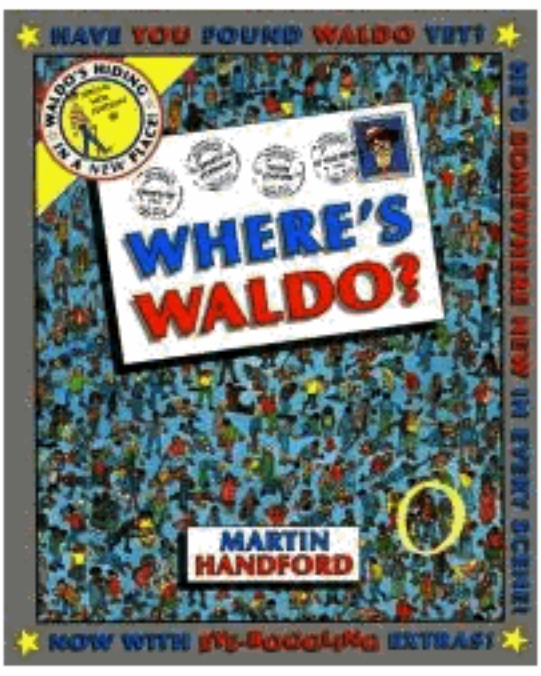
Tiny eye motions help us find where Waldo is

by Lisa Zyga



Waldo, from the book series by Martin Handford, has helped to advance researchers' understanding of how the brain visually searches scenes.

(PhysOrg.com) -- To recognize faces in a crowd, the brain employs tiny eye movements called saccades and microsaccades to help us search for objects of interest. While researchers know that these movements are involuntary and vary in magnitude, they still do not fully understand how saccades and microsaccades work.

Now, a recent study by researchers at the Barrow Neurological Institute led by Susana Martinez-Conde has taken an important step toward understanding how the brain uses saccades and microsaccades in order to "sharpen" a scene. Previously, it has been unclear whether saccades and microsaccades have inherent differences or not. Here, the researchers found that both movements are likely generated by the same neural mechanism in the brain's strategy for optimal visual sampling.

In experiments, participants viewed various visual scenes ranging from blank images to complex pages of the *Where's Waldo?* books by Martin Handford. Then, the researchers measured the amount of saccades and microsaccades produced by the eyes when participants were either fixating on a specific point in an image or freely viewing the entire image.

Because microsaccades are operationally defined as movements that occur when fixating on a scene, the researchers looked for the same small magnitude of these movements when participants were freely viewing the scene. The researchers defined saccadic movements relative to microsaccades, with saccades having higher magnitudes than microsaccades.

The results showed that, when participants were freely viewing images, they produced more microsaccades when looking at the complex scenes than when viewing the blank and duller scenes. Specifically, more microsaccades occurred when participants were viewing an object of interest, such as when they found Waldo. Since participants stared longer at fixed points in the blank scenes than in the Waldo scenes, the increase in microsaccades could not be attributed to viewers fixating on Waldo for long times.

Instead, as the scientists explained, these results may support the proposal that microsaccades significantly re-sharpen an image and improve spatial resolution, as suggested in a recent study. While microsaccades occurred when participants viewed target objects, saccades occurred more often when participants freely viewed complex images as a whole. But rather than differentiating between microsaccades and saccades, the researchers suggested that both movements belong on a continuum of eye movements, which may together reflect an optimal sampling method by which the brain discretely acquires visual information.

The researchers hope that these findings may help understand the neural mechanisms underlying search behavior, both in the normal brain and in patients with eye movement deficits. In addition, understanding saccades and microsaccades could also help researchers design future neural prosthetics for patients with brain damage, as well as help to create intelligent machines that can see as well as humans.

More information: Otero-Millan, Jorge; Xoana Troncoso; Stephen Macknik; Ignacio Serrano-Pedraza; and Susana Martinez-Conde. "Saccades and microsaccades during visual fixation, exploration, and search: Foundations for a common saccadic generator." Journal of Vision, Volume 8, Number 14, Article 21, Pages 1-18, **doi:10.1167/8.14.21**