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New vision of how we explore our world

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Brain researchers at Barrow Neurological Institute have discovered that we explore the world with our eyes in a different way than previously thought. Their results advance our understanding of how healthy observers and neurological patients interact and glean critical information from the world around them.

The research team was led by Dr. Susana Martinez-Conde, Director of the Laboratory of Visual Neuroscience at Barrow, in collaboration with fellow Barrow Neurological Institute researchers Jorge Otero-Millan, Rachel Langston, and Dr. Stephen Macknik, Director of the Laboratory of Behavioral Neurophysiology. The study, titled "An oculomotor continuum from exploration to fixation", was published in the *Proceedings of the National Academy of Sciences*.

Previously, scientists thought that we sample visual information from the world in two main different modes: exploration and fixation. "We used to think that we make large eye movements to search for objects of interest, and then fix our gaze to see them with high detail," says Martinez-Conde. "But now we know that's not quite right."

The discovery shows that even during visual fixation, we are actually scanning visual details with small eye movements—just like we explore visual scenes with big eye movements, but on a smaller scale. This means that exploration and fixation are two ends of the same continuum of oculomotor scanning.

Subjects viewed natural images while the team measured their eye

movements with high-speed eye tracking. The images could range in size from the massive, presented on a room-sized video monitor in the Barrow Neurological Institute's Eller Telepresence Room, normally used for Barrow's surgeons to collaborate in brain surgeries with colleagues around the world, to images that are just half the width of your thumb nail.

In all cases, the researchers found that subjects' eyes scanned the scenes with the same general strategy, along a smooth continuum of dynamical changes. "There was no abrupt change in the characteristics of the eye movements, whether the visual scenes were huge or tiny, or even when the subjects were fixing their gaze. That means that the brain controls eye movements in the same way when we explore and when we fixate," said Dr. Martinez-Conde.

Scientists have studied how the brain controls eye movements for over 100 years, and the idea —challenged here—that fixation and exploration are fundamentally different behaviors has been central to the field. This new perspective will affect future research and bring focus to the study of neurological diseases that impact oculomotor behavior.

Provided by St. Joseph's Hospital and Medical Center

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