Capturing the "Aha!" Moment

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Countless times a day—often without realizing it—humans make split-second decisions based on what we see and on our subjective knowledge. It might be as simple as clicking a link that catches our interest online, or recognizing a friend from a 50-millisecond glimpse of his or her face across a crowded room. But no matter how effortless the decision-making process may seem, the effort to translate that into an automated system has proved daunting.

"We can build a computer that's good at very constrained decision making, but general purpose, rapid decision making is difficult," said Paul Sajda. "It might be able to detect what is interesting or novel, but it doesn't always know what's interesting or novel to you."

Those two tasks—rapid decision making and identifying subjective interests—are, however, exactly what Sajda and his team are succeeding in building. At the same time, Sajda is attempting to reveal the most basic neural structures in the brain that process visual information. In his Laboratory for Intelligent Imaging and Neural Computing, Sajda connects subjects to an EEG and flashes a series of images on a computer screen to record the neurological equivalent of the "Aha!" moment signaling interest or recognition. Once the "cortically coupled computer vision system" is calibrated to recognize the things that interest an individual, it can present more images that are likely to pique that person's interest.

His work has drawn the attention of the Defense Advanced Research Projects Agency for its potential to help conduct a sort of visual triage by sifting quickly through petabytes (that's a million gigabytes) of satellite imagery or hours of surveillance tapes. He also works with researchers at Columbia University Medical Center on techniques that enhance the brain's ability to make quick decisions. But the question that most fascinates Sajda is what his studies of the brain's visual recognition networks can do to reveal the organ's fundamental ability to process massive amounts of information.

"It's still unclear at what scale the brain processes information," said Sajda. "It could be groups of neurons, it could be the whole brain. We don't know." But he and his research group stand a good chance of finding out.

Growing up on Long Island, Sajda knew he wanted to be an engineer, but was also fascinated by anatomy and physiology. That fascination with living systems continues to infuse his work, at the same time that his engineering perspective is helping redefine what we know about the human brain.

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