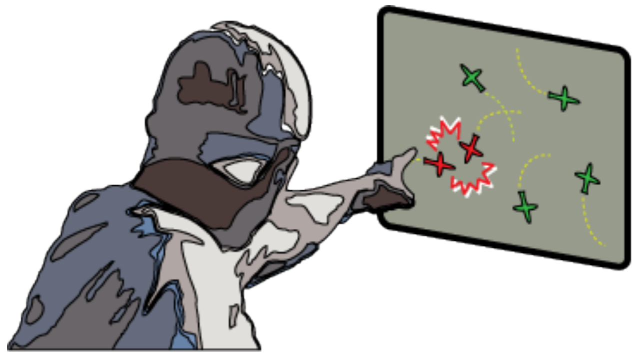
Strategic and Fluid Allocation of Visual Attention



It's easy for our brains to focus on one thing at a time: watching the road when we're driving, or catching a ball in the air. This is known as *visual attention*: the ability to pick out the most important object we see and keep track of it. But paying attention gets more difficult the more objects there are to keep track of – a problem well known to lifeguards trying to watch multiple children at a swimming pool, or air traffic controllers monitoring radar images of aircraft in a busy airport. People can perform such tasks successfully, but with certain limitations. Attention, it seems, is a limited resource.

Given a limited amount of attention to distribute to the objects that we see, what is the best way to allocate attention to optimize performance? Certain tasks require a very specific allocation of attention. For example, when watching a swimming pool full of children, a parent may pay closer attention to his or her own child and to that child's friend, among all the others. Little previous research has addressed the ability of people to allocate attention strategically and fluidly according to task demands.

At the NSF-funded CELEST Science of Learning Center, Jeffrey Doon and Ennio Mingolla at Boston University and George Alvarez at Harvard University are investigating the underlying limitations of visual attention and testing the limits of how people can allocate attention in response to task demands. Their experiments ask human participants to view a computer screen and report information about changes in the appearance of displayed objects, whose value varies from time to time as indicated on a computer monitor. Data indicate that participants are able to strategically and fluidly allocate attention among objects of varying importance so as to maximize their performance, but that the limited resource of attention constrains overall performance.

The results of these experiments will help guide research in another CELEST laboratory, that of Earl Miller's lab at MIT, where recordings of electrical activity in monkey brains is helping to uncover the fundamental neural basis for the bottleneck of attention. Experiments on humans such as those described here help to define the key behavioral paradigms that can be used for monkey electrophysiology, which will in turn help us to better understand the neural basis of the limits of human attention.

Doon and Mingolla have begun to develop a computational model of fluid allocation of attention that will succinctly describe the attentional dynamics probed by the present experiments and related work in laboratories throughout the world.