

Remodeling the Mind

Cognitive psychologist uses TACC's Lonestar supercomputer to explore vision, cognition, and attention

What is wonder? What does it mean to look for something? How does the brain create the present moment? These may not sound like questions that require a supercomputer, but David Gilden, professor of psychology at The University of Texas at Austin, used the computational power at the Texas Advanced Computing Center (TACC) and a toolbox of cognitive tests to probe the workings of the brain more fully than ever before. In the process, he settled long-standing debates in his field, and spawned new ones.

By bringing computational methods to psychology, Gilden is able to test models of human cognition in ways that were not possible prior to the advent of supercomputing. In doing so, he joins a revolution that is transforming the social sciences.

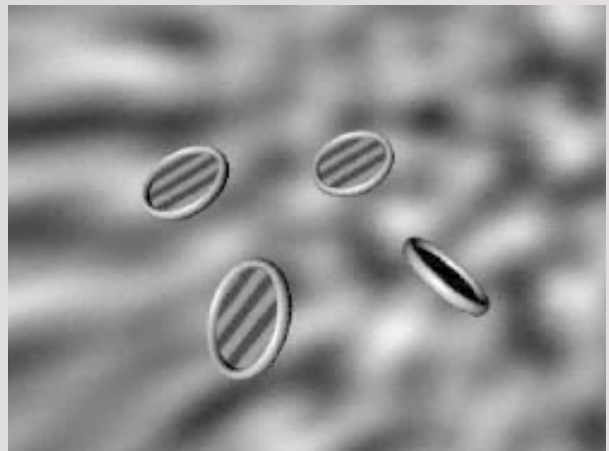
Among the first questions that Gilden tackled in experimental psychology was how humans conduct visual searches and whether the process is serial (individual rotations are sensed on a one-at-a-time basis), parallel (all rotations are sensed simultaneously, though the sensing of each rotation is slowed), or some context-specific combination of the two.

"These problems couldn't have been approached without vast computers that can give you decent feedback on a reasonable timescale. And once you begin to see how well these models can be articulated, then you really want to push it" Gilden says.

In the 1970s, cognitive psychologist Ann Treisman developed a theory of object understanding that was based on an experimental method that seemed to distinguish between serial and parallel allocations of attention. However, it was ultimately shown that the distinction could not be made on the basis of any of the visual search methodologies in current practice. Eventually psychologists decided that the serial/parallel distinction was hopeless.

"Computational science has largely been associated with the physical sciences and engineering. However, expanding methods for collecting and analyzing data have enabled the social and behavioral sciences to record more and more information about human social interactions, individual psychology and human biology."

The President's Information Technology Advisory Committee



Above is an example of a visual search test showing four disks rotating in depth.

But Gilden didn't think the question was unsolvable. He suspected the impasse reflected cognitive psychology's unwillingness to apply advanced computational methods to their data, and began prying the problem apart with creative supercomputing approaches.

From the parallel processing mind, to model comparisons, to new tests to predict and accommodate individuals with ADHD, Gilden's application of the ideas and power of HPC systems are a harbinger of how cognitive psychologists will do research in the 21st century.

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