

# Web-Based Programs Assess Cognitive Fitness

## Originating Technology/NASA Contribution

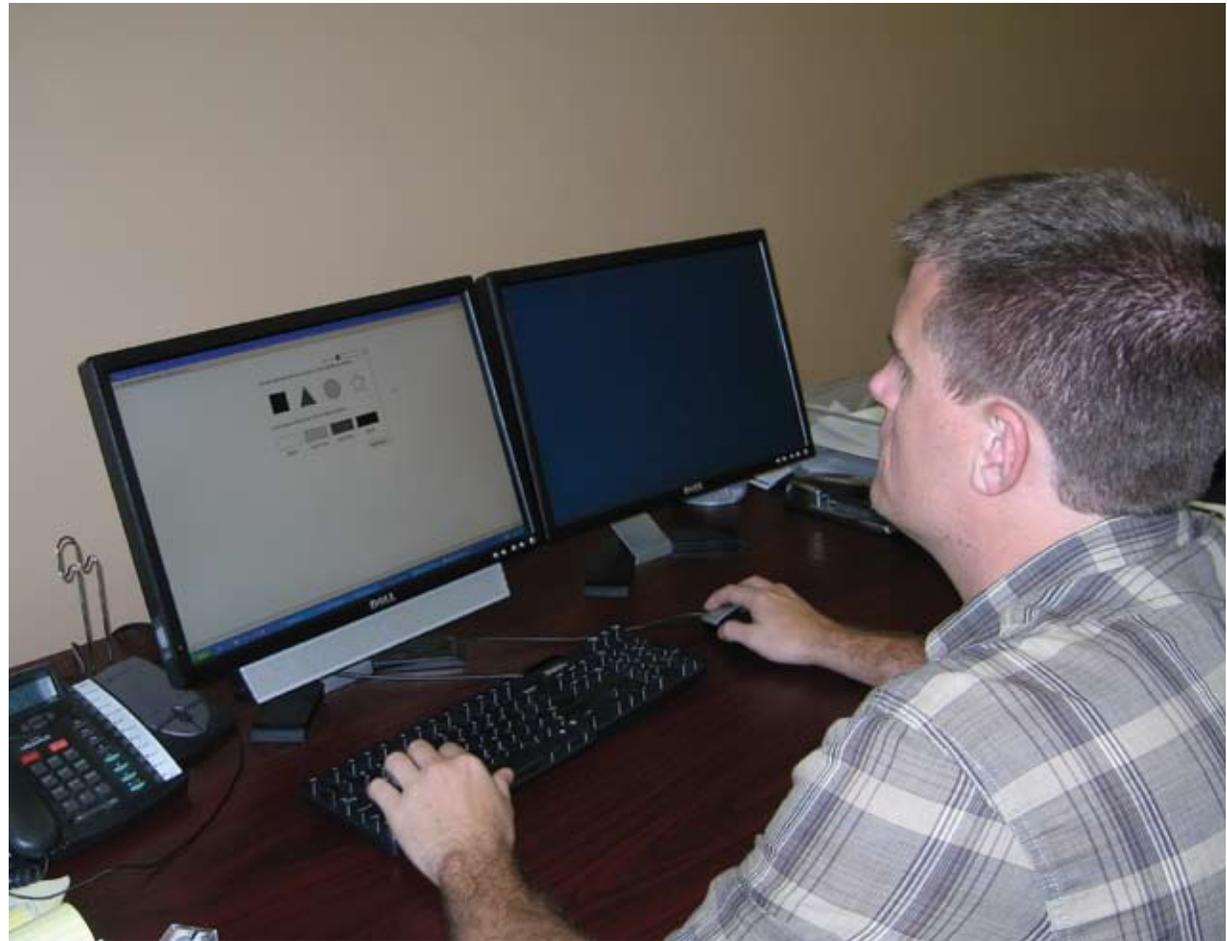
Astronauts, pilots, air traffic controllers, truck drivers, shift workers, and mountain climbers have something in common: All are at risk for impaired cognitive abilities due to stress or sleep deprivation. Whether in space or on Earth, stress and sleep loss can cause a reduction in certain cognitive abilities, such as working memory, reaction time, and problem solving. Because mission safety and success depend on being able to think clearly and function well, NASA began exploring a small, portable way for astronauts to monitor themselves and their cognitive fitness while in space, especially on future missions to Mars that will require extended periods in stressful environments.

## Partnership

The National Space Biomedical Research Institute (NSBRI), based in Houston and funded by NASA, leads a science and technology program to develop solutions to the health-related problems and physical and psychological challenges men and women face on long-duration space flights. The research results and medical technologies developed often have impact for conditions experienced on Earth.

In 2001, the NSBRI began funding research by Harvard University researcher, Dr. Stephen Kosslyn, now dean of social sciences, and research assistant, Jennifer Shephard. The project included the development of cognitive task scripting and administration software for personal digital assistants (PDAs) and an accompanying set of portable cognitive fitness tests, the MiniCog Rapid Assessment Battery (MRAB).

The test battery, which Kosslyn refers to as “a blood-pressure cuff for the mind,” assesses nine different cognitive functions and is intended to gauge the effects of stress-related deficits, such as fatigue, on astronauts as well as professionals on Earth. The original hand-held MRAB enabled someone to test his or her own alertness quickly



The MiniCog Rapid Assessment Battery (MRAB) measures the ability to sustain attention and vigilance, as well as the ability to divide one's attention. A test subject's aptitude in these areas correlates with fitness to perform attention-demanding tasks.

and easily; depending on the assessment, users might realize they should take a nap or drink coffee instead of proceeding with any sort of risky or complex activity. In 2003 and 2004, in collaboration with the NSBRI, Mount Everest climbers self-administered the MRAB on Palm PDAs to test themselves for cognitive deficits in the oxygen-poor higher altitudes.

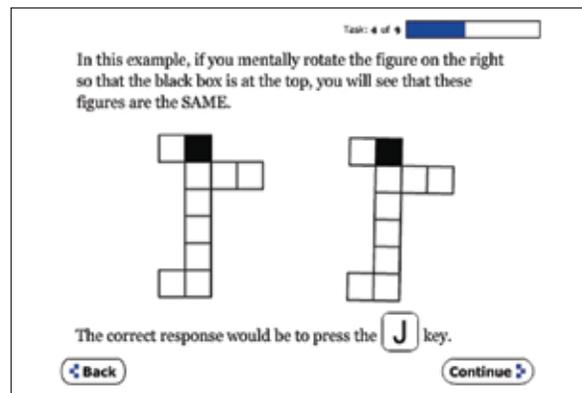
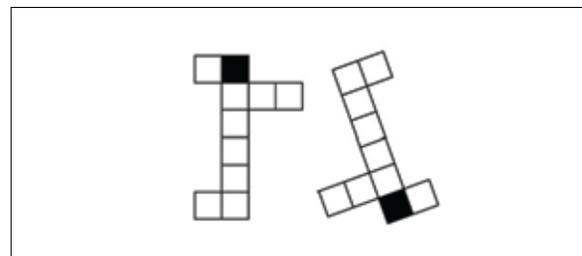
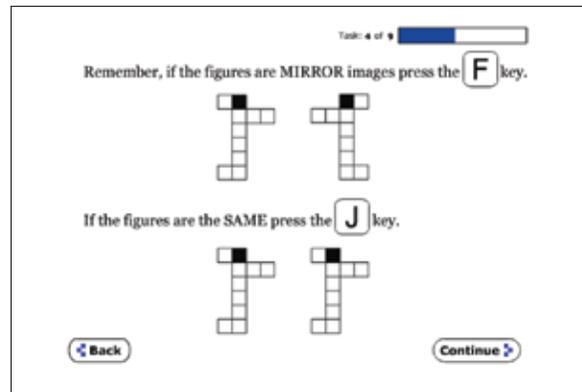
Harvard owns the software copyright, and a patent is pending. Although NSBRI funding ended for the MRAB in 2007, a California company now is using the battery in Web-based employment tests. In 2005, Drs. Josh Millet, Eric Loken, and David Sherman founded Criteria Corporation, based in Los Angeles. Now the company's chief research scientist, Loken knew of Kosslyn's research

from his own experiences at Harvard and recommended the MRAB to Millet, a fellow Harvard graduate and Criteria's CEO. After hearing about the MRAB, Criteria decided to license it from Harvard and adapted a Web-based version of it for delivery in 2006.

## Product Outcome

Criteria offers subscription-based employment testing, and the MRAB is included in the company's HireSelect subscription service along with about 15 other tests. The MRAB can be used not only for pre-employment testing but also for repeated administrations to measure day-to-day fluctuations of mental functioning. Unlike other aptitude tests, such as traditional college assessment exams, the MRAB focuses less on verbal skills and more on working memory, concentration, and problem-solving; testing involves tasks such as recognizing patterns within time limits and reacting accurately to information while attention is divided.

The MRAB consists of nine short Web-based exercises that measure a person's information-processing functions. It takes about 25 minutes to complete, and users are instructed that final scores will be based on both speed and accuracy. Subtests measure the subject's ability to focus while ignoring irrelevant information: Users are required, for instance, to rapidly indicate the number of digits in "6666" by pressing "4" rather than "6," the numeral that is actually repeating. Other subtests measure working memory, functioning similarly to the game Concentration, quizzing the user on where or when a numeral appeared on the screen. Mental rotation, the ability to identify whether shapes are flipped versus merely rotated, is a problem-solving skill that MRAB tests, as is verbal reasoning, assessed by asking users whether a series of statements are logically connected. Perceptual reaction time is a subtest that requires a user to press keys corresponding to red-flashing numerals as quickly as possible. The MRAB also measures the ability to sustain attention



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and vigilance, as well as the converse ability to divide one's attention.

A test subject's aptitude in these areas correlates, Millet says, with fitness to perform attention-demanding tasks. "The MRAB is based on neuroscientific research that focuses on understanding the brain as an information processing unit. Because the MRAB measures mental fitness, attention, and concentration, it's gotten significant traction in the transportation and logistics industries as a tool to help select drivers," he says. It can also be used after a candidate is hired; truck drivers or pilots can self-test their alertness before beginning long trips. Millet, however, sees the potential for wider applicability in other industries: "For example, things like divided attention, focus, and concentration would be very helpful in someone who is screening bags and doing surveillance at the airport."

Although Kosslyn and the Harvard team have no current plans for pursuing additional development of the MRAB, Millet says Criteria probably will investigate additional applications for the software with Kosslyn's advice on product direction and development as a member of the company's scientific advisory board. "We certainly have a number of validity studies in progress to explore new applications of the MRAB, specifically with respect to job performance," Millet says. ❖

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