Most of us can easily recall the name of our first-grade teacher. But what about a street name and house number jotted down just minutes earlier?

The brain activity used for the latter, known as “working memory,” is how humans focus on immediate mental tasks involving multiple bits of information. Discovering the cognitive process behind working memory—and how it applies to language and culture—is of prime interest at the Center for Advanced Study of Language (CASL), a partnership between the university and the federal government in what may be the nation’s top language research facility.

Maryland faculty are using behavioral testing, sophisticated brain-imaging techniques and mental exercises that can dramatically “beef up” working memory skills, all in an effort to expand and enhance the language capabilities of the U.S. intelligence community and the military.
“The mission and landscape for language analysts has shifted immensely in the last decade,” says Richard Brecht, director of CASL. “Linguists today are tasked with interpreting information that is often ambiguous, spoken or written in colloquial dialects, and transmitted through social media like Twitter or blogs.”

To gain an edge in this new environment, Brecht says, analysts need sharper cognitive skills that allow them to perform complex tasks under duress. For instance, a specialist at the National Security Agency might overhear a conversation about an imminent plot in an obscure dialect and in code. Or a military linguist in Afghanistan might have to interpret both the verbal and body language of local elders in a remote village, while under enemy fire.

“The working memory research at CASL coincides with our own work in improving fluid intelligence, which is the ability to reason quickly and to think abstractly,” says Harold Hawkins, a cognitive psychologist and program manager with the Office of Naval Research (ONR), the Department of Defense agency that provides scientific and technical knowledge to the Navy and Marine Corps. “Both are essential to decision makers who have to react on a dime under very uncertain conditions.”

TOTAL RECALL

Most government language experts are already proficient in working memory. They have to be. The research at CASL is intended to build upon this expertise, similar to keeping an athlete in shape with a dedicated exercise regimen.

“We’re basically looking to strengthen their brains to help keep them on task better,” says Michael Dougherty, an associate professor of psychology who is leading much of the working memory research at Maryland.

In his Decision, Attention and Memory Lab, Dougherty develops brief, cost-efficient behavioral tests that assess working memory skills. They’re an effective option for the federal government to screen candidates for foreign language training.

The tests can also evaluate the cognitive process of people from almost any age group—from children having difficulty with math or reading to older adults seeing a memory decline.

A series of online exercises that Dougherty created, asking users quickly recall locations and differences in sets of numbers or letters flashed on a computer screen, is particularly useful for pinpointing how and where working memory occurs.

“There are very specific networks in the brain that relate to the maintenance and updating of information,” Dougherty explains. “If we can actually see that happening, it gives us a place to look for physical changes related to an improvement or a decline in cognitive skills.”

These neural networks play an important role in working memory, says Donald “D.J.” Bolger, an assistant professor of human development who works closely with Dougherty.

“Cognitive scientists have known for decades which areas of the brain control specific functions related to language interpretation and language processing,” Bolger says. “But we’re just starting to understand these areas as complex networks that work in concert together for different tasks.”

The Maryland Neuroimaging Center (see page 3) offers Bolger and others detailed insight into this research. Using a functional magnetic resonance imaging (fMRI) machine, scientists can observe real-time images of the brain as test subjects perform language-related tasks.

These fMRI scans play an important role in other work by Bolger and Dougherty. In one ONR-funded project, the two Maryland researchers—in collaboration with other experts at CASL—are
testing how stress affects working memory. Once again, subjects are asked to recall the sequence and placement of data on a computer screen, but this time there are audio interruptions and other stimuli that cause anxiety, with the fMRI capturing every minute change of oxygen levels in the brain.

Ultimately, Bolger and Dougherty want to ramp up what they call “cognitive control networks” that will allow people, including military personnel, to perform better under stress.

YOUR BRAIN ON A TREADMILL

In a sense, brain components are similar to individual muscles. If you can enhance, or train, one part of your brain to perform better, your overall ability to quickly interpret complex information also improves.

Maryland researchers are hoping to do just that with a set of computer-generated “cognitive enhancement” programs they’ve developed. Dougherty says it’s like “asking specific areas of your brain to do jumping jacks, or run on a treadmill.”

One regimen requires users to exercise their cognitive skills for about 30 minutes a day over a period of 10 to 12 weeks. Sound tedious? Not so with the online training designed by Dougherty and Bolger.

“[The CASL researchers] are developing programs tailored for all levels that are both motivating and palatable to the end users,” says ONR’s Hawkins.

And just like a weightlifter standing in front of a mirror at the local gym admiring his training progress, the CASL researchers can visually see the results of their brain-training program using fMRI. “We can actually scan these connecting pathways, and see if they are growing in size and strength, after individuals have completed several rounds of cognitive training,” Bolger says.

It’s exactly this type of substantial increase in cognitive performance related to language that the military and the U.S. intelligence community is looking for, says CASL’s Brecht.

The military has already rotated numerous linguists out of Iraq and Afghanistan, he notes, and many of these skilled professionals are now being asked to retrain in another language critical to U.S. interests. Whether it’s an obscure Somali dialect or a vernacular yet to be determined, budget constraints and security needs demand that they be learned quickly and fully.

“We’re going to see a future where these experts are going to be asked to do more with less,” Brecht says. “That’s why CASL was established—to provide innovative solutions to specific language-related challenges like this.”

WORKING MEMORY 101

For a quick tutorial on working memory, check out the phrase: “As Anna dressed the baby stood up on the bed.”

So did Anna dress, or did Anna dress the baby?

The human brain goes into overdrive when asked to decipher this seemingly simple message, says Maryland psychologist Michael Dougherty.

First, you must grasp and hold in place information concerning “Anna” and the word “dress.” Then, as you scan the remainder of the sentence—interpreting additional words that either correlate or conflict with the original information on hold—your brain disambiguates, or makes clear, the true meaning of the phrase.

People with high levels of working memory are able to make these cognitive decisions quickly and accurately, Dougherty explains.

No worries, though, if you feel you’re lacking. People with less working memory are usually more creative thinkers who come up with unexpected answers—another skill often needed for critical jobs in the intelligence community.