Cognition Without Control

February 24 2010

(PhysOrg.com) -- Kids' inability to filter out distractions is a good thing. In fact, it's precisely what makes them such prodigious learners of language.

Teachers work hard to get and keep the attention of a classroom full of kids, and on the night shift, parents put lots of effort into keeping their flitting and impetuous brains on track with homework. Sometimes it can seem a wonder that kids learn anything at all. We might think grownups are the better learners, but remember that toddlers pick up all the unspoken rules and complex utterances of language better and faster than adults learning a new language. By age four, a child is speaking and has already learned many things about the world. That's the real wonder.

In "Cognition Without Control: When a Little Frontal Lobe Goes a Long Way," neuroscientist Sharon Thompson-Schill argues that kids' inability to filter out distractions is a good thing. In fact, she argues, it's precisely what makes them such prodigious learners of language. Written with a scientist from Stanford and a postdoc from her lab and published in Current Directions in Psychological Science, the paper looks at how immature, driven-to-distraction brain structures make possible the learning of complex social and linguistic conventions.

Thompson-Schill, the Class of 1965 Term Professor of Psychology, studies the biological bases of human cognitive systems—perception, memory, language, thought, cognitive control—and the interrelations among these systems. She is an expert on the brain bases of memory and language in humans. Her research focuses mainly on semantic

memory—recall of knowledge about objects, facts, concepts, and words and their meanings. Using imaging and other brain-science techniques, she seeks to understand how and where in the frontal lobes semantic information is selectively and flexibly retrieved.

When a baby is born, "a massive proliferation of synapses" gets underway in the immature brain, Thompson-Schill says. Nerve fibers branch across the cerebral cortex, chemical reactions begin churning, and sugar to feed the growing brain becomes metabolized. Unlike in other primates, different regions of the human brain mature at different rates. The visual and auditory cortex develops within a few months, but the prefrontal cortex, the part of the brain that governs attention and disciplines impulse, doesn't catch up in synaptic density until age four.

Because of this long period of brain development, Thompson-Schill says, children show impaired behavioral and cognitive control just like people with injuries to their prefrontal cortex. But, she adds, those underdeveloped powers of attention in kids are just what's needed for language learning. "Ever since the discovery that young children have a slowly developing frontal cortex—and the observation that this results in behavior that looks a lot like neurological patients who sustain damage to their frontal lobes—the focus has been on the behavioral cost of this developmental trajectory. We are interested in shifting the focus of this research to the possible benefits. That is, instead of asking, 'What can children do in spite of their immature frontal cortex?' we ask, ‘What can children do because of their immature frontal cortex?'"

Unlike the adult prefrontal cortex, an immature one is often not "on task" but is more open to absorbing raw experience, unfiltered by any plan, goal or agenda. "Because of this difference in frontal control," Thompson-Schill contends, "young children learn differently than adults." An undeveloped cortex allows young language learners to quickly pick up and put together words in the right order—more or

less—and in the right context. They may have some initial trouble with exceptions to language rules—saying "mouses" instead of "mice," for example—but they hear and apply the main conventions for speaking because their brains are not under the control of some overriding goal, such as looking for and substituting exceptions.

The delayed maturing of frontal lobes may be evolution's way of programming the human brain to learn early the very things—language and social conventions—that make us human. The cost of prolonged brain development, Thompson-Schill notes, is a longer period of vulnerability for human offspring, but the trade-off is the rough but rapid learning that turns infants into human beings. "The benefits of a long period of 'hypofrontality,'" she argues, "outweigh the costs."

If the theory is correct, programs to develop self-control in the very young might not be such a good thing, Thompson-Schill cautions. "Young children might benefit more from informal, undirected learning," she says, pointing to how Brazilian kids learn the skills of soccer simply by kicking the ball around, while Americans typically learn through drills in soccer classes. "In other words, by considering the function of the developmental trajectory, a more balanced picture of costs and benefits emerges, and then an effort can be made to capitalize on the abilities that are enhanced by hypofrontality rather than simply focusing on correcting the abilities that are hindered by this state."

Provided by Pennsylvania State University

provided for information purposes only.