Health Sense; The Evidence Speaks Well of Bilingualism's Effect on Kids

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Abstract:

[Ellen Bialystok] tests bilingual and monolingual 4-year-olds with what she calls the "tower game," which involves building towers with either Lego or Duplo blocks. Duplo blocks are similar to the familiar Lego ones, but they're roughly twice as big. Every block, regardless of its size, holds one "family," Bialystok tells kids. The child's task then becomes to look at a tower and say how many families it can hold. The trick is that a tower made of seven Lego blocks is the same height as a tower made of four Duplos. To answer correctly the question of which tower holds more families (the Lego tower), the child has to ignore this obvious visual fact.

[Adele Diamond] then uses functional MRI scans to see which areas of the child's brain are needed when the rules keep switching. Constant rule switching, she said, causes the brain to recruit extra neural circuits, whereas tasks that don't involve rule switching do not.

At the Montreal Neurological Institute, Denise Klein also finds brain differences depending on when people learn a second language. Using PET scans, she has found that people who are fully bilingual in French and English use the same area of the brain as an "internal dictionary," regardless of which language they're speaking. By contrast, people who are not truly bilingual, that is, who learn a second language after childhood, need to recruit additional brain areas to find words in their nonnative language, suggesting the brain has to work harder to do this.

Kids who grow up in bilingual homes may be slower to speak than other kids, but once they've learned both languages they appear to have a number of intellectual advantages. People who speak two languages early in life quickly learn that names of objects are arbitrary, said Suzanne Flynn, a professor of linguistics and second-language acquisition at the Massachusetts Institute of Technology. "So they deal with a level of abstraction very early."

Also, bilingual kids become exceptionally good at learning to ignore "misleading information," said Ellen Bialystok, professor of psychology at York University in Toronto. Bialystok tests bilingual and monolingual 4-year-olds with what she calls the "tower game," which involves building towers with either Lego or Duplo blocks. Duplo blocks are similar to the familiar Lego ones, but they're roughly twice as big. Every block, regardless of its size, holds one "family," Bialystok tells kids. The child's task then becomes to look at a tower and say how many families it can hold. The trick is that a tower made of seven Lego blocks is the same height as a tower made of four Duplos. To answer correctly the question of which tower holds more families (the Lego tower), the child has to ignore this obvious visual fact.

"By age 5, monolingual children can do this," said Bialystok, but bilingual kids can do it at 4. "This is the advantage of bilingualism"--in other words, a child can focus attention and ignore distractions. Bilingual kids also learn another useful skill--how to switch back and forth between tasks when the rules (such as the rules of a language) change, said Adele Diamond, director of the Center for Developmental Cognitive Neuroscience at the University of Massachusetts Medical School in Waltham.

Learning to adapt to a new set of rules means learning how to inhibit--or not pay attention to--a previously learned set, a skill that depends on development of a particular part of the brain, the prefrontal cortex, which functions in concert with other areas. In bilingualism, said Diamond, "you are constantly having to exercise inhibition because otherwise one language would intrude. We think this puts such a heavy demand on the system that it pushes the brain to mature earlier." This ability to filter out distractions and switch back and forth between tasks may give bilingual kids a leg up in school, she said.

In many studies, researchers use the Stroop test. The child is presented with a list of colors, but each color's name is written in ink of a different color. For instance, the word "red" would be written in green ink. Sometimes, the rule is that the child must say the name of the color and sometimes the child must say the color of the ink instead. For kids who can't yet read, Diamond uses pictures of circles on a computer screen.

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Large Area of Brain Used

Even in monolingual people, language processing is so central to being human that the brain devotes a huge amount of "real estate" to it, said Patricia K. Kuhl, director of the Center for Mind, Brain and Learning at the University of Washington. For 99% of right-handed people, the brain processes language mostly in the left hemisphere. In left-handers, it's often, though not always, reversed. Specifically, speech production is governed by Broca's area, a small region in the left inferior frontal cortex of the brain-- beneath the temple. Language comprehension, on the other hand, occurs in Wernicke's area, which lies farther back. (Sign language, by the way, uses the same areas, as well as visual processing areas. If a person who communicates by sign language has a stroke in Broca's area, he may become aphasic--unable to speak--just like a person who uses oral speech.)

Getting the brain up to speed for language processing takes years. A recent imaging study by Steven Petersen, a cognitive neuroscientist at Washington University in St. Louis, showed that even in kids ages 7 to 10, the brain was working harder at language tasks than brains of adults. That's because "kids are still learning," he said. And kids who learn two languages, not surprisingly, have an even tougher challenge. When babies are born, they are "citizens of the world," said Kuhl, who studies language development in babies in the U.S., Sweden, Japan and Russia. Newborns don't classify sounds; they simply hear and respond (by turning their heads) to all sounds. But over the first six months, as they become "bathed" in their native language, a baby's brain does a kind of statistical analysis that said, in essence, "This sound is important. I'd better file it away for future use." Or, "This other sound is not important. I can forget it." Using computer-generated vowel sounds and sophisticated statistical analyses of babies' responses, Kuhl has shown that by 6 months of age, Swedish babies and American babies "have totally different perceptions of the exact same sound" from the computer. Other researchers, including those from the University of British Columbia, have shown similar results.

These distinctions become ingrained for life. While Japanese babies learn that there's no meaningful difference between the sound for "L" and the sound for "R," American babies learn there is. The result, for Japanese adults, is that it is very difficult to distinguish between "L" and "R" because the two sounds, said Kuhl, are in the same storage "bin." But mapping exactly where language "bins" reside is a tricky, and fascinating, business. Neuroscientist Joy Hirsch of Columbia University uses functional MRI scanning to study bilingual adults, half of whom became bilingual as toddlers and half of whom learned a second language as an adult. The question was simple: "When one learns a second language, is that represented in the same area of the brain as the native language?"

Hirsch's subjects, who spoke a variety of languages--English, Chinese, German, French, etc.--were shown a picture and were asked to describe it first in one language, then in the second language. In adults who had learned a second language early, as toddlers, electrical activity in Broca's area looked virtually identical, regardless of which language was being used. But when people had acquired a second language later, the scans showed two separate parts of Broca's area lighting up. This suggests that when the learning is early, "the brain treats multiple languages as one language. But when one learns later in life, the sorting out seems to be done more spatially," says Hirsch, whose research has been used by both sides in the bilingual education debate.
At the Montreal Neurological Institute, Denise Klein also finds brain differences depending on when people learn a second language. Using PET scans, she has found that people who are fully bilingual in French and English use the same area of the brain as an "internal dictionary," regardless of which language they're speaking. By contrast, people who are not truly bilingual, that is, who learn a second language after childhood, need to recruit additional brain areas to find words in their nonnative language, suggesting the brain has to work harder to do this.

Neurosurgeons, too, have documented that multiple languages can be stored in discrete parts of the brain. Dr. George Ojemann, a professor of neurology at the University of Washington School of Medicine in Seattle, operates on people who suffer severe epileptic seizures, some of whom are bilingual, and maps the precise location of each language. With the patient awake and able to speak, Ojemann shows a picture of, say, a banana, and asks the patient to name it. By using very precise electrical stimulation of specific regions in the brain, Ojemann can get the patient to talk, say, in French but not English, then stimulate a nearby area and get the opposite result.

Separate Circuits

Though there is some overlap, this suggests that there are "somewhat separate neuronal circuits for different languages," said Ojemann, who has recently been able to map different languages to single neurons. "If you have two languages, all lines of evidence show there is separate real estate for different languages" in the brain, agrees Patricia Kuhl of the University of Washington. So what, if anything, does all this imply for bilingual education? "We are nowhere near knowing what it implies," she said, though researchers are trying to find out. Even though the answers are not all in, she added, there seems to be a "great advantage" to being multilingual.

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