Your brain on Big Bird: Sesame Street helps to reveal patterns of neural development

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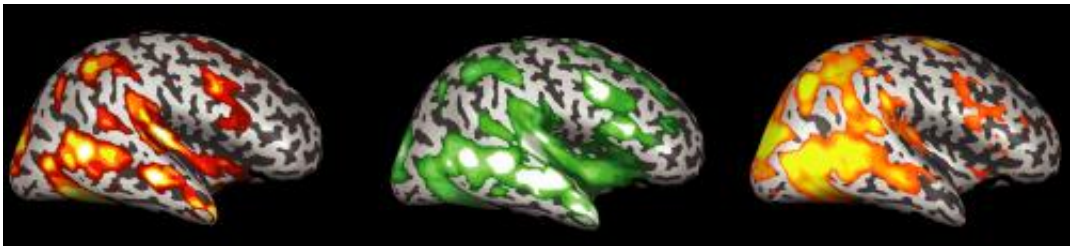

The fMRI scan on the left represents correlations in neural activity between children and adults, in the middle between children and other children, and on the right between adults and other adults. Such neural maps, says University of Rochester cognitive scientist Jessica Cantlon, reveal how the brain's neural structure develops along predictable pathways as we mature. Credit: Jessica Cantlon, University of Rochester

Using brain scans of children and adults watching Sesame Street, cognitive scientists are learning how children's brains change as they develop intellectual abilities like reading and math.

The novel use of brain imaging during everyday activities like watching TV, say the scientists, opens the door to studying other thought processes in naturalistic settings and may one day help to diagnose and treat learning disabilities.

Scientists are just beginning to use brain imaging to understand how humans process thought during real-life experiences. For example,

researchers have compared scans of adults watching an entertaining movie to see if neural responses are similar across different individuals. "But this is the first study to use the method as a tool for understanding development," says lead author Jessica Cantlon, a cognitive scientist at the University of Rochester.

Eventually, that understanding may help pinpoint the cause when a child experiences difficulties mastering school work. "Psychologists have behavioral tests for trying to get the bottom of learning impairments, but these new imaging studies provide a totally independent source of information about children's learning based on what's happening in the brain," says Cantlon.

The neuroimaging findings are detailed in a new study published Jan. 3 by the Public Library of Science's open-access journal PLoS Biology, by Cantlon and her former research assistant Rosa Li, now a graduate student at Duke University.

For the investigation, 27 children between the ages of 4 and 11, and 20 adults watched the same 20-minute Sesame Street video. Like the regular program, the recording featured a variety of short clips focused on numbers, words, shapes, and other subjects. The children then took standardized IQ tests for math and verbal ability.

To capture the neural response to the show, the researchers turned to functional magnetic resonance imaging (fMRI) scans. Unlike X-rays, CAT scans, and other types of brain imaging, fMRI involves no risks, injections, surgery, or exposure to radiation. Using magnetic fields, the scans virtually segment the brain into a three-dimensional grid of about 40,000 pixels, known as voxels, and measure the neural signal intensity in each of those tiny sectors. The study produced 609 scans of each participant, one every two seconds, as they watched Big Bird, the Count, Elmo and other stars of the educational series. Using statistical

algorithms, the researchers then created "neural maps" of the thought processes for the children and the adults and compared the groups.

The result? Children whose neural maps more closely resembled the neural maps of adults scored higher on standardized math and verbal tests. In other words, the brain's neural structure, like other parts of the body, develops along predictable pathways as we mature.

The study also confirmed where in the brain these developing abilities are located. For verbal tasks, adult-like neural patterns in the Broca area, which is involved in speech and language, predicted higher verbal test scores in children. For math, better scores were linked to more mature patterns in the intraparietal sulcus (IPS), a region of the brain known to be involved in the processing of numbers.

Using normal activities, like TV watching, may provide a more accurate indicator of children's learning and brain development in the real world than the short and simple tasks typical of fMRI studies, the authors argue. Like the Sesame Street video, learning environments in schools are rich in complexity along with the academic lessons, write the authors.

To test that assumption, Cantlon and Li had the children perform traditional fMRI tasks by matching simple pictures of faces, numbers, words, or shapes. During these more limited activities with simple images, the neural responses of the children did not predict their test scores, unlike the more naturalistic task of watching Sesame Street.

Although the study does not advocate TV watching, it does show that "neural patterns during an everyday activity like watching television are related to a person's intellectual maturity," says Cantlon. "It's not the case that if you put a child in front of an educational TV program that nothing is happening–that the brain just sort of zones out. Instead, what we see is

that the patterns of neural activity that children are showing are meaningful and related to their intellectual abilities."

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