Children's complex thinking skills begin forming before they go to school

January 23 2013

New research at the University of Chicago and the University of North Carolina at Chapel Hill shows that children begin to show signs of higher-level thinking skills as young as age 4 ½. Researchers have previously attributed higher-order thinking development to knowledge acquisition and better schooling, but the new longitudinal study shows that other skills, not always connected with knowledge, play a role in the ability of children to reason analytically.

The findings, reported in January in the journal Psychological Science, show for the first time that children's executive function has a role in the development of complicated analytical thinking. Executive function includes such complex skills as planning, monitoring, task switching, and controlling attention. High, early executive function skills at school entry are related to higher than average reasoning skills in adolescence.

Growing research suggests that executive function may be trainable through pathways, including preschool curriculum, exercise and impulse control training. Parents and teachers may be able to help encourage development of executive function by having youngsters help plan activities, learn to stop, think, and then take action, or engage in pretend play, said lead author of the study, Lindsey Richland, assistant professor in comparative human development at the University of Chicago.

Although important to a child's education, "little is known about the cognitive mechanisms underlying children's development of the capacity to engage in complex forms of reasoning," Richland said.

The new research is reported in the paper "Early Executive Function Predicts Reasoning Development" and follows the development of complex reasoning in children from before the time they go to school until they are 15. Richland's co-author is Margaret Burchinal, senior scientist at the Frank Porter Graham Child Development Institute at the University of North Carolina at Chapel Hill.

The two studied the acquisition of analogical thinking, one form of complex reasoning. "The ability to see relationships and similarities between disparate phenomena is fundamental to analytical and inductive reasoning, and is closely related to measurements of general fluid intelligence," said Richland. Developing complex reasoning ability is particularly fundamental to the innovation and adaptive thinking skills necessary for a modern workforce, she pointed out.

Richland and Burchinal studied a database of 1,364 children who were part of the Early Child Care and Youth Development study from birth through age 15. The group was fairly evenly divided between boys and girls and included families from a diverse cross-section of ethnic and income backgrounds.

The current study examined tests children took when they were 4 ½, when they were in first grade, third grade, and when they were 15. Because the study was longitudinal, the same children were tested at each interval. Among the tests they took were ones to measure analytical reasoning, executive function, vocabulary knowledge, short-term memory and sustained attention.

Children were tested at 4 ½ on their ability to monitor and control their automatic responses to stimuli. In first grade they worked on a test that judged their ability to move objects in a "Tower of Hanoi" game, in which they had to move disks between pegs in a specific order.

In third grade and at 15 year olds, they were tested on their ability to understand analogies, asked in third grade for instance to complete the question "dog is to puppy as cat is to__?" At 15 year olds, they were asked to complete written tests of analogies.

The study found a strong relationship between high scores among children who, as preschoolers, had strong vocabularies and were good at monitoring and controlling their responses to later ability on tests of understanding analogies.

"Overall, these results show that knowledge is necessary for using thinking skills, as shown by the importance of early vocabulary, but also inhibitory control and executive function skills are important contributors to children's analytical reasoning development," Richland said.

Provided by University of Chicago