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As easy as 1, 2, 3: Number sense correlates with test scores

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Knowing how precisely a high school freshman can estimate the number of objects in a group gives you a good idea how well he has done in math as far back as kindergarten, researchers at The Johns Hopkins University found.

Good "number sense" at age 14 correlates with higher scores on standardized math tests throughout a child's life up to that point and weaker "number sense" at 14 predicts lower scores on those standardized tests, said Justin Halberda, assistant professor of psychological and brain sciences in the university's Krieger School of Arts and Sciences.

"We discovered that a child's ability to quickly estimate how many things are in a group significantly correlates with that child's performance in school math for every single year, reaching all the way back to when he or she was in kindergarten," Halberda said.

Halberda teamed up on the research with colleagues Michèle Mazzocco, associate professor of psychiatry and behavioral sciences in the Johns Hopkins School of Medicine and researcher at the Kennedy Krieger Institute, and Lisa Feigenson, also a Johns Hopkins assistant professor of psychological and brain sciences. The results of their investigation are scheduled for advance online publication by the journal *Nature* on Sept. 7.

Though people often think of mathematics as a pinnacle intellectual achievement of humankind, research reveals that some intuition about

numbers, counting and mathematical ability is basic to almost all animals. For example, creatures that gather or hunt for food keep track of the approximate number of food items they procure in order to return to the places where they get the most sustenance. Humans share this very basic "number sense," allowing them, at a glance, to estimate the number of people in a subway car or bus, Halberda says.

The Johns Hopkins team wondered whether this basic, seemingly innate number sense had any bearing on the formal mathematics that people learn in school. So the researchers asked 64 14-year-olds to look at flashing groups of yellow and blue dots on a computer screen and estimate which dots were more numerous. Though most of the children easily arrived at the correct answer when there were (for example) only 10 blue dots and 25 yellow ones, some had difficulty when the number of dots in each set was more nearly equal. Those results helped the researchers ascertain the accuracy of each child's individual "number sense."

They then examined the teenagers' record of performance in school math all the way back through kindergarten, and found that students who exhibited more acute number sense had performed at a higher level in mathematics than those who showed weaker number sense, even controlling for general intelligence and other factors.

"What this seems to mean is that the very basic number sense that we humans share with animals is related to the formal mathematics that we learn in school," Halberda concludes. "The number sense we share with the animals and the formal math we learn in school may interact and inform each other throughout our lives."

Though the team found this strong correlation between number sense and scholastic math achievement, Halberda cautions against concluding that success or failure in mathematics is genetically determined and,

therefore, immutable.

"There are many factors that might affect a person's performance in school mathematics," Halberda says, "What is exciting in our result is that success in formal mathematics and simple math intuitions appear to be related."

Future directions for research include investigating the trainability of one's number sense and seeing whether early help in number sense could affect later formal math learning.

Video demonstration of study task: www.psy.jhu.edu/~labforchildde … askVideoH264,360.mov

Source: Johns Hopkins University