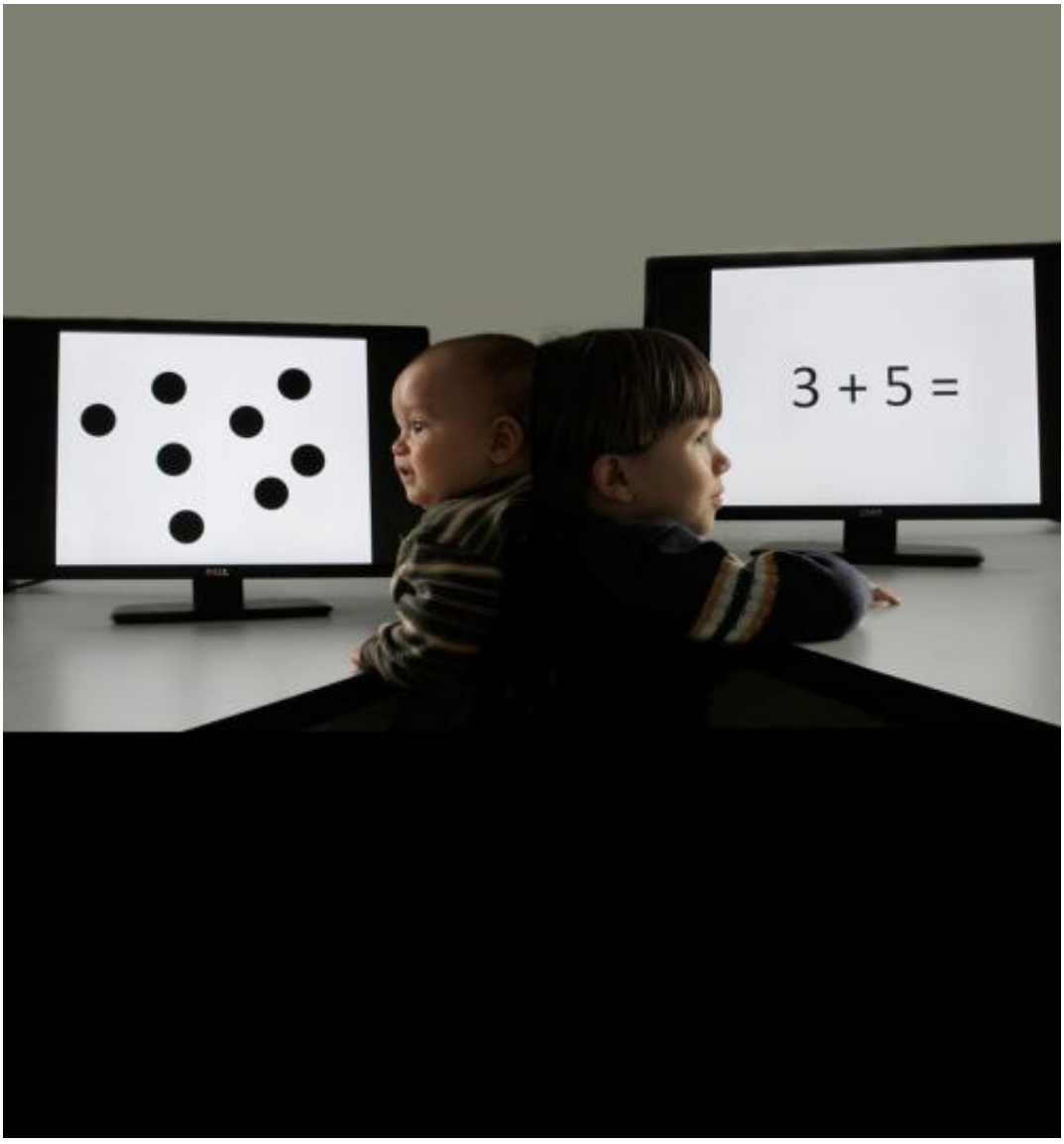
Babies' number sense could predict future math skills

October 22 2013, by Marcia Malory



Six-month-old infants' intuitive number sense as measured through their looking times to images with different numbers of objects predicts their performance on

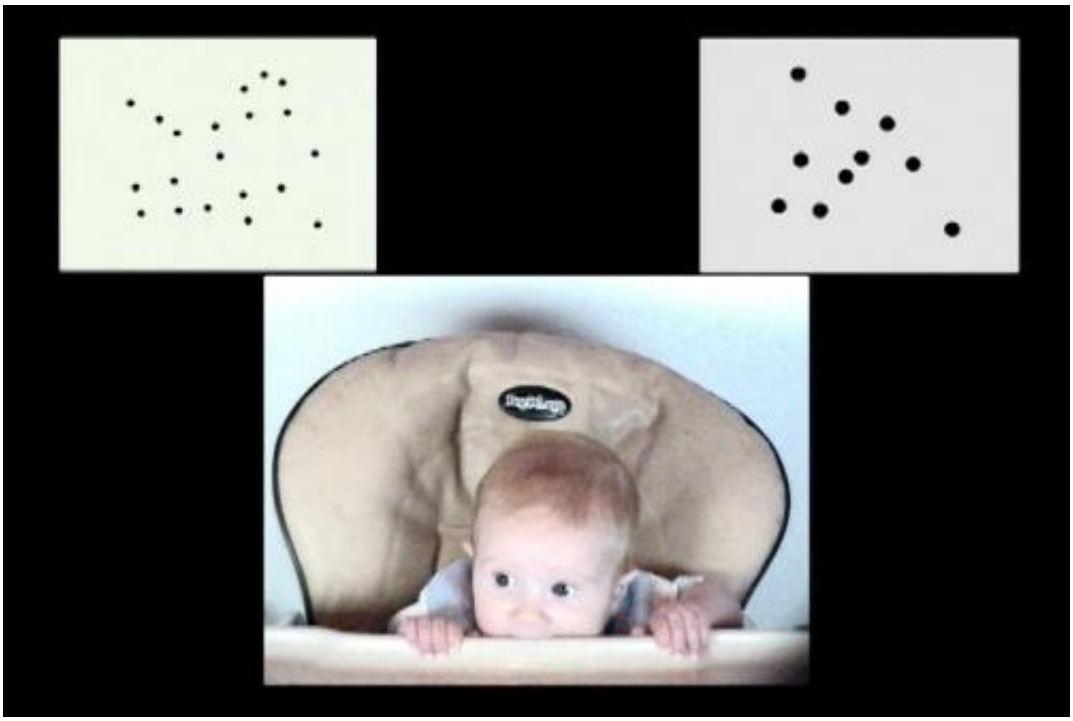
math tests at 3.5 years of age. This link cannot be explained by differences in general intelligence and suggests that infants' number sense is an important building block for later mathematical abilities. Credit: Melissa Libertus

(Medical Xpress)—Infants have a primitive number sense that allows them to recognize whether a group of objects has changed in size. Scientists have suspected a correlation between this innate number sense in infancy and future mathematical ability, but until recently, have been unable to prove its existence. Now, Elizabeth Brannon of Duke University in Durham, North Carolina and her colleagues have confirmed this correlation by testing six-month-olds for their innate number sense and then retesting the same children for mathematical aptitude three years later. The research appears in the *Proceedings of the National Academy of Sciences.*

Humans are among many animals with an approximate number system (ANS), an innate ability to distinguish between differently sized groups of objects. Human babies have an ANS and can tell when the number of dots on a screen changes. Only humans, however, can understand and manipulate mathematical symbols. Scientists think our innate number sense could provide a basis for mathematical reasoning, and past studies have already shown that people with a well-developed ANS tend to be good at math. These studies, though, do not show a relationship between ANS in infancy and mathematical ability later in childhood. In addition, the subjects of these studies have always been of preschool age or older. This means that they already know how to speak and could have picked up mathematical skills from parents, teachers or other adults, both formally and informally.

To avoid these problems, Brannon and her team studied six-month-olds. In a study performed in 2010, they showed six-month-old infants a

screen on which one side always contained the same number of dots, while the other side contained a varying number of dots. The pattern of dots varied on both sides. If an infant spent more time looking at the side of the screen where the number of dots changed than at the side where the number of dots remained constant, the researchers concluded that it had a well-developed innate number sense.



Duke University neuroscientists Elizabeth Brannon and Ariel Starr test a rudimentary understanding of numbers in infants called a "primitive number sense." When looking at two collections of dots presented on video screens, primitive number sense allows the child to identify which set is larger even without verbal counting or knowing numbers. The length and direction of the child's gaze is used to infer their sense of novelty. Credit: Brannon Lab, Duke University

Three years later, the team tested the same children on their ANS acuity,

their ability to count and their mathematical skills, including their understanding of Arabic numerals, their ability to compare numbers and their ability to do basic calculations. They tested the children's general intelligence to control for any differences. The researchers found that ANS scores at six months of age significantly predicted ANS acuity, counting ability and mathematical aptitude at three and a half years.

The researchers suggest that educators develop ways to improve the number sense of young children even before they are old enough to count.

More information: Number sense in infancy predicts mathematical abilities in childhood, *PNAS*, Published online before print October 21, 2013, DOI: 10.1073/pnas.1302751110

Abstract
Human infants in the first year of life possess an intuitive sense of number. This preverbal number sense may serve as a developmental building block for the uniquely human capacity for mathematics. In support of this idea, several studies have demonstrated that nonverbal number sense is correlated with mathematical abilities in children and adults. However, there has been no direct evidence that infant numerical abilities are related to mathematical abilities later in childhood. Here, we provide evidence that preverbal number sense in infancy predicts mathematical abilities in preschool-aged children. Numerical preference scores at 6 months of age correlated with both standardized math test scores and nonsymbolic number comparison scores at 3.5 years of age, suggesting that preverbal number sense facilitates the acquisition of numerical symbols and mathematical abilities. This relationship held even after controlling for general intelligence, indicating that preverbal number sense imparts a unique contribution to mathematical ability. These results validate the many prior studies purporting to show number sense in infancy and support the hypothesis that mathematics is built

upon an intuitive sense of number that predates language.

Press release