Medical Xpress

Study shows babies grasp number, space and time concepts

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A 9-month-old can make intuitive leaps across number, space and time. Photo by Carol Clark.

(PhysOrg.com) -- Even before they learn to speak, babies are organizing information about numbers, space and time in more complex ways than previously realized, a study led by Emory University psychologist Stella Lourenco finds.

"We've shown that 9-month-olds are sensitive to 'more than' or 'less than' relations across the number, size and duration of objects. And what's really remarkable is they only need experience with one of these quantitative concepts in order to guess what the other quantities should look like," Lourenco says.

Lourenco collaborated with neuroscientist Matthew Longo of University College London for the study, to be published in an upcoming issue of Psychological Science.

In his 1890 masterwork, "The Principles of Psychology," William James described the baby's impression of the world as "one great blooming, buzzing confusion."

Accumulating evidence is turning that long-held theory on its head.

"Our findings indicate that humans use information about quantity to organize their experience of the world from the first few months of life," Lourenco says. "Quantity appears to be a powerful tool for making predictions about how objects should behave."

"It's like we have a ruler in our heads," Lourenco says. Photo by Carol Clark.

Lourenco focuses on the development of spatial perception, and how it interfaces with other cognitive dimensions, such as numerical processing and the perception of time. Previous research suggests that these different cognitive domains are deeply connected at a neural level. Tests show, for instance, that adults associate smaller numbers with the left side of space and larger numbers with the right.

"It's like we have a ruler in our heads," Lourenco says of the phenomenon.

Other tests show that when adults are asked to quickly select the higher of two numbers, the task becomes much harder if the higher number is represented as physically smaller than the lower number.

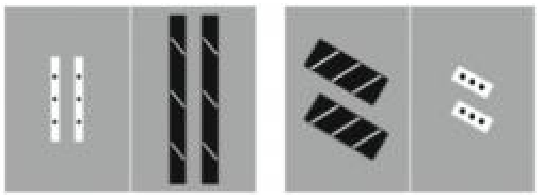
Lourenco wanted to explore whether our brains just pick up on statistical regularities through repeated experience and language associations, or whether a generalized system of magnitude is present early in life.

Her lab designed a study that showed groups of objects on a computer screen to 9-month-old infants. "Babies like to stare when they see something new," Lourenco explains, "and we can measure the length of time that they look at these things to understand how they process information."

When the infants were shown images of larger objects that were black with stripes and smaller objects that were white with dots, they then expected the same color-pattern mapping for more-and-less comparisons of number and duration. For instance, if the more numerous objects were white with dots, the babies would stare at the image longer than if the objects were black with stripes.

"When the babies look longer, that suggests that they are surprised by the violation of congruency," Lourenco says. "They appear to expect these different dimensions to correlate in the world."

The findings suggest that humans may be born with a generalized system of magnitude. "If we are not born with this system, it appears that it develops very quickly," Lourenco says. "Either way, I think it's amazing how we use quantity information to make sense of the world."



Lourenco recently received a grant of $300,000 from the John Merck Fund, for young investors doing cognitive or biological science with implications for developmental disabilities. She plans to use it to further study how this system for processing quantitative information develops, both normally and in an atypical situation such as the learning disorder known as dyscalculia - the mathematical counterpart to dyslexia.

"Dyslexia has gotten a great deal of attention during the past couple of decades," Lourenco says. "But as our world keeps getting more technical, and students in the United States lag other countries in math, more attention is being paid to the need to reason about numbers, space and time. I'd like to explore the underlying causes of dyscalculia and maybe get a handle on how to intervene with children who have difficulty engaging in quantitative reasoning."

More information: Journal paper: pss.sagepub.com/content/early/ … 97610370158.abstract

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