Hello from the research team in the NYU Infant Perception Lab! We want to thank you, the parents (and infants!), for your part in these studies. Without you, we couldn't do our work, and we appreciate your contributions very much.

Who are we? We are scientists who conduct research on perceptual and cognitive development in infancy and childhood. Dr. Scott Johnson is Research Director in the lab, and supervisor of the graduate students. Dr. Johnson is an Associate Professor of Psychology here at NYU. Kristin Bellanca is the Lab Manager, organizing everything to ensure things go smoothly in the lab. Dima Amso and Sarah Shuwairi are graduate students in the Psychology Department. They are apprentice researchers, and contribute to the flow of ideas, testing, and publishing results. We also rely on a team of undergraduates to assist us.

What do we do? Our research participants are little, but our questions are big: We investigate issues that are central to cognitive and developmental science, such as origins of knowledge in humans: how infants come to understand objects, how they direct their attention, and how they learn about the visual and auditory patterns in their world.

How do we do it? Infants can't tell us what they think with words, so we use indirect methods. Sometimes we measure looking times to various visual displays, because infants get bored with repetition and recover interest to novelty. We tap "interpretation" of various displays with this method, such as perception of depth and motion. We also record eye movements, gaining access to the timing and spatial patterns of scanning. Finally, we measure brain activity more directly with arrays of sensors that are placed across the infant's scalp. Which of these measures we choose depends largely on which question we are asking; each has advantages and disadvantages.

Why do we do it? With an understanding of fundamental perceptual, cognitive, and brain development, scientists can diagnose and treat problems that arise in some children. We are funded by the government (the National Science Foundation and the National Institute of Child Health and Human Development) and feel a strong obligation to conduct and report the best possible science we can. We disseminate this information by publishing our findings in scientific journals. You can access many of these by visiting our "Publications" website (http://www.psych.nyu.edu/johnson/infantperceptionlab/publications.html).

Here are some details of current research:

Object perception: Unity. The display below shows a partly occluded rod, whose top and bottom segments are visible above and below a box. Displays such as this are used to examine when infants perceive the rod parts as unified. This is a very simple example of something we see all around us (partly hidden objects), but research from our lab and others demonstrates that very young infants do not perceive unity. This developmental process is among the most important perceptual achievements of infancy, and we are trying to determine out how that happens.

Object perception: Persistence. The display below shows a ball moving back and forth, the center of its trajectory
hidden by a box. Perceiving the ball as persistent in a simple event such as this is a perceptual achievement that we (adults) take for granted, yet young infants apparently are unable to perceive persistence in this way. There are parallels between perception of unity and perception of persistence (taking account of something hidden), and we are investigating whether similar mechanisms enable us to solve both problems.

Intermodal binding. The display below shows two squares, one of which contains a toy. The toy bounces in time with a sound. Notice the horizontal and vertical lines that meet on the toy, an indication of a baby's "point of gaze" when the baby views the display. We measure infants' eye movements as they view moving and sounding toys in this display—hence the term "intermodal" (one mode of perception is vision, another is hearing). After the infants view two toys, they hear the sounds alone, and we record which empty square they look at more. Interestingly, they look longer at the square associated with each individual sound, suggesting that they "bound" the visual and the auditory information. Current work explores more closely how such associations are formed.

Rhythm perception. Infants are played a series of rhythmic sequences that suggest, to adults, either a 3/4 or a 4/4 time (say, a waltz vs. a march), until they lose interest (indicating familiarity). Each sequence is unique, yet all conform to either the waltz-like or march-like meter. After familiarization, infants hear a different rhythm from the familiar category, or a different rhythm from the unfamiliar category. We have found that despite the uniqueness of each rhythm, infants categorize them in just the same way as do adults, suggesting that they may be sensitive to the metric "pulse" of the music they hear. We are now probing more deeply into the development of rhythmic meter awareness.

Rule learning. The display below shows a set of simple shapes, each a distinctive color and shape. We show infants sequences of such shapes and test their perception of the rules that govern the patterns underlying the sequences. For example, each shape (say, the diamond) might appear in a unique location (say, the upper left), and other shapes in other unique locations. We have found that even very young infants can learn basic sequences, but cannot bind them to locations until nearly a year of age. We have also found that young infants are poor at generalizing their sequence learning to learn new "rules," such as an "AAB" sequence (say, square-square-triangle). Such rule learning is crucial to language acquisition. We are currently investigating the possibility that rule learning is a central, general process, not specific to any perceptual or cognitive domain (such as visual perception or language). We are also exploring auditory rule learning using non-linguistic stimuli, such as musical sounds. We believe that these studies will yield fundamental and important new knowledge about how infants are able to learn about the many kinds of structured information in the world.
Visual attention. The display below shows a set of squares, one of which contains a toy, and the other a gray diamond. The toy bounces in time with a sound and tends to attract infants' attention. The toy and diamond are then replaced with a new toy, in a new location. We have found that when the new toy replaces the diamond, eye movements are slightly delayed than when the new toy appears in one of the other locations. We believe that infants' attention is "divided" initially between the toy and the diamond, even though the baby did not look directly at the diamond. This means that in infants, as in adults, glances around the world take in more information than just the point of gaze. We are currently at work to discover the brain mechanisms that underlie attentional engagement, and their development.

Brain development. Below at left is a photo of Dr. Johnson's daughter Veronica (and his lovely wife Kerri) wearing a "sensor net" that measures her brain activity. We use the sensor net to explore how infants learn objects and patterns. This technique tells us about how the brain processes information on a very short time scale, and also tells us where in the brain the information might be coded. For example, the two colored displays below show an overhead view of Dr. Johnson's brain activity as he participated in a task to find discrepant visual stimuli ("odd man out"), while wearing a sensor net. The colors show brain activity, as viewed from above. Red means (roughly) more activity. In the center figure, there is more red toward the bottom, meaning more activity in the visual part of the brain. This reflects the initial visual inspection of the stimulus. In the right figure, there is more red in the center, meaning more activity in parts of the brain that code for associations and other, higher cognitive functions. This took place only about 2/10 of a second after visual inspection, showing how rapidly the brain is able to make decisions. We are very excited at the prospect of testing developmental changes in brain function, as we believe we are getting close to answering some of the most important questions facing cognitive and developmental science today.
Thanks again for your important contributions to this research! If you would like more information, you can contact Dr. Johnson at scott.johnson@nyu.edu or (212) 998-3714.

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