What triggered your interest in developmental psychology?

I changed majors at university many times, and I was somewhat rudderless. At one point I dropped out and took a job washing dishes at a preschool. I didn’t know anything about children prior to that point, but I found them fascinating, and greatly enjoyed hanging out with and talking to them. Eventually, I went back to school and took classes in developmental psychology so I could better understand children. I did well and my performance was noticed by a professor who encouraged me to apply for graduate school. It was there that I learned about infant development – I was immediately hooked. I thought it was amazing that we could investigate how infants understand the world.

Could you introduce the scope and objectives of the University of California, Los Angeles (UCLA) Baby Lab, for which you are Research Director?

The principal focus of our research is perceptual and cognitive development. Infants are born with no visual experience, and are suddenly confronted with a barrage of new sights and sounds. How do they begin to make sense of this new sensory input? We explore this question, and many others, with studies that investigate visual and auditory perception and learning processes in infants, children and adults.

We ask fundamental questions about human nature and its causes – how it comes to be. We pay particular attention to infancy because we seek to understand developmental change, and change is exceptionally rapid early in life, so infancy is a natural target for our investigations. The ultimate goal of our studies is to provide information about developmental trajectories so that appropriate interventions can be devised when these trajectories are under threat from developmental disabilities.

In lay terms, can you define statistical learning as it applies to infant developmental psychology?

Statistical learning is a type of pattern learning – about how objects, people and events in the world are structured. Pattern learning allows the child to begin to predict what’s coming next, which is essential for effective interpretation of the child’s experience. Statistical learning per se refers to patterns in which there are consistent associations between distinct stimuli. For example, in the English language, the word ‘the’ is usually followed by a noun later in the sentence. Once an infant comes to learn such associations, he or she can begin to identify more and more complex patterns through processes of categorisation, abstract rule learning and so forth. In my view, statistical learning might be the foundation for some of these skills.

What are the potential real-world applications of elucidating the mechanisms underlying statistical learning in infancy?

We study learning for two reasons. First, experiments that examine learning and development shed light on the origins and causes of human nature. Second, studies of learning in ‘typically developing’ populations help us understand what happens when learning is compromised due to some developmental disability. Autism, for example, is characterised (in part) by impairments in social interaction. One prominent theory of autism’s developmental origins suggests that reduced social attention in infancy results in decreased opportunities to learn from social interactions. Social interactions are semi-structured and predictable, and so a general impairment in pattern learning could play an important role. Consistent with this possibility, my colleagues and I reported recently that statistical learning was related to adaptive social function in autistic children.

Could you outline the major challenges associated with conducting research with infant subjects? How does the UCLA Baby Lab overcome these?

Most of our research participants are too young to follow verbal instruction or answer questions, so we rely on indirect methods, such as looking times and eye tracking. A second challenge is that infants are not always entirely cooperative, so we design our studies to be as interesting and entertaining as possible for the babies. This keeps them interested and looking towards the object of focus.

In your opinion, what has been your greatest professional achievement to date?

I’m simply pleased to have a lab and the freedom and resources to pursue questions of early development. Infants are endlessly fascinating!
At the University of California, Los Angeles, an interdisciplinary team of researchers is working to elucidate the learning mechanisms that underlie cognitive and perceptual development in infancy and early childhood.

**How do neonates**, surrounded by a sea of new sensory experiences, come to develop the cognitive and perceptual skills required to interpret the world around them? Developmental psychology only emerged as a scientific field in the early 20th Century, and the first systematic studies of infant cognitive development were only performed in the 1920s. Since then, the field has seen numerous advances in scientific understanding and methodologies, but nonetheless, numerous questions remain unanswered.

**Baby Lab**

At the University of California, Los Angeles (UCLA) Baby Lab, a team of researchers is working to drive forward understanding in this area. Led by Professor Scott Johnson, the group has two overarching aims: firstly, to accurately describe age-related changes in visual and auditory perception, and learning abilities, in infancy, childhood and adulthood; and secondly, to unearth the mechanisms underlying these changes. In this way, the group hopes to elucidate the complex processes involved in human cognitive and perceptual development.

The field of perceptual and cognitive development is highly interdisciplinary by its very nature, located at the intersection of developmental psychology, vision science, cognitive science and developmental neurobiology. This diversity of disciplines is reflected by the areas of expertise represented within the UCLA Baby Lab. “We have colleagues around the world working across several different research areas,” Johnson outlines. “I collaborate with experts in face perception, social psychology, computational modelling, language acquisition, motor development, brain development, developmental disabilities and other fields.”

**Inside infants’ minds**

While the UCLA Baby Lab scientists work with humans of all ages, the vast majority of their test subjects are infants, as early infancy is the period in which many key perceptual and cognitive developments occur. Of course, working with infants brings with it its own set of challenges. For example, the researchers rely on parents to volunteer both their and their children’s time to participate in the Lab’s experiments. Furthermore, infants can prove unruly in experimental situations as they do not have the capacity to understand or follow instructions. To overcome these challenges, Johnson and his colleagues go to great lengths to design studies that are relatively quick (usually 30 minutes or less), and which are interesting and entertaining for both child and parent.

However, a far greater hurdle arises from the fact that infants do not have the ability to answer questions or verbalise their thoughts. Since insights into their inner worlds cannot be obtained directly, they must instead be observed indirectly. The UCLA Baby Lab therefore employs a number of experimental methodologies aimed at achieving this. For example, the researchers measure looking times to assess visual attention and interest; record eye movement to obtain precise data...
LEARNING IN INFANCY

OBJECTIVES
• To better understand perceptual and cognitive development in infants, children and adults
• To design effective interventions based on information about developmental trajectories to address disabilities

KEY COLLABORATORS
Dr Gavin Bremner, Lancaster University, UK • Dr Alan Slater, Exeter University, UK • Dr Hermann Bülf, Dr Chiara Turati, Dr Viola Brenna, University of Milan, Italy • Dr Eloisa Valenza, University of Padova, Italy • Dr Olivier Pascalis, University of Grenoble, France • Dr Ingmar Visser, Dr Maartje Rajmakers, University of Amsterdam, Netherlands • Dr Kang Lee, University of Toronto, Canada • Dr Paul Quinn, University of Delaware, USA • Dr Gary Marcus, Dr Ed Vessel, New York University, USA • Dr Fred Shi, Yale University, USA • Dr David Moore, Pitzer College, USA • Dr Justin Wood, University of Southern California, USA • Dr Lauren Stone, Dr Hongjing Lu, Dr Mirella Dapretto, Dr Shafali Jeste, Dr Kerri Johnson, University of California, Los Angeles, USA • Dr Paola Escudero, University of Western Sydney, Australia

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CONTACT
Professor Scott Johnson
Research Director
UCLA Baby Lab
3291 Franz Hall
Los Angeles, CA 90095, USA
T +1 310 825 5537
E scott.johnson@ucla.edu

www.babylab.ucla.edu

DR SCOTT JOHNSON received his PhD in 1992 from Arizona State University, followed by a postdoctoral fellowship in the Center for Visual Science at Rochester. Prior to his current position at the UCLA Baby Lab, he was Associate Professor at New York University and Assistant Professor at Cornell University. His first job was as a lecturer at Lancaster University, UK, where he is now Visiting Research Fellow. His research concerns the origins and development of perception and cognition in humans, with a focus on attention, speech perception, face perception, object knowledge, learning mechanisms, brain development and developmental disabilities.

The group hopes to elucidate the complex processes involved in infant cognitive and perceptual development regarding timing and spatial scanning patterns, and measure brain activity to attain cortical correlates of perception and learning.

The UCLA Baby Lab researchers also play an active role in the development of novel methodological approaches suitable for their research needs. “We have pioneered the use of eye tracking in a variety of infant paradigms, including methods to examine infants’ detection of social content in complex scenes, novel mathematical tools for the analysis of eye movement data, assessments of complementary processes of visual selection and visual inhibition, and brain imaging,” Johnson reveals.

STATISTICAL LEARNING
One of the major goals shared by researchers at the UCLA Baby Lab is to generate findings that contribute to the formulation of novel scientific theories of cognitive development. In recent years, the researchers have devoted much of their time to investigations of statistical learning – a kind of pattern learning through which an individual gains an understanding of how particular external objects, people and events are structured, and so develops the ability to make consistent associations and predictions. It is hypothesised that statistical learning lays a foundation for the acquisition of numerous other important skills, from face perception to language learning.

Johnson and his colleagues have conducted a range of experiments aimed at elucidating the mechanisms underlying statistical learning in infancy and early childhood. Highlights of past discoveries involving the UCLA Baby Lab members include a 2002 study exploring visual statistical learning in infancy indicating that the discipline is a domain-general learning mechanism; a 2009 paper that demonstrated differences in abstract rule learning for visual sequences between eight- and 11-month-olds, suggesting that this skill develops incrementally; and a 2013 review discussing auditory and visual statistical learning and outlining the generality and constraints of statistical learning.

FURTHER ACTION
The UCLA Baby Lab’s findings to date have led Johnson and his colleagues to hypothesise that infant cognitive development relies on a number of different factors, including a rapid pace of brain development, ample time to observe the world, the ability to direct attention via eye movements, and a combination of simple learning mechanisms (such as statistical learning).

While this insight provides the scientists with a general overview of the processes by which humans develop perceptual and cognitive skills, there are many more factors to understand. Fortunately, the UCLA Baby Lab team is well situated to address them. “In terms of next steps, I look forward to learning more about cortical underpinnings of learning and perception, and the means by which brain development supports perceptual and cognitive function,” Johnson hints.

CLINICAL APPLICATIONS
The UCLA Baby Lab scientists have an additional motivation: they hope to improve fundamental understanding of perceptual and cognitive brain development, with the aim of translating these insights into novel diagnostics and therapeutics for various developmental disabilities. Much of their recent work in this area has centred on the relationship between statistical learning and autism spectrum disorder (ASD).

Notably, this year saw Johnson and his collaborators publish findings from the first ever study to identify electrophysiological markers of visual statistical learning in young children with ASD. This paper demonstrated heterogeneity in statistical learning in ASD that maps onto non-verbal cognition and adaptive social function – an insight that the researchers hope will one day pave the way for the design of novel interventions targeted to specific statistical learning profiles.