Cognitive Development

How much do toddlers really learn from watching educational videos and listening to classical music? Why are some children shy, and why are others unable to tell when someone is obviously joking? Why is it exactly that we can walk, chew gum, and think about dinner at the same time?

The University of Maryland's Neuroscience and Cognitive Science (NACS) Program seeks to answer these and other questions to improve our understanding of cognitive disorders, language acquisition, and memory and motor skill development.

Rochelle Newman studies how children acquire language. Her "stream segregation" model suggests that environmental factors like acoustics significantly affect an infant's ability to perceive words.

Amanda Woodward explores how infants learn to perceive others' intentions. Her work has implications for the study of social cognition disorders like autism.

Nathan Fox uses neural imaging technology to predict the development of anxiety disorders and design early-stage therapeutic interventions.

Tracy DeBoer studies the factors that affect memory development and decline, work that helps target therapies for Alzheimer's Disease and other memory disorders.

Jane Clark's work with motor skill development examines how the brain processes sensory input to solidify muscle memory and coordination.

With the aid of high resolution video, Jeffrey Lidz studies language acquisition by observing similar patterns in multiple languages. His "triangulation" approach helps pinpoint the exact nature of various problems in acquiring language.

http://www.nacs.umd.edu/

Segregating Multiple Streams of Sound

Rochelle Newman's groundbreaking work facilitates language acquisition among infants. Newman combines two typically separated fields of inquiry – speech perception (understanding sounds) and word recognition (understanding meaning). This approach showed how people separate a single voice from background noises, a process called "stream segregation." Newman found that infants cannot segregate as well as adults, and she created a model for predicting the environments most amenable for children to acquire language. This research affects everything from how daycare centers are organized to how televisions are watched – or not watched.

Dr. Newman's research has also changed our understanding of adult speech problems. She found, for example, that stuttering is a difficulty arising from a very early stage in the process of producing speech.

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Intentions, Interpretations, and the Social Cognition of Infants

When do infants learn that picking up a toy off the floor may signal a larger intention of cleaning a room? How does the social awareness of an infant with autism differ from that of a normal child? To what extent do babies teach themselves?

Amanda Woodward investigates such questions at the Maryland Infant Studies Laboratory, where she develops innovative approaches for understanding normal and abnormal infant social cognition.

Woodward's research focuses on how babies interpret others' intentions. This critical skill teaches children about language, values, interaction, and safety. Designing a variety of experiments that gauge level of interest, Dr. Woodward figures out what babies are thinking, and from there she determines whether they understand intentions underlying certain acts – an issue at the heart of problems such as autism.

Woodward has also shown how babies teach themselves in different settings. She found that "passive" methods for enhancing cognitive development, such as listening to classical music or watching educational videos, are less effective than learning by doing.

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Early Intervention to Prevent Social Anxiety Disorders

Nathan Fox's research at the Child Development Laboratory has enabled early recognition of anxiety disorders. He has found that the predispositions for some disorders can be identified as early as the age of two.

Fox uses state of the art electroencephalogram (EEG) and neuro-imaging techniques to monitor brain circuitry with great specificity. By determining the neural pathways associated with unease, Fox can locate anxiety in children too young to vocalize their feeling.

Dr. Fox's Temperament Over Time Study integrates insights from investigations into temperament, cognitive development, and parent socialization to formulate very early interventions for anxiety. His work is funded by the National Institute of Child Health and Human Development, a MERIT award, and a MacArthur Foundation grant.

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Preventing Abnormal Memory Development

Tracy DeBoer investigates the irregular growth of memory among children with neuro-developmental disorders.

Using MRI, EEG, and Event-Related Potential (ERP) scans, Dr. DeBoer tests the connection between brain activity and behavior at the neuro-chemical level. For example, we know that fluctuating glucose levels in pregnant mothers with diabetes can affect the cognitive development of a fetus. However, the specific neuro-cellular activity is not well understood. By experimenting at this neural level, Dr. DeBoer can discover tailored, early interventions for problems related to memory development.

DeBoer's research has also advanced studies of children with a specific chromosome abnormality that causes an array of problems, including heart defects, speech delays, cleft palates, and immune system deficiencies.

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Fostering Motor Skills in Infants and Adults

Jane Clark charts human motor skill growth by pinpointing its connections to perception. This precision mapping derives from insights into the specific interactions among the body's many dynamic systems. Clark has shown how the brain can reduce its workload by maximizing the body's physical capabilities – one way of putting it is that we now understand exactly why we can walk and chew gum at the same time.

By determining how the brain processes information to produce locomotion, Dr. Clark examines the causes of such problems as Developmental Coordination Disorder (DCD). In one set of experiments, she uses a highly sensitive bar that measures applied force to determine how infants react to changing sensory input. In addition to developing therapeutics for DCD, Clark's work on inter-sensory coordination could improve an array of motor skill improvement techniques for areas such as athletic training.

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"Triangulating" to Identify Specific Linguistic Constraints

Jeffrey Lidz applies a novel cross-cultural analysis to understand how the mind sometimes thwarts language acquisition. By looking at both the structure of different languages and the structure of learning, Lidz engages in a linguistic triangulation that helps determine the exact points at which these constraints occur.

Working with children from 9 months to six years old, Lidz determines common patterns of speech among different languages and also examines common patterns of interpretation among children. With advanced video equipment that captures the tiniest increments of eye movement, Dr. Lidz measures levels of recognition to gauge how children understand sound patterns (phonology), piece together the elements of words (morphology), determine word meaning (semantics), and combine words into sentences (syntax). Finding shared patterns isolates the critical elements of language difficulties.

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