MAGNIFYING TIME

CHEN YU'S HOMELAB CREATES A POWERFUL NEW LENS THROUGH WHICH TO STUDY CHILD DEVELOPMENT

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CHILDREN'S WORD-LEARNING UNFOLDS IN TIME, IN SEQUENCES OF PERCEPTIONS, ACTIONS AND INTERACTIONS THAT CAN TAKE MILLISECONDS, MINUTES OR MONTHS. NOW A NEWLY CONSTRUCTED LAB, CONCEIVED BY PBS DEVELOPMENTAL PSYCHOLOGIST CHEN YU, AIMS TO CAPTURE THE MOST MICROSCOPIC UNITS OF THIS EARLY LANGUAGE LEARNING. IN ITS UNIQUE DESIGN AND SHEER TECHNICAL APTITUDE, YU'S LAB IS BLAZING A TRAIL IN THE STUDY OF CHILD DEVELOPMENT, TO GIVE RESEARCHERS A MORE FINELY GRAINED VIEW OF THE EVENTS ON WHICH LANGUAGE LEARNING DEPENDS.

One hundred and thirty years after William Lowe Bryan laid the groundwork for PBS by establishing IU's first psychology lab, Yu is taking the concept of the lab to a new level. And while the comparison may seem quaint, the first tool Bryan purchased – with $100 of university funding – to begin practicing the so-called "new science" at IU was a Hipp chronoscope that could measure human reaction times at the otherwise imperceptible speeds of brain and behavior. This state-of-the-art electromagnetic "time viewer" could measure human reaction time to sounds, for example, at varying volumes on a timescale of tenths, hundredths and thousandths of a second.

Like a 21st century re-make of that dramatic scenario, Yu's newly configured, IU- and NIH-funded lab likewise promises a new lens on the timescales of brain and behavior. In fact, more than one lens, it offers multiple lenses – to which you can add motion sensors, eye-trackers, recording devices, object detection and computer vision technology – all of which transmit the multimodal behavioral data to the computer system that sits in the small "control room" of the lab, a separate room adjacent to the larger staging area for parent and child interactions. This larger, highly monitored staging area includes a simulated kitchen, living room and most prominently, a colorful playroom that sits on a three-foot high platform, beckoning its subjects on board. Raised in order to install motion sensors below the floor, the elevated play area is no doubt also a big draw to toddlers.

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The child researcher's dilemma

"If we want to make a difference in the world," Yu observes, "the behavior and mechanisms we elicit in the lab need to be generalizable to those which occur in the world."

Like many psychologists in his field, Yu has sought increasingly better approximations of real-time, real-world - or naturalistic - behavior. For him, the focus is to better understand the two-way interaction between young children and parents, and the role these interactions play in language learning. He has made use of several settings in which to observe such interactions, having parent and child sit across from each other at a table in the lab with eye-trackers and head cameras, for example, and having parent and child outfitted with head cameras and eye-trackers in their own homes to record mealtimes and other daily events in which they interact most intensively.

While each approach has its advantages, they also present certain drawbacks. Lab settings in which parents and children interact with each other and with objects across a table limit the participants' movement and thus provide a narrow view of the more fluid learning opportunities afforded in more typical, real-world situations. They also give children a more structured situation in which to learn

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the names of objects than they would otherwise have in the home environment, where circumstances change or transpire more quickly and serendipitously. As Yu explains, "Children's learning in the lab with plenty of time and focus is one thing. But the questions remain, 'Can they do it, or how do they do it in the real-time context, where everything happens so fast?'"

In search of a naturalistic, real-world setting, Yu and his collaborators took their experiments into the home, where parents and children (not to mention siblings, aunts, grandfathers, pets) interact, placing head cameras on both parents and children at certain times of the day. Yet, this situation posed its own challenges. No two homes are alike. Some are more crowded than others, some sparser or cleaner. Across the lack of uniformity, Yu observes, it is hard to generalize about children's learning.

"That made me think," he explains, "that we can create a lab environment more like a home, which can be both naturalistic and controllable, and in which what we find can potentially be generalized to the real world."

Chen Yu

"IN CHILDREN AT HIGH-RISK FOR AUTISM, YOU FIND LITTLE ODDITIES AT THE PRECISION SCALE, THE FRACTION-OF-A-SECOND SCALE OF COORDINATED BEHAVIOR."

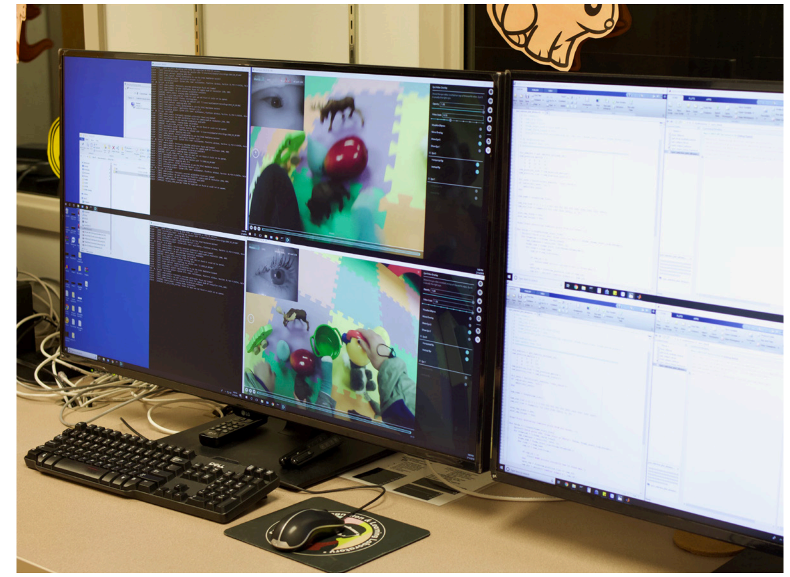
There's no place like HOMElab

Between the two extremes of lab and home comes HOMElab. The Homelike Observational Multisensory Environment Laboratory creates an intermediate ground for finding the kind of generalizable data useful for solving real-world problems by simulating the living spaces in which everyday parent-child interactions take place. Unlike previous lab setups, HOMElab provides for a range of contexts in which children and parents can play and interact, allowing researchers to zoom in on a greater scope of movement, collecting vast quantities of high-density data as they do so. Unlike actual home settings, HOMElab is equipped floor to ceiling with a vast array of sensing technology, collecting data for computational analysis.

No doubt the situation, like its many predecessors, will have its own challenges. So complex are the sensing and computational techniques involved, for instance, that he and others are still, Yu says, "figuring it out." Yet, he has a number of extraordinary collaborators with whom to work out the technological and other issues. Among these collaborators are computer scientist David Crandall in the IU School of Informatics, Computer Science and Engineering, as well as fellow psychological and brain sciences researchers Linda Smith and Dan Kennedy.

All are optimistic about the uses of this new lab, which makes possible major breakthroughs in understanding typical and atypical development, and for creating interventions for disorders like autism. As Smith explains, for example, when a child interacts socially well with parents, "child and parent move together synchronously, like dancers. But in children at high-risk for autism, you find little oddities at the precision scale, the fraction-of-a-second scale of coordinated behavior. If you measure the eye gaze, head movements, hand movements, body and postures at this scale, you can detect minute disruptions that can affect learning and the quality of interaction that contributes to it."

The promise of HOMElab is that one day such minute disturbances can be detected and addressed – that as researchers break down the choreography of language learning into smaller and smaller units, they can also piece them together.



Chen Yu (left) with lab manager Daniel Pearcy

How HOMElab Works

By simulating a home environment within the lab, HOMElab provides a range of contexts in which children and parents can play, interact and move more freely than in most lab situations, while researchers collect vast quantities of high-density data. Unlike actual home settings, HOMElab is equipped floor to ceiling with a vast array of sensing technology, collecting data for computational analysis.