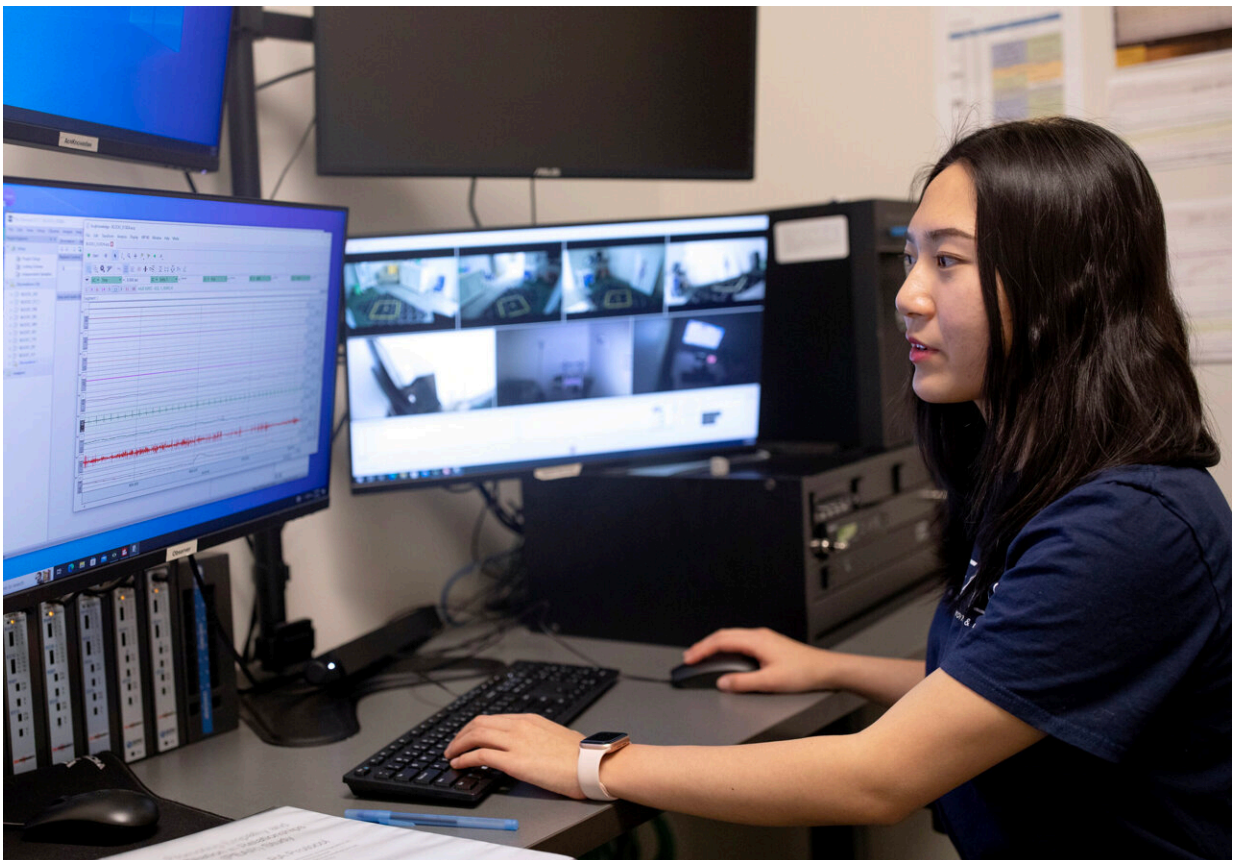


Psychiatric research uses linguistics models to analyze game play and listen in on ways environment shapes interaction

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Sydney Sun. Credit: University of Pennsylvania

When Sydney Sun decided to transcribe 100 hours of audio recordings,

she had no idea what would come of the effort. The recordings had been made by parents as they played games with their child, part of a research study being conducted by the Emotion, Development, Environment, and Neurogenetics (EDEN) lab run by Rebecca Waller, an assistant professor of psychology and Sun's supervisor. Sun wanted to know whether the games affected the language the children used, and whether this effect might vary in children with behavioral problems.

There was little prior research to suggest that Sun's analysis would yield significant results. But she pressed on, spending months painstakingly typing out each word. And her work paid off: By counting and classifying the words, Sun discovered that a family's environmental context can shape the ways in which parents and children interact—results she's since presented at an international conference and [published](#) in the journal *Scientific Reports*.

"I would never have been able to predict what would happen when she walked in my door," says Waller.

A mind for research

Sun's love of research began in childhood. Her parents had moved to the United States from China when her mother, a pediatric oncology researcher, took a job at the University of Kentucky. The halls of the lab fill her early memories. Her mother's colleagues set up toy experiments and taught her to make bubbles from dry ice and soap. She often traveled with her mother to scientific conferences.

At home, she watched with curiosity as her two siblings—three and 12 years her junior—turned from babies to children, developing personalities and learning to communicate. "I've always had such an interest in learning about how their brains developed and how they came to interact with the world around them," Sun says.

As a high schooler, she joined a math and science program that required 360 hours of research work. She again found herself in the University of Kentucky halls, this time the lab of Ai-Ling Lin, a neuroimaging researcher who studies Alzheimer's disease. Sun took care of research mice and helped with data analysis and visualization for a project investigating how the gut microbiome influences the disease, which her grandfather has. Before she finished [high school](#), she was listed as an author on [a publication](#) in the journal *PLOS ONE*, a milestone most don't reach until graduate school.

"It was a time of teamwork and collaboration that really showed me what it means to be a researcher," Sun says. "That's what research is: collaborating with others to pursue these universal questions."

When Sun began college in 2020—as a virtual student in the midst of a global pandemic—she worried that research in her desired area of child development would be impossible to conduct. But as a participant in the University Scholars program, which enables an undergraduate to do independent research, she discovered Waller and her EDEN lab.

Waller and her team normally bring [young children](#) and their families into their lab to participate in studies, but when the pandemic struck, they had to get creative in finding ways to continue working with their families, many of whom have children with behavioral difficulties. They decided to mail board games to participants' homes and measure whether playing the games together improved the children's behaviors.

Forty families received a [game](#) focused on [social skills](#), and another 40 received a math-based game. An instruction sheet asked parents to play the games with their child four times over six to eight weeks and record audio of the sessions. At a time when all parts of this work were happening remotely and asynchronously, Waller envisioned using the audio to simply confirm participation. Then Sun chimed in with an idea.

Family talk

Through the board game experiment, Waller wanted to measure how children changed before and after playing. Sun spotted another opportunity: to measure how the games served as distinct moments that could alter how parents and children communicate. They reminded her of how different situations influenced the ways her parents interacted with her siblings.

"It was fascinating to see these games as ways that we can manipulate the context in which parents and children were interacting," Sun says.

She asked Waller if she could use the audio recordings for her own analysis. Waller said yes—she says she generally gives a thumbs up to anyone with a decent idea—but had little bandwidth to supervise Sun: She was experiencing a complex pregnancy and on bed rest in a hospital. That was no deterrent to Sun, who recruited two of her fellow lab assistants to help. Together, they transcribed around 100 hours of audio recordings. Sun also took a class at Penn on the coding language R so she could analyze the transcripts.

With the help of a postdoc in the EDEN lab, Sun used a text analysis program to count the number of words used by parents and children in each of four categories: emotion words such as "happy" or "sad;" social behavior words such as "said" or "love;" cognitive process words such as "think" or "know;" and words related to numbers.

At times, Sun worried that all her hours transcribing and coding would not lead to any useful discoveries. Little research had been done using linguistic models to study the relationship between social-emotional language and behavioral problems, especially in naturalistic settings like the at-home [board games](#).

But by analyzing the data, Sun found that parents and children used more social-emotional words when playing the social board game than the math one—to a statistically significant degree—suggesting the games worked as intended. What's more, children tended to match the frequency with which their parents used social-emotional language, but only when playing the social game. Children with behavioral problems also tended to use fewer social-emotional words in the context of the social game, but not in the math game.

"It was really surprising and astounding to see how the social context radically changes the way parents and children interact with language," Sun says. "If we want to develop treatment plans or find ways to elicit dialogue between parents and children, it's important that we figure out the best context in which children will be most responsive."

Medical-school bound

By the beginning of her junior year, Sun had her results in hand, which she submitted to the Society for Affective Science conference, an international meeting taking place in Long Beach, California. Not only was she accepted, but she was selected to give a short lecture—and won an honorable mention for "Best Flash Talk."

Shortly after the meeting, the team submitted a manuscript of the results to *Scientific Reports*. The journal published the paper in January 2024, with Sun as first author. With that, Sun completed nearly the entire the arc of the research process, from idea to publication, over the course of four undergraduate years.

"Many Penn undergraduates are exceptional, but she just really goes above and beyond even that," Waller says. "The opportunities she's created for herself and the ideas she's bringing are quite rare."

And Sun still isn't finished. Even as she approaches graduation, she is working on a study that examines how 3-, 4- and 5-year-old children parse the emotions associated with music. Most 3-year-olds cannot match the tone of a music clip with the emotion on a face, the study is revealing, but most 4- and 5-year-olds can. Sun will be the first author on that paper when it is published.

Her work has inspired Waller to conduct more studies on the associations between language and children's [behavioral problems](#), opening new directions of research for the EDEN Lab. "What she's doing is really foundational to an emerging field," Waller says.

Ultimately, Sun says she hopes to pursue a career in pediatrics as a clinical researcher, following in her mother's footsteps. Next fall, she's planning a move to Baltimore to attend Johns Hopkins Medical School. She's not certain how her career will pan out, but whatever direction she takes, she says she'll keep taking risks in the name of scientific pursuit.

More information: Sydney Sun et al, Childhood conduct problems and parent–child talk during social and nonsocial play contexts: a naturalistic home-based experiment, *Scientific Reports* (2024). [DOI: 10.1038/s41598-024-51656-w](https://doi.org/10.1038/s41598-024-51656-w)

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