

DEEP DIVE

The social network: How everyday interactions shape autism

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Illustration by Julia Yellow

One afternoon in October 2012, a communication therapist from Manchester, U.K., visited the home of Laura and her three children. Laura sat down at a small white table in a dimly lit room to feed her 10-month-old daughter, Bethany, while the therapist set up a video camera to record the pair's every movement. (Names of research participants have been changed to protect privacy.)

Bethany sat quietly in her high chair, nibbling on macaroni and cheese. She picked up a slimy noodle with her tiny fingers, looked up at Laura and thrust out her hand. “Oh, Mommy’s going to have some, yum,” Laura said. “Clever girl!”

Bethany beamed a toothy grin at her mother and let out a brief squeal of laughter, and then turned her head to peer out the window as a bus rumbled by. “Oh, you can hear the bus,” Laura said. “Can you say ‘bus?’”

“Bah!” Bethany exclaimed.

“Yeah, bus!” Laura said.

This ordinary domestic moment, immortalized in the video, is part of the first rigorous test of a longstanding idea: that the everyday interactions between caregiver and child can shape the course of autism¹.

The dynamic exchanges with a caregiver are a crucial part of any child’s development. As Bethany and her mother chatter away, responding to each other’s glances and comments, for example, the little girl is learning how to combine gestures and words to communicate her thoughts.

In a child with autism, however, this ‘social feedback loop’ might go awry.



Revealing recreation: An infant who doesn't attend to her parents as they play together gives the parents few opportunities to engage.

Birkbeck College, University of London

An infant who **avoids making eye contact**, pays **little attention to faces** and doesn't respond to his or her name gives parents few opportunities to engage. The resulting lack of social interaction may reinforce the baby's withdrawal, funneling into a negative feedback loop that intensifies mild symptoms into a full-blown disorder.

"It's not the whole explanation, but it might contribute a bit to the unfolding trajectory," says **Jonathan Green**, professor of child and adolescent psychiatry at the University of Manchester in the U.K.

It's not yet clear whether Bethany has autism, but her older brother was diagnosed with the disorder in 2012. That makes her **20 times more likely** than an average child to be diagnosed with it herself. The risk is still small: Only about one in every five so-called '**baby sibs**' are diagnosed with autism by age 3 or 4. Still, even baby sibs who are not diagnosed often **show autism-like signs** at an early age.

Green's team is tracking Bethany and 53 other baby sibs from infancy to document how autism unfolds — including what happens during those crucial months and years before a diagnosis is made.

"One of the misconceptions people have about autism is that autism is just in the child," says **Gordon Ramsay**, director of the Spoken Communication Laboratory at the Marcus Autism Center in Atlanta. Ramsay is not involved in Green's study, but is studying how parent-child interactions influence vocal development. "Autism disrupts the relationship between the child and the caregiver, and that plays out in many ways."

If the idea that faulty parent-child interactions contribute to autism proves to be correct, it might point to a new way of preventing or treating the disorder — by teaching parents how to adapt and respond to their child's peculiar way of interacting with the world.

Controversial claim

The notion that a parent's behavior may exacerbate autism at first seems like a replay of the infamous '**refrigerator mother theory**.' This shameful episode in the history of psychiatry suggested that cold and uncaring mothers cause autism, and was soundly refuted in the 1980s, but the three decades of its existence cast a long shadow on the field of autism research.



Sound shift: A noninvasive technique called electroencephalography measures brain responses to speech sounds.

Birkbeck College, University of London

One unfortunate side effect of the theory has been that scientists — and the general public — are wary of any hypothesis that implicates parents in their children's trajectory.

In the past few decades, research into autism's origins has focused mostly on genetics. "The traditional view is that it's very much a biological disorder, and it just unfolds in its own time and there's nothing that the environment can do," Green says.

But Green wasn't satisfied that this view fully accounts for the way autism emerges. It was already clear from research with typically developing children that early interactions are essential for social-skill development and language acquisition — faculties often affected in children with autism.

In fact, in the mid-1970s, child psychologist Arnold Sameroff proposed the **'transactional' model of child development**. This model posits simply that the relationship between infant and caregiver is shaped by reciprocal feedback. An infant's sounds and gestures elicit responses from a parent, and those reactions, along with the environment, in turn shape the child's future behaviors.

Green suspected that these cycles sometimes falter or even come to a halt in autism. To find out, he examined a group of 6- to 10-month-old infants who had a family history of the disorder, hypothesizing that the high-risk babies might interact with their caregivers differently than babies in the general population do.

He found that as the baby sibs played and interacted with their parents, they tended to be less lively than low-risk babies². The parents of the baby sibs were, in turn, less responsive to their infants' subtle bids for attention and more intrusive in their attempts to engage — for example, touching their babies more frequently to try to elicit responses.

Other differences between the two groups emerged by the time the children were between 12 and 15 months old³. Children with a family history of autism tended to not show interest in their parents and they smiled and laughed less than low-risk toddlers. The children who were later diagnosed with autism at age 3 were among the least attentive. In this preliminary study, only the infants' behaviors, not parental reactions, tracked with later diagnosis.

Cracking circuits

Around the same time, other teams were making similar discoveries. **Jana Iverson**'s group at the University of Pittsburgh explored how mothers respond verbally to their baby-sib toddlers' social gestures, such as pointing at or sharing a toy. The mothers' behaviors were no different from those of mothers in the general population⁴. However, the team found that these children tended to make fewer gestures overall than children in the general population, giving their mothers fewer opportunities to respond.

"Basically, parents have to work with what the child brings to the table," says Iverson, professor of

psychology at the university.



Attention analysis: Eye-tracking tasks assess how long a child takes to shift his gaze from picture to picture.

Birkbeck College, University of London

In this way, a behavioral peculiarity that begins with the children ends up depriving them of guidance from their mothers. “They’re not getting the kind of rich linguistic input that would be really beneficial for them,” Iverson says.

Her observation was borne out by a much larger study last year that recorded an entire day’s worth of **verbal sounds** made by 183 children — 77 of whom have autism — and their adult caregivers⁵. The children ranged from 8 months to 4 years of age. Here, too, children with autism made fewer sounds overall than did children without the disorder.

In this study, the caregivers’ patterns of responses to their children in each group also differed. Caregivers of children without autism responded more frequently to speech-related sounds, such as speaking or babbling, than to sounds unrelated to speech, such as grunting or laughing. By contrast, the caregivers of children with autism responded whether the child’s sounds were speech-related or not.

It may be that the parents of children with autism mistook non-speech sounds for speech, or just that children with autism make unusual sounds, says study leader **Anne Warlaumont**, assistant professor of cognitive and information sciences at the University of California, Merced.

In either case, the findings suggest that autism disrupts the feedback loop that supports speech development. Because they produce fewer sounds, children with autism go through fewer iterations of this loop.

Taken together, the three studies established that there is indeed something amiss in the exchanges between parents and children at risk of autism. But whether this can contribute to autism severity is a much bigger — and more controversial — question. “It’s kind of a hard thing to prove,” says **Robert Schultz**, director of the Center for Autism Research at the Children’s Hospital of Philadelphia.

The proof would require researchers to alter the behavior of the parents and document its effects on the child, or vice versa. “To assess causality, you need an experiment,” says **Daniel Messinger**, professor of psychology at the University of Miami in Florida.

Social networks



In the loop: Jonathan Green says cycles of social feedback falter when interacting with a child who

has autism.
J. Green

Green's study is that experiment.

By changing the dynamic between parents and children at high risk of autism, Green says, his team is trying to change the trajectory of the children's development.

When Bethany was between 9 and 14 months old, a therapist visited Laura's home once every two weeks and recorded them engaging in ordinary activities such as mealtime or play. The therapist then analyzed each video, picking out segments to replay for Laura during the next visit.

The goal was to help Laura better recognize and interpret Bethany's attempts to communicate, whether through gestures, glances, grunts or other sounds. The therapist pointed out moments when Laura did particularly well at noticing and responding to her daughter's cues.

For instance, when Bethany turned to look at the bus, she was communicating the focus of her attention; by translating this gesture into words, Laura gave her daughter an opportunity to expand her vocabulary.

The therapist also helped Laura spot small signs she had missed — for example, that Bethany had lost interest in a particular toy or game, or that she had not yet finished playing with something Laura was bored with. "Parents don't always notice these subtle things," Laura says.

Laura also learned strategies she could use to respond to Bethany's bids for attention, practicing them for at least 30 minutes a day to help Laura's behaviors become habit. "It was loads of fun," Laura says. "None of this study has been hard work."

The intervention starts in infancy in the hopes of changing the feedback loops before they become fixed, says **Teodora Gliga**, a neuroscientist at Birkbeck College, University of London, who helps to assess the infants' behaviors. "Once they become the usual way in which the parent and child interact, it becomes more difficult to modify them."

Half of the families in the study are getting this intensive hands-on coaching, and the other half make up a control group. To make sure that they're seeing an effect of change in the parent's behavior, the researchers are careful to interact only with the parents.

In Green's study, "Any effect on the baby comes through a change in the parental behavior," he says. "There's no other route through which the baby could be affected."

The study is still underway, but early results, reported 21 January in *Lancet Psychiatry*, indicate that the intervention makes a difference for both parents and children. Parents who received the training became less controlling in their interactions, instead waiting for their child to make the first move. What's more, the children in those families became more attentive to and engaged with their parents. They also showed fewer autism-like behaviors when they were 14 months old, compared with children whose parents did not receive training.

It is not yet possible to determine whether the intervention in Green's study prevents autism or lessens its symptoms because most of the children are still too young to be accurately diagnosed. Bethany turned 3 in January, and her mother says she showed no signs of autism at her last checkup at Green's lab in February. "She's incredibly bright," Laura says. "She's the most sociable, most interactive child."

At the very least, the study's results suggest that therapists can teach parents strategies to boost the social attention of a child who is biologically predisposed to autism.

"That is pretty exciting," says **Aubyn Stahmer**, associate professor of psychiatry at the University of California, San Diego, who was not involved in the study. "What that means for them long-term, I don't think we know yet, but certainly it suggests that very early intervention with kids who might be at risk is a good idea."

An added benefit is that the treatment is easy for parents to do and doesn't require a diagnosis. "The more that we work towards some type of intervention that's non-stigmatizing, that becomes more normalized, then parents will be able to do it in the privacy of their own homes and maybe make a difference for their babies," says **Connie Kasari**, professor of human development and psychology at the University of California, Los Angeles. Kasari was not involved in the study, but has led **interventions in preschoolers with autism**.

The study's final evaluations will take place later this year. But already, Green sees these preliminary findings as support of his theory that parent-child interactions play a role in autism's trajectory.

"I don't want to say that one can 'cure' autism like this, that's not true," Green says. "But I hope we'll be able to make a difference."

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