

FROM HEAVENLY BODIES TO HUMAN BRAINS

44 What holds matter together? What binds the universe? What is the nature of human thought? Charlotte Grosse Wiesmann of the Max Planck Institute for Human Cognitive and Brain Sciences has always been interested in the big questions. Grosse Wiesmann, who originally studied physics, now investigates which developments in the brain enable children to empathize with others.

TEXT: CATARINA PIETSCHMANN

It's one of those blisteringly hot July days in Berlin's Prenzlauer Berg district, when all you want is to find some shade. Through the open windows of the old apartment building tinkle the sounds of chimes. They come from the nearby heritage brewery. A carafe of water containing lemon slices and mint is on the table. Charlotte Grosse Wiesmann pours two glasses of water and sits back in her chair. Her workplace is, in fact, the Max Planck Institute for Human Cognitive and Brain Sciences in Leipzig, a little more than an hour away from Berlin on the intercity train. She would normally spend the travel time constructively by reading or writing scientific papers. But because of COVID-19, Grosse Wiesmann, a neuropsychologist, is currently working from home. And it's been that way, with brief interruptions, since March 2020. The hygiene regulations at the Insti-

tute are very strict, particularly for researchers like her who work with young children. Much to their frustration, her staff members had to suspend their research projects for an extended period of time. The 35-year-old's team, which includes a philosopher, a biomedical scientist, two psychologists, and a mathematician, have only recently been able to get going again. Naturally, masks and, for the kids, negative lollipop tests are mandatory.

Charlotte Grosse Wiesmann heads the Minerva Fast Track Research Group "Milestones of Early Cognitive Development" at the Institute. The group investigates why and at what age young children are able to empathize with others – at what point do they understand that other people have a conception of the world that may differ from their own? This mental ability – referred to by scientists as having a "theory of mind" – is essential for living among other people. Anyone who has a deficit in this area, for instance people with autism or schizophrenia, will experience problems in their interpersonal relationships. A theory of mind is something unique to humans. Other animals, even primates, are thought to be capable of it to only a limited extent. Perhaps this shouldn't surprise us, since the ability to empathize with others appears to be related to another typically human skill: expressing oneself through language.

"When we construe what someone else might be thinking, we say things like, 'He thinks that ...'. I wanted to discover whether children learn to empathize with others at the same age when they also learn to

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VISIT TO

CHARLOTTE
GROSSE WIESMANN



PHOTO: DAVID AUSSERHOFER FOR MPG

Values deep insight: Charlotte Grosse Wiesmann investigates milestones in the development of children's brains, testing the behavior of children and recording their brain activity.

employ such sentence constructions,” says Grosse Wiesmann. To get the children’s attention for her behavioral tests, she stages playful scenes. One such scene, for example, involves a toy mouse who puts a jelly bear in a bag and then takes a nap. “While the mouse is napping, the child and the researcher take out the jelly bear and put it in a box. Then we ask the child where the mouse should look for it when it wakes up,” says Grosse Wiesmann. Two to three-year-olds invariably point to the box, while four-year-olds say, in the bag. “In other words, they understand that the mouse thinks the jelly bear is still where it hid it.” Younger children can’t yet accomplish this change of perspective.

What is different in older children? Has something changed in their brain? To discover this, the researchers record, among other things, the activity within the brains of their test subjects while they watch cartoons. This is done using electroence-

the sassy squirrel Scrat from *Ice Age* are having their adventures, the researchers view the monitor on which the child’s brain structures appear slice by slice. “Starting at about four years of age, we find a stronger connection across a bow-shaped nerve fiber bundle – the “fasciculus arcuatus” – which, starting at this point in development, connects two important areas of the brain. One of these is located in the posterior temporal lobe and assists us in thinking about other people. The other lies within the frontal lobe of the cerebral cortex and is presumably responsible for distinguishing between different perspectival levels, and thus differentiating one’s own viewpoint from another’s.” Only when this “information superhighway” is in place are children able to consider someone else’s perspective. The connection develops at about the same time as the ability to articulate conjectures about what others are thinking. “Interestingly, the new neural connection supports

Charlotte Grosse Wiesmann performed research in particle physics before she found her way to her current subject, the brain

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phalography (EEG), a technique that measures the electrical activity of the brain by means of voltage fluctuations on the scalp. “The younger children will mostly sit on their mother’s lap during this process, and we briefly distract them to put EEG electrode caps on them,” explains Grosse Wiesmann. In addition, we frequently use magnetic resonance imaging (MRI), which visualizes to within a millimeter the structures of the maturing young brain. How, though, does she get children to lie in the narrow space in the scanner? “They don’t yet experience claustrophobia. In the case of the one-and-a-half-year-olds, we usually time the scan to coincide with their midday nap. Hence, the parents arrive around the same time as the normal midday nap and go through the standard sleep routines – reading to the child or singing – and when the child is asleep, they lay him or her on the MRI table.” We tell the five-year-olds that the MRI is a spaceship in which they can watch a movie. “Once they put on the headphones and video goggles, they quickly forget about their surroundings,” she says. While Mickey Mouse or

this ability irrespective of how well other mental abilities – intelligence, language comprehension, or impulse control – have yet developed,” Grosse Wiesmann emphasizes. She suspects that having a well developed fasciculus arcuatus explains why some people are particularly good at empathizing with others. “Great apes aren’t that good at it, and, conversely, this may simply be the result of a weaker connection.”

The human brain is a small universe unto itself. Charlotte Grosse Wiesmann only discovered her path to it after conducting research in a completely different world – that of quantum physics. Her father, himself a physicist, isn’t entirely blameless regarding the early awakening of her interest in physics. He brought back a telescope from a trip to the U.S., through which they looked at the stars in the evenings. This was followed by physics projects at school and participation in the German youth science competition “Jugend forscht.” For this, she meticulously recorded the orbits of Jupiter’s moons over time and then, using this data, verified

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PHOTO: MPI FOR HUMAN COGNITIVE AND BRAIN SCIENCES



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Hand puppets as lab equipment: Charlotte Grosse Wiesmann employs playful methods to investigate the relationship between the ability to empathize with others and language development.

Crucial connection: from around the age of four, the fasciculus arcuatus (green) links two areas of the brain: a region in the posterior temporal lobe (brown), which helps us as adults to think about the thoughts of others, and an area in the anterior cerebrum (red), which is thought to help us distinguish between our own and other people's perspectives.

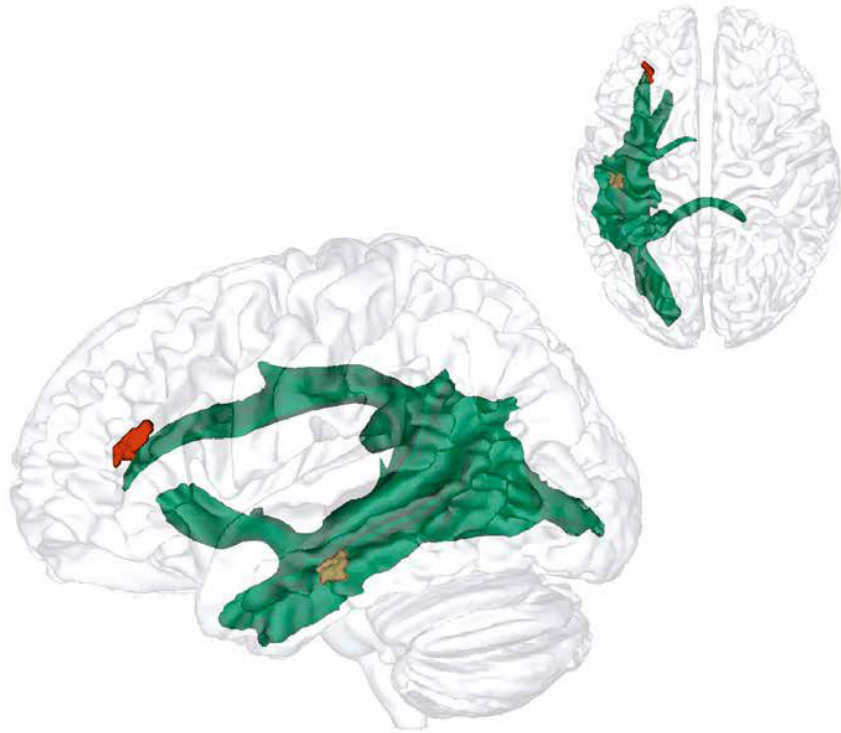


IMAGE: MPI FOR HUMAN COGNITIVE AND BRAIN SCIENCES

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Kepler's laws describing the orbits of smaller bodies around a central body. It was the fundamental questions of theoretical physics – gravitation and elementary particle physics – that interested her, and she enrolled at the University of Hamburg to study physics – as well as philosophy. “At school, I had always been torn between the humanities and conceptual scientific questions. And I thought I had found a way to combine studying both subjects,” she says. When she transferred to the Humboldt University in Berlin to complete her primary studies, she realized it would be impossible to pursue two degrees at the same time. The physics classes were held in Adlershof on the outskirts of the city, while the philosophy seminars were held almost simultaneously in Berlin-Mitte.

It couldn't be helped; she would have to concentrate on one course of study. She chose theoretical physics, in particular, the question of how the theory of gravity can be reconciled with particle physics. The German Academic Scholarship Foundation enabled her to spend a year abroad in Paris, at the renowned Ecole Normale Supérieure. But conceptual work – working out the big picture – wasn't how Grosse Wiesmann had imagined it would be. Frustrated, she abandoned her doctorate in mathematical physics after half a year. “All I seemed to be do-

ing was calculating integrals. It was all very technical, and it seemed like getting my head round all the theories of fundamental physics would take forever, before I could even begin to work creatively myself.”

But there were so many other exciting questions to explore. How do humans behave and function? How do they think? The philosophy of mind. Brain research! After a brief time out, she looked around for research groups working in these fields and came across neuropsychologist Angela Friederici, Director at the Max Planck Institute in Leipzig. “I contacted her and asked her: how does language affect thought? That's how we started talking, and pretty soon we'd found a project for my doctorate.”

At academic conferences, she repeatedly bumped into Victoria Southgate from the Center of Early Childhood Cognition at the University of Copenhagen. “Her theory of development seemed related to my own ideas. Going to her for my postdoc seemed like the logical thing to do.” Southgate, a psychologist, offered her a job, but Grosse Wiesmann wanted to conduct her own research project, and she successfully applied for a Marie Curie Fellowship from the EU. To spend the year in Copenhagen, she even postponed starting the Minerva Working Group for which Angela Friederici had already proposed her.

Copenhagen! It's an expensive place to live, where affordable housing is in short supply. Eventually she found accommodation in a shared apartment. She had a whole eight square meters of living space to call her own. But the fascinating research and career opportunities made it all worthwhile. What Grosse Wiesmann couldn't have imagined was that Copenhagen would change her private life as well. She had only been living in the city for a few weeks when she found herself stranded on the way to the airport one day: "We had to get off the train, and everyone was crowding around a Metro employee trying to get information. I couldn't understand a word, because at the time I didn't speak any Danish," she says. That didn't go unnoticed. A Dane on his way to the U.S. stepped in and translated for her. Together they searched the Internet for ways to reach the airport as quickly as possible, because Grosse Wiesmann was running late. The two hit it off and her helper, a historian who specialized in restoring and building furniture, suggested they meet when he got back. "He wanted to show me around Copenhagen – on a tour of the city's best bakeries," she recalls with a smile. Cinnamon pastries and Wienerbrød, a fluffy puff pastry filled with vanilla cream and/or assorted fruit preserves. Mmmmh, simply irresistible! The rest, as they say, is history. They moved in

mendous pressure. Half of their time has already run out, and unfortunately I can't offer them an extension." Staff posts at the Institute, like the Minerva grant, are limited to three years. For her own part, she can apply afterwards for a standard position as a junior research group leader, either within the Max Planck Society or elsewhere. In the long term, Grosse Wiesmann is aiming for a professorship, preferably in the field of brain development in young children. "Of course, it would also be interesting to explore the research on adults in this field. Or the research on great apes. But the core question – how the human brain develops – is one I will stick with," she says.

At the moment, her research is occupying all her time, so her husband will be taking most of the couple's parental leave. Even though her scientific field is completely unrelated to that of Angela Friederici, she appreciates having her support during her "Minerva time." "Having her as a mentor is fantastic; I still need to figure out how so many things function in the world of research." There's only one thing she does miss: having the time to get involved politically and socially, as she did when she was active in the "Netzwerk Europa" alumni program. One of the trips for the program took her to Bos-

What she misses right now is the time to get involved politically and socially, to support refugees or to organize panel discussions

together while still in Copenhagen. That same Dane has now built most of the furniture in her Berlin apartment, and they are expecting their first child together in October – a girl.

That means that in two years' time she will have her own little "test subject" at home – very practical. Will she take advantage of that? "Of course!" she says with a laugh. "It's a great way to try out new behavioral tests." Until that time, her focus will be on advancing her scientific career. However, she is more preoccupied with her staff's research at the moment; due to the COVID-19 pandemic, her four doctoral students have been able to collect almost no data in the last year and a half. "They are under tre-

nia-Herzegovina ten years after the war in Yugoslavia, where she got to see how cultural initiatives are helping to overcome conflicts between the former factions of the civil war. "We handed out disposable cameras to the various ethnic groups, asked them to take photos of their daily lives, and then organized an exhibition." More recently, Charlotte Grosse Wiesmann volunteered to tutor Syrian refugees and organized panel discussions on migration issues. But right now, all she has time for is to play her flute or go for a run. Due to her pregnancy, she has switched from jogging to Nordic walking. Soon, however, even that will no longer be possible, and a great many other aspects of her life will also change.

