# Observing the specific roles of cells that have been lost in the noise of the body

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Abigail Koppes, assistant professor of chemical engineering, is isolating cell groups on tiny plastic chips, enabling her team to observe the specific roles of cells that have gotten lost in the noise of the body. Credit: Ruby Wallau/Northeastern University

You know when you walk onstage and immediately get "butterflies" in

your stomach? That's the cells in your brain and gut talking to each other, says assistant chemical engineering professor Abigail Koppes.

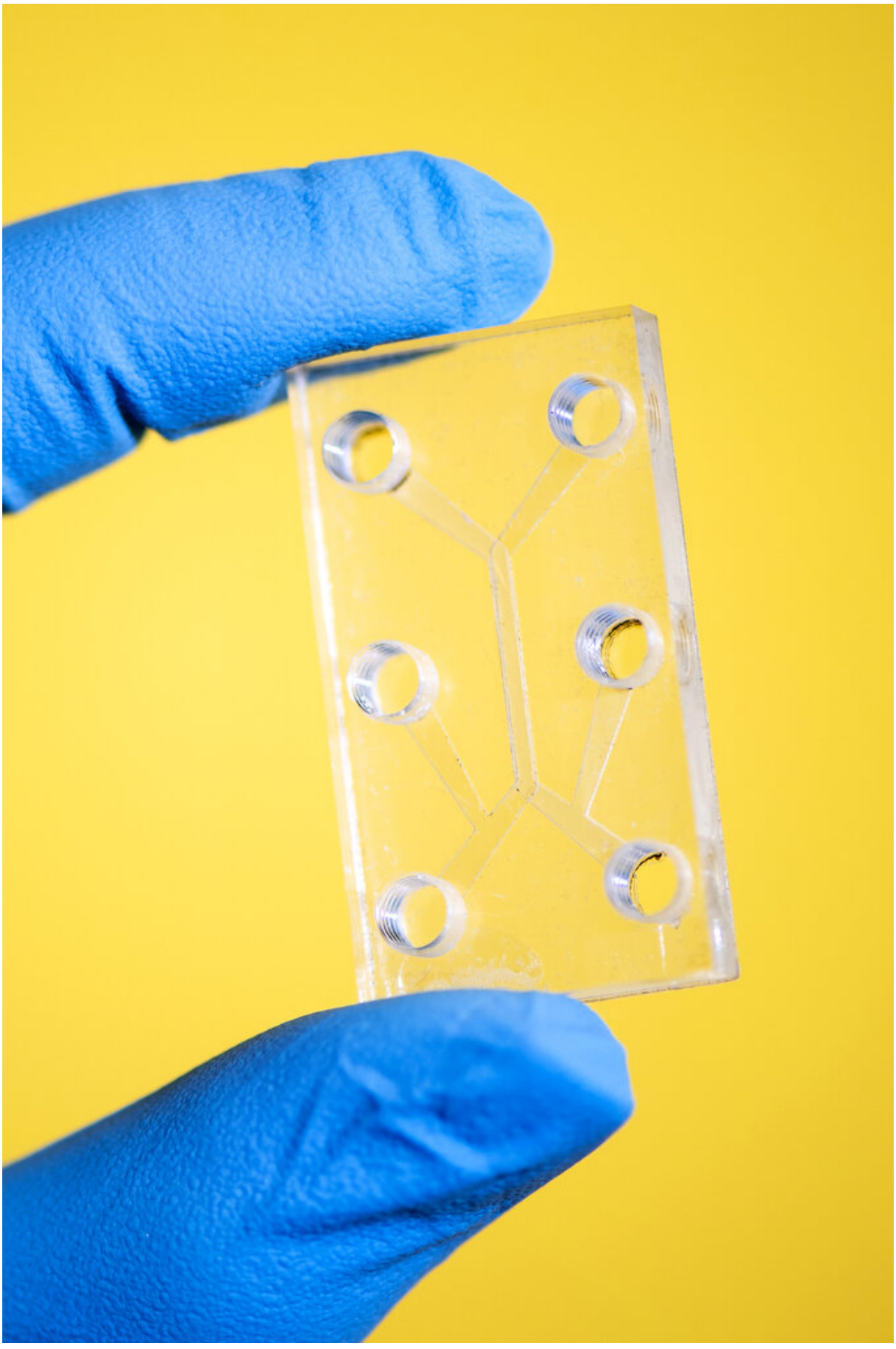
But exactly how these cells communicate is more complex than even scientists like Koppes understand, largely because many lines are blurred in the body. As Koppes says, "you have more neurons that live in your gut than you have in your spinal cord."

To boil down this performance to its characters—whose chemistry can get lost in the whirlwind of the production—Koppes's lab is isolating individual types of cells on handheld chips. Each person's unique diet and microbiome set the stage differently, but Koppes's technology could clarify both what these cells are supposed to do and how they might do it in a different environment—the combined knowledge of playwright and director.

The first step? Perfecting the technology that allows such oversight.

Koppes's team has created plastic slides that, to the naked eye, appear empty. But their surfaces are teeming with pared-down communities of the smooth muscle cells that allow you to digest food or the neurons that send bacterial information from your gut on upward.

Koppes calls these "organs on a chip." At the current stage of the research, these handheld environments serve as representations of their donors' age, sex, and disease status (e.g., irritable bowel syndrome vs. no irritable bowel syndrome), from which the researchers can piece together trends. As Koppes says, "we need to be able to do that, and validate that the technology works, before it would be adopted for personalized medicine."



Credit: Ruby Wallau/Northeastern University

Eventually, she says, tinkering with these scaled-down versions of the body could correct the assumptions we make about medical findings, treatments, and outcomes, even those derived from diverse samples, because the diversity inside people would be better understood. If all goes well, the team—which includes Ph.D students Adam Bindas, Jessica Snyder, and Jon Soucy and fellow assistant chemical engineering professor Ryan Koppes—could complicate our understanding.

But first, they must simplify.

By eliminating the noisy environment, much like peeling apart layers of lasagne, researchers can observe components in their own right, particularly any roles and strengths of theirs that usually blur into their neighbors."

Such separation is necessary because, if the nervous system is anything, it is crowded. As the body's main highway, it transmits a decision made in the brain down to the body parts that need to execute it, and a lot of information flows from these body parts, too, their cells taking readings of and maintaining systems in a way that's more or less automatic.

The gut is a prime example. When your enteroendocrine cells stick their feelers out into your intestine and detect food that needs to be digested, they don't then wait for you to decide to digest—they just do it. Or, more accurately, they communicate this need to the nervous system, which in turn gives them the green light, all without your (conscious) help.

"We don't really actively think about them happening, but these signals are going back and forth all the time from our sort of 'external' body back to our brain," says Koppes.


Credit: Ruby Wallau/Northeastern University

However, Koppes says, scientists have observed that the brain can override this automatic maintenance, and exactly how and when it intervenes is unclear. That's what Koppes is trying to figure out, on top of uncovering the nuances of these interactions from person to person.

"We think that by building these models, you can actually start to screen

things in a more personalized-medicine type of way," she says.

This needn't be a far-off reality; if Koppes's practice environments prove viable, their implementation could improve existing processes.

"If you're sick, you already can go in and get something like a colonoscopy," Koppes says, and from a tiny skin sample taken during that procedure, "we could use those cells to be able to screen whether or not a certain therapy would work for you."

Predicting the outcomes of the human body, the inner workings of which have evolved over hundreds of thousands of years, may sound as moot as predicting how two strangers will interact, considering the infinite possibilities based on mood and beliefs, not to mention the environment where the interaction takes place.

But our cells are not strangers; they're long-acquainted allies, more akin to participants in a debate. And if you familiarize yourself with the individual participants—observing them in their own environments; reading up on their platforms, experience, and interests; and making note of whom they've cozied up to in the past—you have a better chance of understanding their crosstalk as it happens. You may even be able to predict it.

"What we want to be able to do is ask questions about human biology," Koppes says, "but in a really controllable way."

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