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# The gut-brain axis: Intestinal flora and interaction with the brain

This article is based on a presentation given by Niall Hyland, PhD (Ireland) at the Coloplast Ostomy Days 2018. Niall is a Senior Lecturer in Physiology at University College Cork and faculty member of the APC Microbiome Ireland. His research examines the influence of the microbiota across the gut-brain axis. Widely published, Niall's research has had direct clinical implications for the treatment of gastrointestinal disorders.

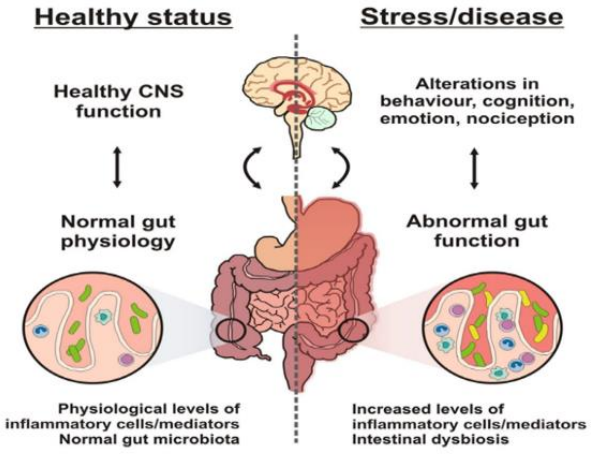
For over three centuries, scientists have explored the connection between the gut and the brain. In this article, we look at some of the latest research into the possible role gut microbiota play in intestinal physiology, and the consequences to the central nervous system when this balance is disrupted.

## The gut-brain connection

"I'm gutted"; "trust your gut"; "I've got butterflies in my stomach"; "it's just a gut-feeling". The English language is littered with phrases that connect our gut with emotions. Perhaps we've known instinctively what researchers are exploring scientifically: that there is a connection between our gut and our brain.

This connection, referred to as the gut-brain-axis, has been known for some time. The earliest research dates back to the 1800s, when physiologist and medical doctor, William Beaumont treated a patient for a gunshot wound to the stomach. The gunshot wound developed a fistula, and the fistula gave Dr Beaumont unique insight into how the gastrointestinal (GI) tract responded to the patient's mental state. He noted that when his patient became anxious, there were observable changes in the GI tract.[1]

Fast-forwarding a few centuries, researchers have now gained further insight into the gut-brain-axis. For example, statistics had already shown that patients with Irritable Bowel Syndrome (IBS) were more prone to anxiety and depression when, in 2006, a study involving IBS patients was able to measure more acute reactions to painful stimuli in this particular patient group. Researchers are also beginning to understand how stress affects our gut microbiome. Studies have shown that stressed or depressed individuals have a very different microbial makeup when compared to healthy subjects.[2]



What is not understood, however, is what changes first. Is someone prone to be depressed and then that impacts the gut? Or do we see changes in the gut first that then cause changes in the central nervous system? Or is it a feedback loop, where one feeds into another? This is what researchers are trying to understand.

### Is a breakdown in the gut barrier the key?

One hypothesis researchers are exploring is the role of the leaky gut. The gut is lined by epithelial cells, which protect the underlying immune system from the contents of the GI tract. If those cells become leaky, or the barrier breaks down, fac-tors that are normally isolated from the immune or central nervous systems will be released into these systems. This disrupted barrier is associated with anxiety, depression, im-paired social function, and cognitive dysfunction. So the idea behind this research is that factors such as stress, infection or antibiotics or poor diet, disrupt the gut microbiome leading to a breakdown in the gut barrier. This then impacts the nervous system and hormone production.

Based on this hypothesis, researchers are conducting several studies to explore ways of strengthening the gut barrier, and then seeing if that can help to alleviate the mental conditions often associated with a disrupted gut barrier.[3]

***"We should really capitalise on the gut. The gut is a real repository of beneficial microbes and factors. We can drive the activity of our microbes by changing our diet."***
***- Niall Hyland***

### Exploring the impact of early-life stress

Another area of research involves using rodent models to understand the impact that early life stress can have on the gut microbiome, and what implications this can have on a person's mental health later on in life. Animals involved in this study exhibited some of the same emotional effects, such as anxiety and depression, as researchers see in IBS patients. Researchers have also examined how short-term exposure to antibiotics during critical life phases can impact future health.[4]

If researchers can identify certain bacteria or microbiome profiles that can have an impact on a subject's emotional state, they can then introduce these bacteria into the gut of people suffering from various mental disorders, such as stress or depression. The idea would be that by altering the gut microbiome, researchers can help people suffering from these mental illnesses.

### Looking to the future

These discoveries have defined two related areas of scientific research: Microbial Endocrinology and Psychobiotics. Both of these areas involve altering the gut microbiome in order to achieve a positive impact on the mind.

Microbial Endocrinology builds on the idea that if there are certain receptors that bacteria can produce that are known to have beneficial effects in the human body, scientists can use the bacteria to produce these receptors and then introduce them into the gut microbiome and achieve the desired positive results. Psychobiotics involves using bacteria in a very targeted manner to treat individuals suffering from psychiatric illnesses.

Research into the gut-brain axis will be hugely significant for patient health in the future. And that's not just a gut-feeling.

**Key terms defined**

- ***Microbiome*:** the microorganisms in a particular environment, including the body or a part of the body
- ***Enteric Nervous System*:** Also known as "the second brain", this is a nearly autonomous part of the nervous system that controls gut functions.
- ***Psychobiotic*:** A live organism that, when ingested in adequate amounts, produces a health benefit in individuals suffering from psychiatric illness.

### Did you know?

There are more neurons in our GI tract than in our spinal cord. We're made up of almost 1.5 kg of bacteria, 40,000 different strains, and we have about 500 times more bacterial genes than human genes in our bodies.

### Find out more?

If you want to learn more about the gut-brain connection and the latest scientific discoveries in this fascinating field, here is a recommended reading list:

- The Psychobiotic Revolution: Mood, Food and the New Science of the Gut-Brain Connection by Scott C. Anderson with John F. Cryan, PhD & Ted Dinan, MD, PhD
- The Gut-Brain Axis: Dietary, Probiotic, and Prebiotic Interventions on the Microbiota by Niall Hyland and Catherine Stanton

## References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