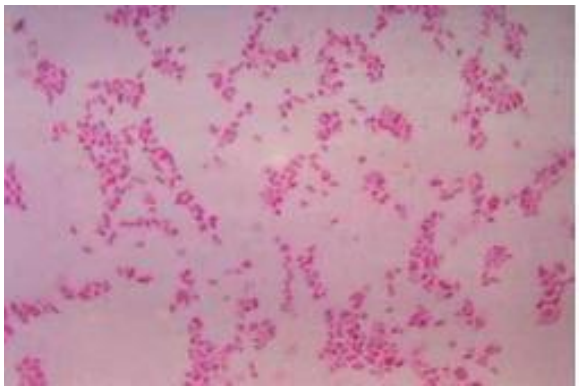
Perceiving Parkinson’s

The Disturbed Gut-Brain Axis In Parkinson’s (Day 17)

The mysterious neuron-killing process in Parkinson's seems to start in either the smell regions of the brain or the enteric nervous system in the gut. These two sites have one major thing in common - both exist in close contact with legions of non-human **microbes**.

The often-neglected **human microbiota** consists of innumerable bacteria, viruses, and other microbes that reside throughout the body in places such as the **nasal cavity** (which connects to the smell regions) and more importantly, the **gut** (which contains the enteric nervous system) of every person on the planet. Since the nasal microbiota is yet to be studied in Parkinson’s, we’ll turn our attention towards the much larger gut microbiota.

The human **gut microbiota** constitutes a massive population of 100 trillion bacteria, viruses, and other microbes that reside within the gut; amazingly, it has been estimated that there may be **ten times** as many non-human cells living in the gut as there are human cells within the entire body, a fact that ought to make us pause and reflect on what it means to be "human." The gut microbiota performs many functions including energy production, immune system regulation, and vitamin synthesis, functions that are of great benefit to the human body.



Most of the cells in the human body are not human at all.

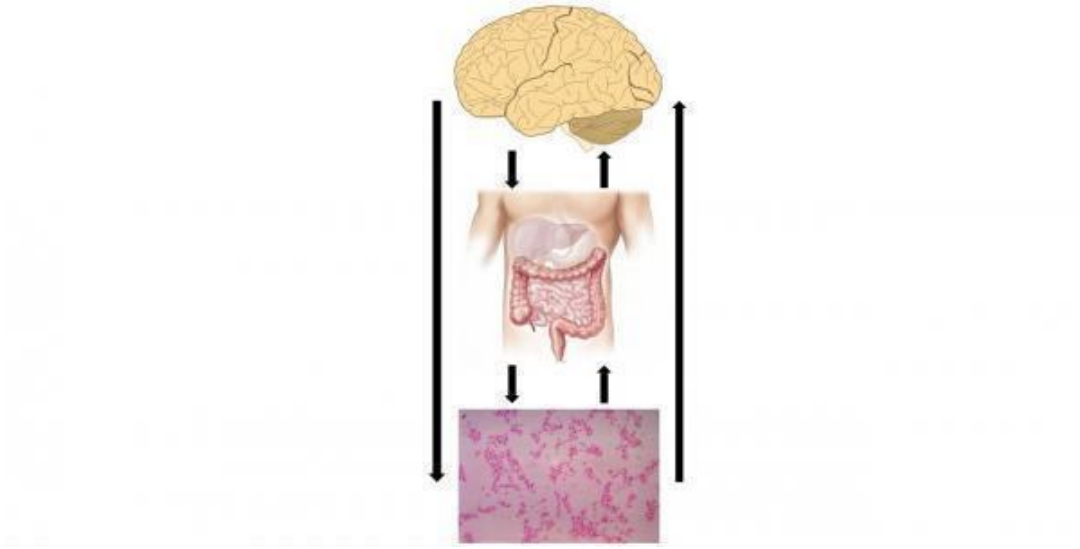
Astoundingly, emerging evidence shows that **the gut microbiota may exert a considerable influence on the brain**. How could a population of gut microbes possibly influence the brain in any way, shape, or form? Actually, there are several ways:

(1) Through the **vagus nerve**, a massive nerve that connects the enteric nervous system with the lower brainstem. The gut microbiota can directly stimulate the neurons of the enteric nervous system; when it does so, the elicited signals ascend the vagus nerve and go straight to the brain.

(2) Through the **immune system**, the cells of which protect the body from invasive bacteria. The gut microbiota acts as a "teacher" to the cells of the immune system, helping them mature so they can distinguish between residential and invasive bacteria. If the gut microbiota is disrupted, this teaching process is also disrupted, leading to an abnormal response by the immune system against the body's own tissues and the dysfunction of those tissues - including the brain.

(3) Through chemical messengers called **neurotransmitters** such as dopamine and serotonin; many gut bacteria synthesize dopamine and serotonin, both of which are used extensively for neuron-to-neuron communication throughout the brain.

Thus, through the vagus nerve, immune system, and various neurotransmitters the gut microbiota exerts a considerable influence not only on the enteric nervous system, but on the brain as well (and vice versa). This complex reciprocal interaction between the gut microbiota and brain is often referred to as **the gut-brain axis**.



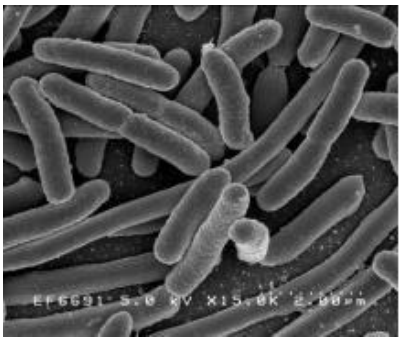
The gut-brain axis, a reciprocal interaction between the gut microbiota and brain.

In 2015, the potential relevance of the gut-brain axis to Parkinson's was put in the spotlight when the Finnish neurologist Filip Scheperjans and colleagues made the remarkable discovery that **the gut microbiota is disturbed** in people with Parkinson's. They assayed the gut microbiota for each of 144 patients, 72 of whom had Parkinson's, and made two major observations.

The first observation was that the abundance of ***Prevotellaceae*** bacteria was reduced by **nearly 80%** in subjects with Parkinson's compared to those without the condition. In humans, *Prevotellaceaea* bacteria produce health-promoting short chain fatty acids and reduce gut inflammation.

The second observation was that the abundance of ***Enterobacteriaceae*** bacteria correlated with the severity of motor symptoms in people with Parkinson's - people who had **more** of these bacteria had

worse postural instability. In humans, *Enterobacteriaceae* bacteria are suspected to exacerbate gut inflammation.



The gut microbiota in Parkinson's - not enough *Prevotellaceae*, too much *Enterobacteriaceae*.

So, we have learned two things - first, there is a reciprocal interaction between the gut microbiota and brain known as the gut-brain axis, and second, the gut microbiota is disturbed in Parkinson's. It logically follows that **the gut-brain axis is disturbed in Parkinson's**. Furthermore, since the gut microbiota lies in close contact with the enteric nervous system, which is one of the first victims in Parkinson's, the disturbed gut microbiota may even be involved in the initiation of Parkinson's. The bottom line? The more we discover about the specific factors that disturb the gut microbiota, and hence the gut-brain axis, the more we may reveal about the neuron-killing process in Parkinson's.

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References

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