The Post-Human Body: Does the fact that our bodies harbour vast quantities of microbes mean we are somehow less human, or even post-human?

Researchers recently discovered that microbes – bacteria, viruses and various other tiny life forms – swarm in huge numbers over all the surfaces of our bodies, and inside them too. The stats are shocking. According to the Human Microbiome Project, the average human body includes up to ten times as many microbial cells as humans ones. That makes me just 10% human! As one author puts it, “a great deal of us is not us!” (Lorimer 2016).

This potentially has all kinds of unsettling implications: if I’m only 10% human, can “I” really take credit for my achievements, or should I thank my microbial collaborators for that essay I wrote? If I’m only 10% human, who is in charge? Did I order that pizza, or did my microbes make me do it? In fact, maybe this “I” I speak of is itself mostly microbial anyway. Does that mean that every time I sanitise my hands I’m slaughtering my own flesh? Furthermore, if microbiome research identifies “imbrications of human and non-human agency”, as Jonathon Turnbull and Adam Searle put it in a recent issue of this magazine, does this force us to bestow gut microbes and other life forms formerly classified as natural with political rights? Do we need to start offering them a seat at the UN? Is it abuse if I don’t rehouse my shits in appropriate sanctuaries?

Such lines of thought are fun but, I’ll argue, generally unfounded. There are far more conventional ways in which we can interpret the statistics about human-microbe interaction, and the research in question doesn’t really warrant any revolutions in the way we think about our selfhood or agency. The Enlightenment-era philosophy known as “Humanism,” on the other hand, does make conceptual commitments (to which we will come shortly) which are untenable in light of modern biology. But I’m not convinced that gut bacteria in particular deliver the decisive blow against Humanism.

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To begin, let’s go back to that shocking figure: the average human body includes around 10 times as many microbial cells as it contains human ones. The word “includes” is important here. If we understand it as saying that 90% of a human’s parts are not human, then the phrase has an air of contradiction about it – how can 90% of something not be itself? On the other hand, if we understand “includes” to mean something like “contains within,” then the mystery is much reduced, as a conventional way to interpret the finding is to think that human bodies contain or host microbes in the same way as a ship might carry rats and fleas. In the human case, the finding is that the average ship carries a surprisingly large number of rats and fleas.

Some people argue that this analogy fails because, unlike rats on a ship, some of the microbes in the human microbiome are beneficial – they actually help the human to digest its food, maintain immune health, and more. Gut bacteria have been heavily implicated in the healthy function of human digestive and immune systems. Imbalanced microbiomes may contribute to a surprising array of health conditions, ranging from IBS, eczema and obesity to diabetes, and even depression, Parkinson’s disease and schizophrenia. A healthy human is one whose gut contains bacteria, there is no doubt about it. Developmental biologist Scott Gilbert has argued that microbes are actually essential parts of a human, in the sense that humans would be unable to carry out their characteristic functions, were it not for the aid of their microbiome. If this is right, then the microbes require us to rethink what we mean by human. They think that we must reconceptualise the microbes, not as resident on a human, but as *integral* to it. On this view, microbes are less like rats on a ship, and more like planks in its hull, or even sailors on its deck. Taking this line of thought, the science journalist Ed Yong writes in 2016 “perhaps it is less that I *contain* multitudes and more that I *am* multitudes.”

Two things should be separated here. First, does the research really force us to think of gut bacteria as being actual parts of a human body, rather than mere passengers? Second, would accepting gut bacteria as actual parts of a human body have radical consequences for human selfhood?

To start with the first question, I don’t think that gut bacteria deserve to be conceptualised as true parts of a human body. The argument given by people such as Scott Gilbert is that we ought to understand the human body as including any parts that are essential to its function. Let’s call this a “functional concept” of the human. Let’s be clear, in the first place, that a functional definition wouldn’t include all of the microbes within a “holobiont” (referring to a host organism and all of the microbes associated with it) because only a subset of those microbes are beneficial. Many are inert or pathogenic. Even so, I don’t think function works well as a principle for demarcating humans. One reason is that the notion of function is itself hard to pin down in a naturalistic fashion. Just what are the characteristic human functions anyway? Another reason, as pointed out to me by Javier Suarez, is that if you define a human as containing all and only things that are essential to its function, you’ll have to exclude things like the appendix. At the same time, you get an absurdly broad understanding of what counts as a human’s parts. Gut microbes contribute to human digestive function. But sexual partners are essential to human reproductive function – so are they parts too? Humans would die if it wasn’t for plants and other photosynthesizers filling the air with oxygen – so are plants parts too? What about the prey animals we depend upon? Causal webs extend far beyond our skin, so I think it is not reasonable to think of microbes as parts only if they benefit us *and* they happen to be physically attached to us.

Furthermore, once you get explicit that a functional definition must be assumed in order for the conclusions to follow, they sound much less surprising. There is an analogous position in philosophy of mind, known as the ‘Extended Mind’ hypothesis, in which the headlines shout things like “Man’s mind found to include notepad!” That sounds radical, because we normally think of minds as supervening on brains only. The surprising headline is generated by considering a person who uses a notepad to help him remember things, because his own, brain-based memory is faulty. If you apply a functional definition of mind, in which the mind includes everything which is essential for the mind to function, then some minds include notepads. But once you spell this all out, the headline looks like a rather sensationalistic restatement of the more adonyne “Notepad found to be useful in helping a man remember things!” In the case of organisms, if you define the organism as including anything which is essential to the organism’s function, then the organism turns out to include some surprising things! But it is open to us to avoid those surprising conclusions, by resisting the functional definition.

I also think that the functional view obscures an important distinction, that is front of view in the main rival to the functional way of defining an organism – an evolutionary definition. Evolutionists recognise that a huge number of entities present in or on the human body *came from without*. They are aliens or foreigners, in the sense that they started out separate from the human lineage they ended up entangled with. But whilst some of those things are transient visitors, others have become permanent fixtures. Gut bacteria, and most of the other microbes featured in holobiont research, don’t stay put. They come and go and, although many of them are courteous guests, they also have fulfilling lives of their own, outside our bodies. When interaction partners come and go during an organism’s lifecycle, picked up from its surrounding environment, we call them “horizontally transferred”. Horizontally transferred symbionts do not qualify, by evolutionary lights, as true parts of an evolutionary individual. But that doesn’t mean that humans have no “alien” parts. Mitochondria were originally free-living bacteria that took up permanent residence inside our cells around 1.45 billion years ago. They release energy from our food, and without them we would die. Crucially, mitochondria have become vertically transferred. This means that rather than picking up new mitochondria after we are born, we are born with them – we inherit them from our mother. In fact, every time a human cell divides, a few of these creatures are seeded into the daughter cell, where they carry out their own replication process to repopulate the cell. So although mitochondria originally came from outside – from a different Kingdom of life no less – they are now permanent fellow-travellers as we make our way in the world. They can’t live without us, nor us without them. The endosymbiotic origins of mitochondria have been accepted as established science for at least three decades.

Mitochondria aren’t the only ‘foreign’ entities whose lineage has become fused with ours. Up to around 8% of the genes in human DNA are hitchhikers that were carried in by retroviruses, and have taken up permanent residence inside our cells. Researchers think that these “endogenous retroviruses” or ERVs have been important in shaping human evolution. For example, the mammalian placenta probably originated in germline infection by a retrovirus.

Mitochondria and ERVs qualify, on an evolutionary definition, as true parts of the human body, despite their exogenous origins, because they are vertically transferred, which means that their lineages have become permanently fused with our own. The reason that evolutionists treat this distinction as important, is because it has consequences for the likelihood that the partners will harm us. Generally speaking, a vertically transferred partner is unlikely to harm us. I am simplifying a little, because there are other factors that matter, such as whether a host’s partners may come into conflict with one another. But in general, the insight is that once an organism shares our evolutionary future, they are unlikely to harm us, because they’d effectively be harming themselves. If you bet all your money on one horse, then you really want that horse to win. But our ‘gut buddies’, as some call them, haven’t made such a bet on humans. They have all sorts of outside interests which, crucially, potentially conflict with our own. This prediction about harm motivates evolutionists to put gut bacteria in a different category, as partners rather than parts, which are capable of either helping or harming.

To summarise, while a functional definition includes gut bacteria as true parts of a human body, on an evolutionary definition the human body includes mitochondria and ERVs, but not gut bacteria or most of the other components of the microbiome. I prefer the evolutionary definition because it incorporates important distinctions about whether an entity is invested in our wellbeing (and the wellbeing of our descendants) or not. Whether you agree or not, it should be clear that microbiome research definitely does not *force* us to think of gut bacteria as being actual parts of a human body, rather than mere passengers.

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I promised to explore a second question: Does microbiome research – in particular the finding that many microbes have beneficial effects on human health – revolutionise our understanding of what it means to be human? A positive answer is given by ‘Post-Humanists’, a movement of anthropologists and critical theorists who argue that our intuitions about what it means to be a human are out of date. Humanism is a widely influential paradigm inherited from the Enlightenment, which treats humans as exceptional among animals, on account of their rational autonomy and agency, which has allowed them, it is supposed, to become separate from and dominant over the rest of nature. Post-Humanists, by contrast, conceive of us as interconnected with nature, and they argue that awareness of our interconnectedness should prompt a new way of valuing nature and of decentring humans in our ethical schemes.

If a Post-Humanist were to accept my arguments in favour of defining humans evolutionarily, he might still have cause to argue that our intuitions about the human need to be updated. There is a deep-rooted folk concept of the human organism, which assumes that our bodies are pure and uncontaminated by outside matter. We think of ourselves as human-all-the-way-through, as though we have an internal essence that is homogenously distributed throughout all our parts. In modern times, we have come to think of this essence in genetic terms, and to imagine that a human starts out as a single cell, whose genetic essence is then copied into all the other parts.

If we define a human evolutionarily then, although gut bacteria are best classified as polite passengers, mitochondria and ERVs qualify as true parts of a human. This means that each human is a chimera, a fusion of multiple lineages. Mitochondria have their own genetic essence running in tandem to ours. Retroviruses sporadically add an additional motif, sometimes snatched straight out of a different species’ genome. For example, the genes underwriting the mammalian placenta are thought to have been introduced by a retrovirus. Humans are patchworks, but this doesn’t make us special – there isn’t a living thing on earth that has never undergone outside edits to its genetic identity. The tree of life doesn’t branch, it reticulates, like a dense jungle thicket.

We might then argue that the revolutionisers are right, but for the wrong reasons. Microbiome research doesn’t deal a death blow to Humanism, because Lynne Margulis’ endosymbiotic theory of mitochondrial origins killed it decades ago. In general, post-humanists are dead right that humans are thoroughly interdependent and functionally integrated with their environments. This view of humans and other life forms as enmeshed in their environment has been argued across the mainstream of biology for ages – we see it in Susan Oyama’s Developmental Systems Theory, Richard Dawkins’ Extended Phenotype, for example. Some biologists argue that there is still too much emphasis on competition rather than on cooperation and symbioses (see, for example, Joan Roughgarden’s *The Genial Gene*) but this isn’t anything specific to microbes. In functional terms, there is no clear boundary between any organism and its environment, microbial or otherwise. That’s one reason why, in so far as we want to demarcate a human, it is better to use evolutionary, rather than functional, notions. In any case, the Humanist doctrine of human autonomy lacks plausibility for reasons that long predate holobiont research. Even Moses was aware that he needed Rachel’s help to reproduce. We now know that we depend upon microbes for purifying the water we drink and the air that we breathe. The idea that mankind enjoys physiological autonomy doesn’t survive a moment of elementary reflection on the way the world works. We shouldn’t treat gut microbes as exceptional here simply because they are inside us rather than in our waterways.

Someone may protest that mitochondria are just not as destabilising to human identity as gut bacteria, because they arrived so very long ago, before we were human. Viewing mitochondria as foreign is like treating Brits with Saxon DNA as foreign: if enough years have passed since a lineage arrived, then it is natural to start to conceive of them as true parts of the entity they once “invaded.” Gut microbes, on the other hand, are the Polish fruit pickers – recently arrived, still recognisably “foreign,” but deserving of citizenship nonetheless on account of their indispensability to the British Economy. Perhaps this is why gut microbes have captured the Post Humanist imagination more than have mitochondria? Mitochondria moved in literally aeons ago. Perhaps folk intuitions about the purity of the human lineage are more threatened by the bewildering menagerie of exogenous lineages that newly enter the human island each day.

Holobiont research does appear to present a genuinely new challenge to the Humanistic belief in man’s dominion over nature in so far as, unlike many other species on the planet, gut microbial species are very likely to outlive the human species. If we’ve become accustomed to thinking of nature as a victim, something foreign and deserving of our charity, something towards which our position of superiority obliges a certain beneficence, holobiont research makes trouble. We are not even close to understanding how to control our microbiomes (yoghurt manufacturers’ claims notwithstanding). We cannot achieve mastery over them by killing them all. As we’ve seen, many microbial lineages have beneficial effects upon human physiology – this is a big change given that since the 19th century we’ve associated microbes with disease and sought to rid them from our lives. And we need our microbes, furthermore, way more than they need us. Insofar as a Humanist is attached to the idea that we humans have the upper hand, then holobiont research really does give us new reason to move on. We should be cautious about over-sanitising our environments, but not because microbes are our parts and we’re therefore obligated to respect their rights. Rather, because we depend upon them and need to figure out how to optimise our partnerships with them.

What, finally, of the self? Tobias Rees argues that microbiome research “challenges our concept of self”. Key to his argument is research showing that gut bacteria can influence mood and the health of the human nervous system. This seems to be a functional argument again, with the added suppositions that the functions influenced in the relevant research are tied up with human selfhood and are characteristic human functions. My view is that this suffers from the general defects described above. If anything that influences mood is a part of a human body, then my body is mostly chocolate!

To be sure, we tend to think of selfhood as something unitary and singular, as if there is a single ‘I’ which acts, chooses, wills. Rees seeks to destabilise this by claiming that ‘I’ is a partnership, between myself and my bacteria. In my view, the generation of the singular subject of experience is certainly mysterious and difficult to explain because, even on the most conventional view, action and agency are products of an aggregate - a collection of neurons. Each neuron is descended from a free-living cell, and acts in partnership with its resident mitochondria. It is difficult to understand how the feeling of a unified self can emerge from the interactions of such parts. Does the addition of influence from gut bacteria make a whole lot of difference? It doesn’t seem much different to allowing that eating chocolate can make a difference to my mood. I don’t encourage anyone to try blaming their bacteria for their actions, any more than they try blaming their lunch or their neurons.

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To conclude, research on the human microbiome has revealed that a huge number of microbes swarm on the inner and outer surfaces of our bodies. Some of them are bad for us but some of them are very good for us, and we’d be worse off if we eradicated them altogether. None of them, however, are as integral to the human body as are mitochondria or ERVs, which have truly put their alien origins aside and taken up residence as true human parts.

Post-Humanists are right to call out some Humanistic assumptions as incompatible with modern biology. Humans are chimeras and are deeply enmeshed with and dependent upon their environments in ways that aren’t particular to interactions with microbes that happen to live on or under our skin.

On the other hand, in so far as Post-Humanists are motivated by microbiome research, we might say they are right for the wrong reasons. Are we less human that we thought we were? It really depends on how human you thought you were. Did you think humans were pure and autonomous, uncontaminated by outside lineages, and in mastery over the rest of nature? If you did then you’re wrong, but we don’t need microbiome research to tell you that.

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*Jonathan Turnbull and Adam Searle (2019)* Anthropo(s)cene I: Posthumanisms*. The Philosopher 107.2: 52-4.*

*Ed Yong (2016)* I contain multitudes: The microbes within us and a grander view of life*. Random House.*

Further resources:

*Human Microbiome Project* [*https://www.hmpdacc.org/*](https://www.hmpdacc.org/)

*Scott Gilbert, Jan Sapp and Alfred Tauber (2012)* A symbiotic view of life: we have never been individuals. *The Quarterly review of biology 87, no. 4: 325-341.*

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