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# Microbial states and social behaviour: towards an extended influence of symbiosis?

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# ➤ **Microbial states and social behavior:**

## **towards an extended influence of symbiosis?**

Julien TAP (INRAE, France) et Béatrice de MONTERA (UCLy, France)

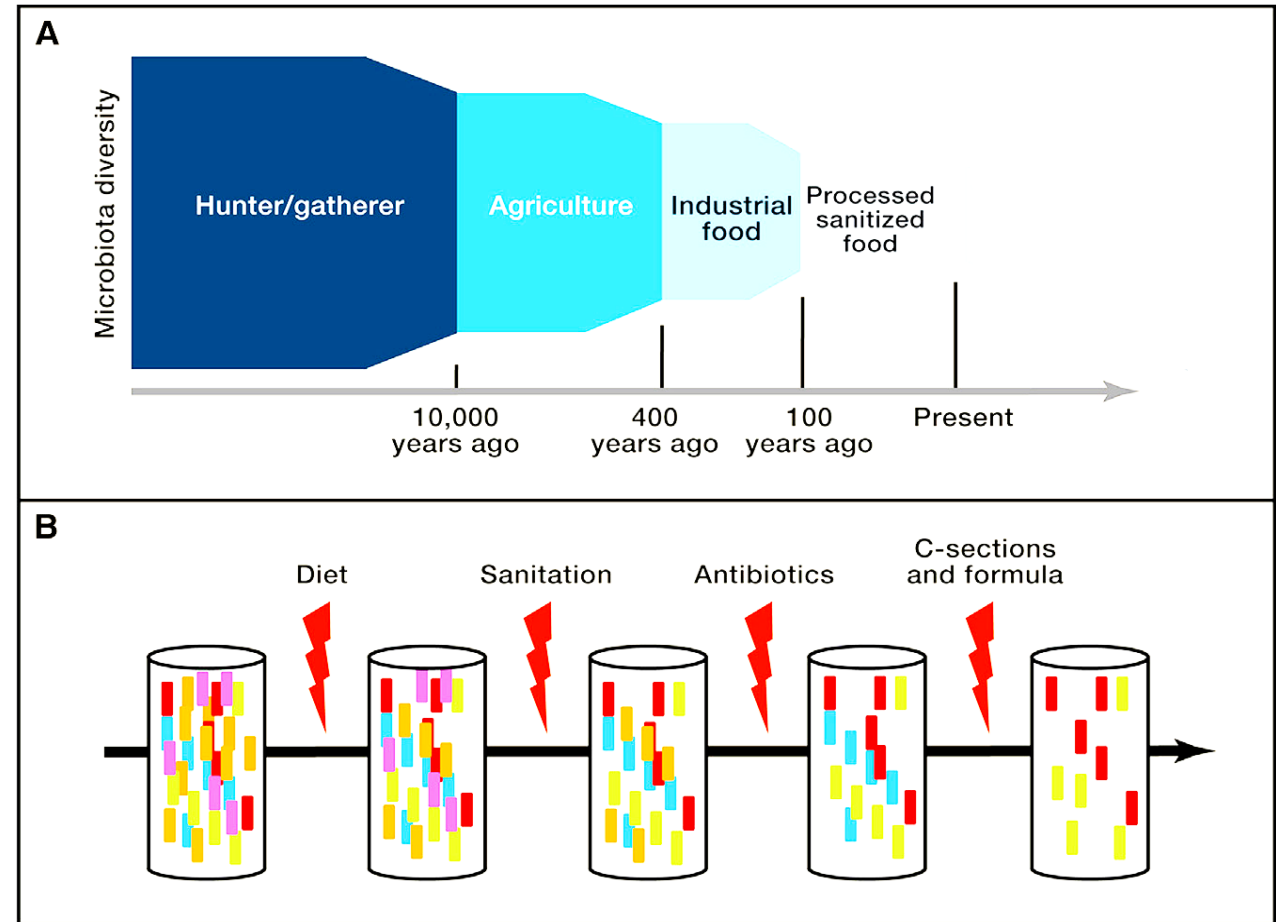
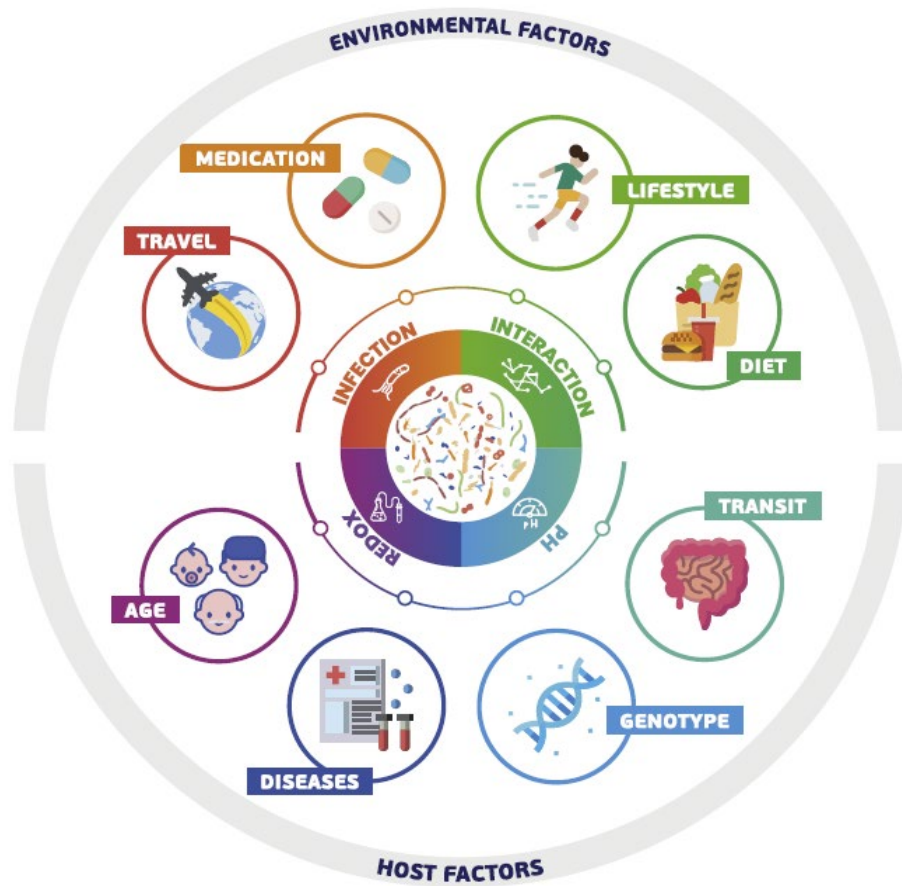


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# ➤ Different factors shapes the human gut microbiome



Are we uncoupling our metagenome and our genome?



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# ➤ Microbiome states resilience as key factor



Healthy state



Resistance



Recovery

Resilience



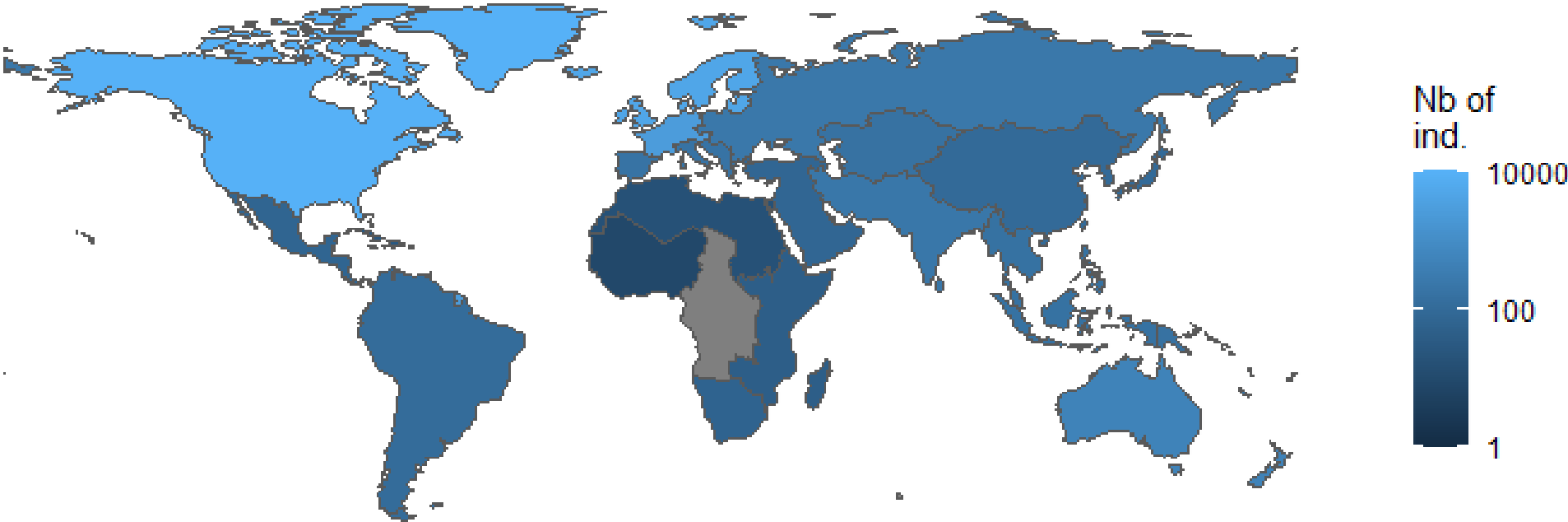
Healthy state



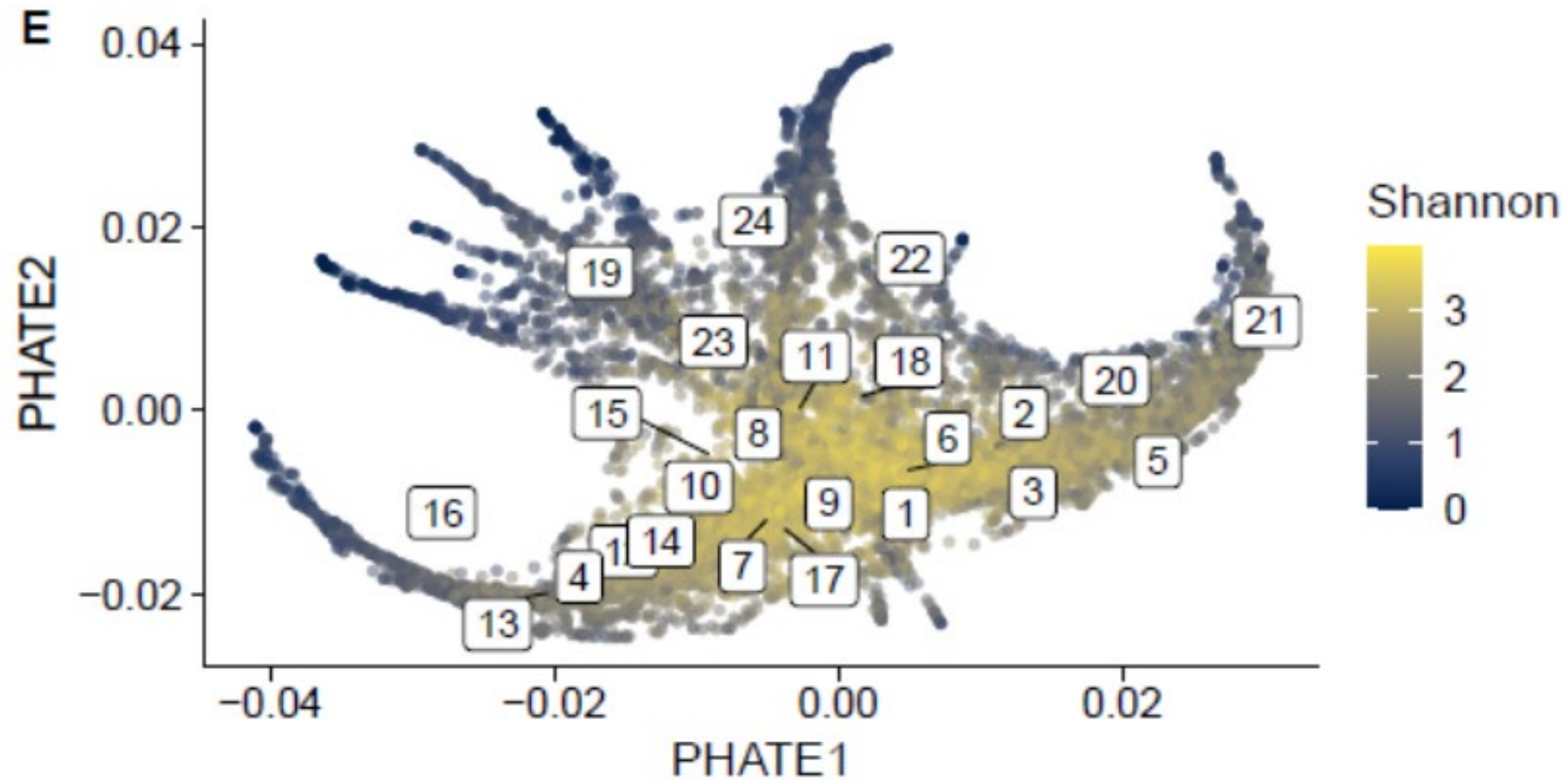
Degraded state



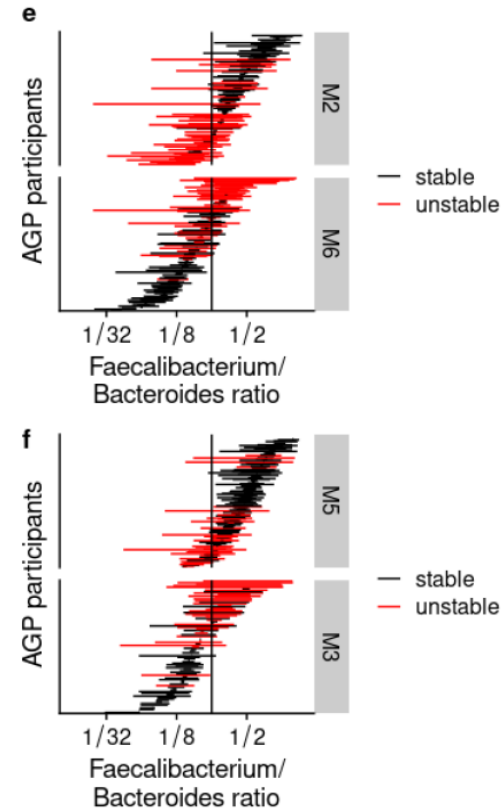
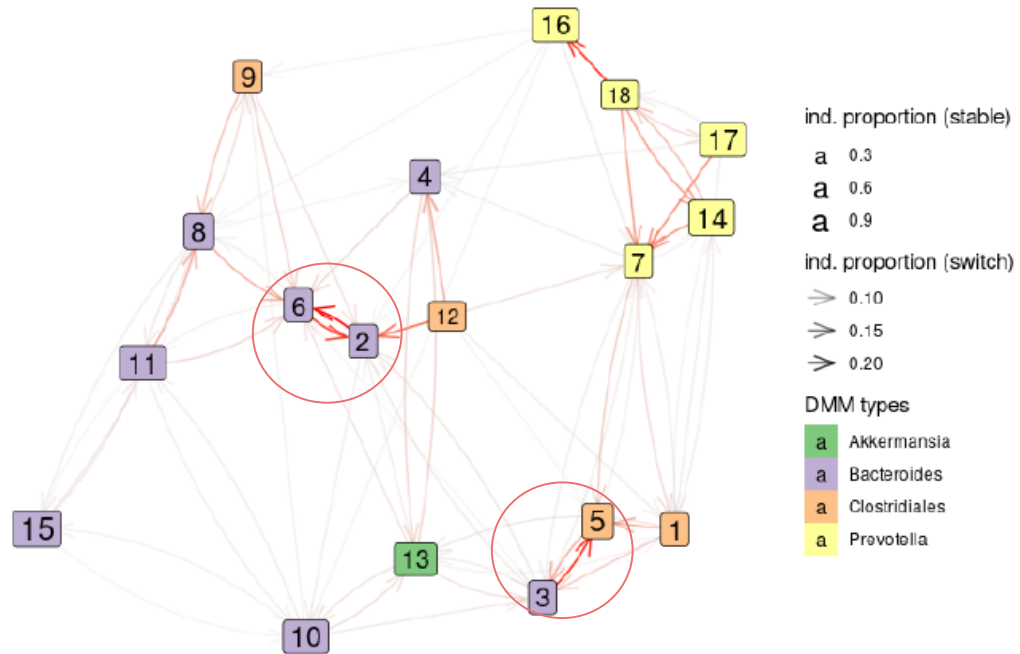
# > 35,000 human gut microbiome samples analyzed worldwide



# ➤ Global branches and local states of human gut microbiomes



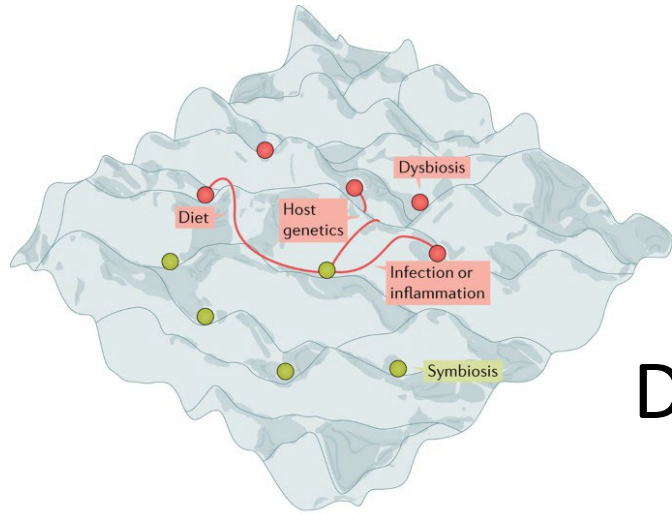
# ➤ Dynamics between partitions are associated to branches



We can identify tipping point between different stable states

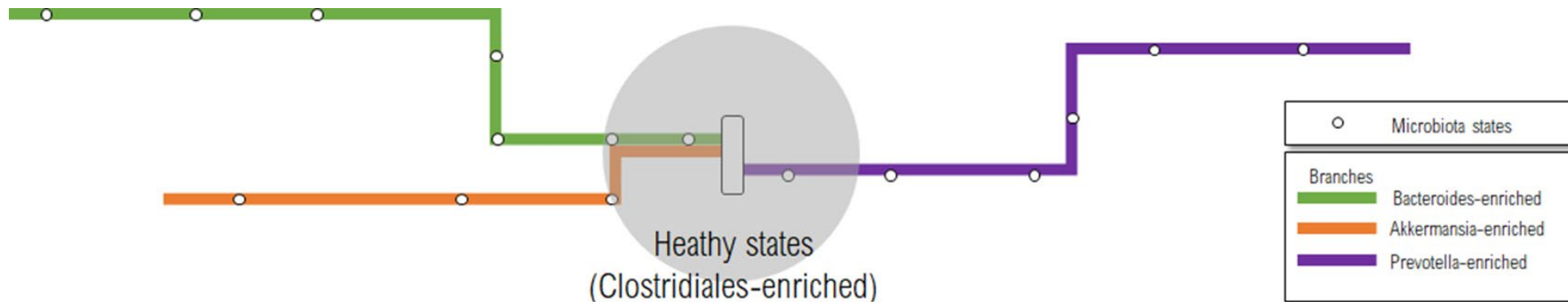


# ➤ Branches help to monitor gut microbiome recovery



Do we have a gut microbiome navigator?

Nature Reviews | Immunology

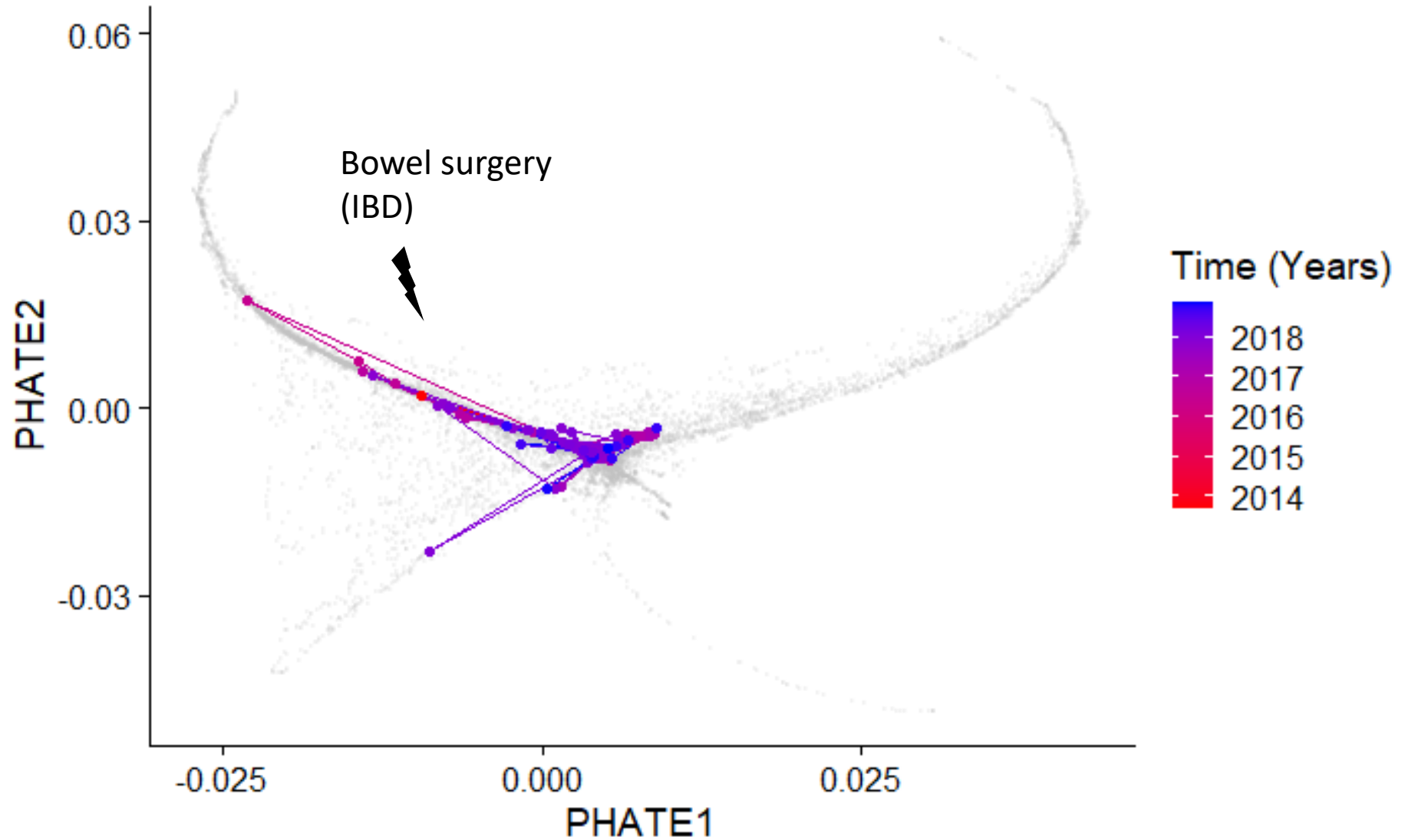


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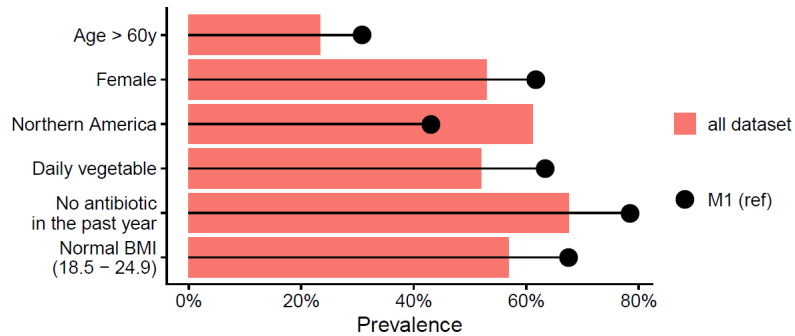
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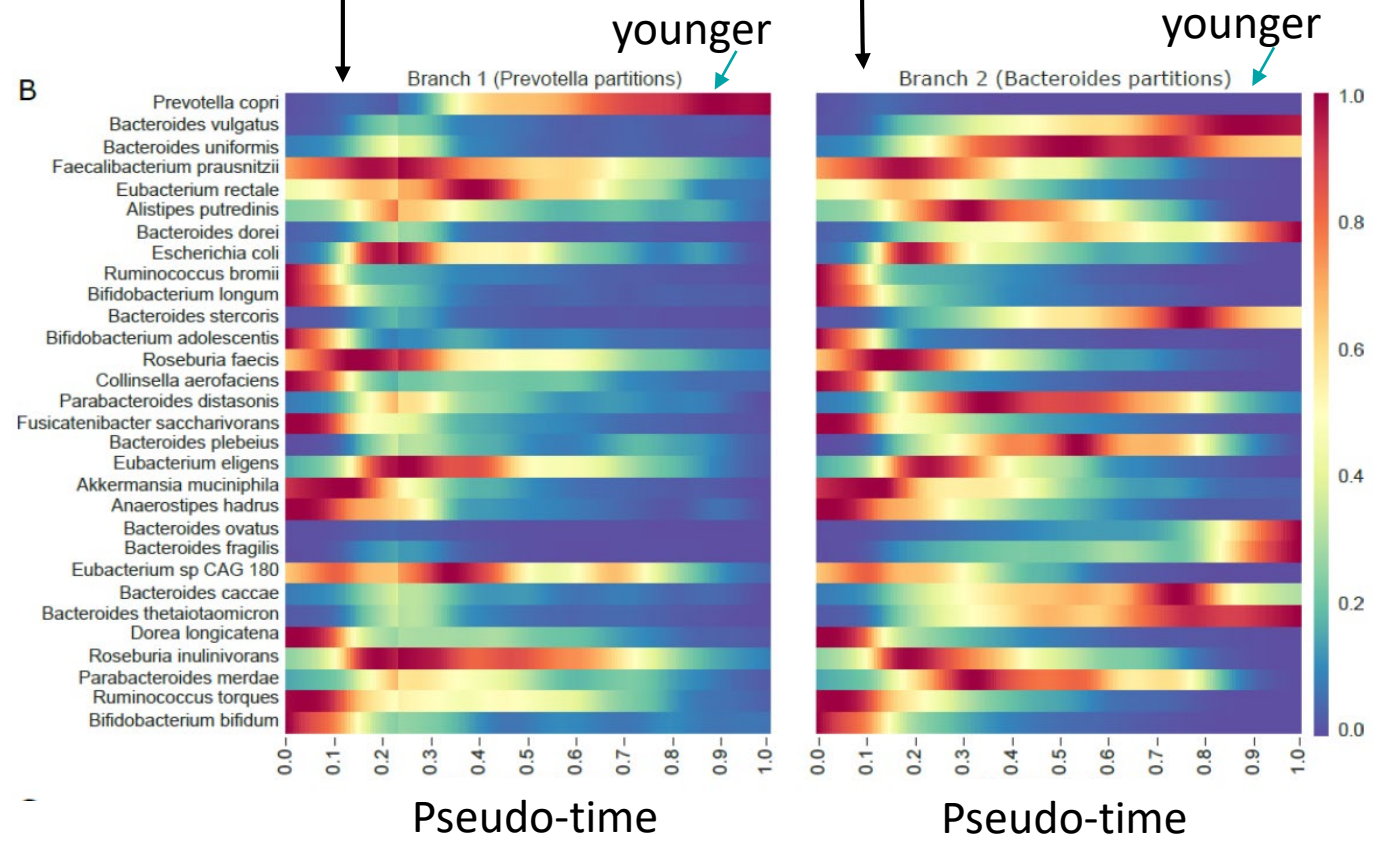
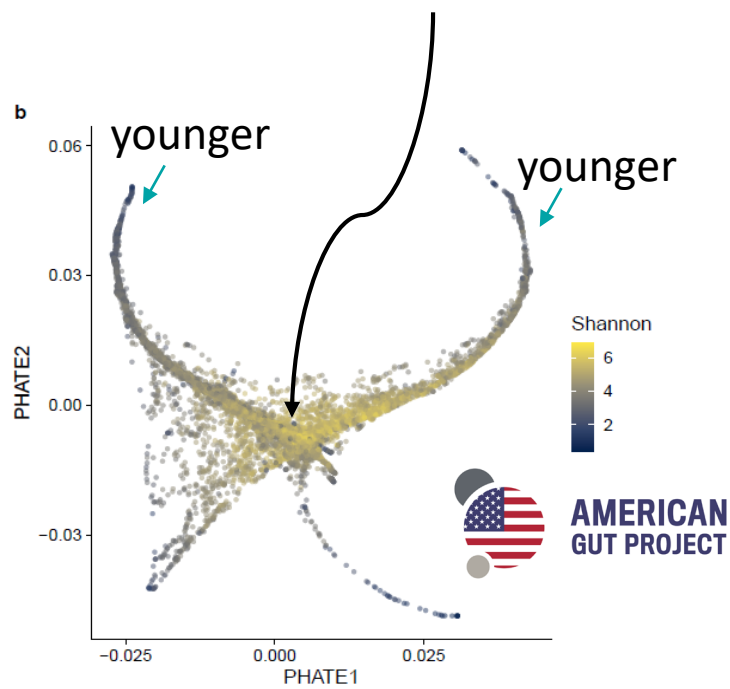
## ➤ Branches help to monitor gut microbiome recovery



# > Do we already observe an intergenerationally mass extinction?



Older and healthy diet and lifestyle

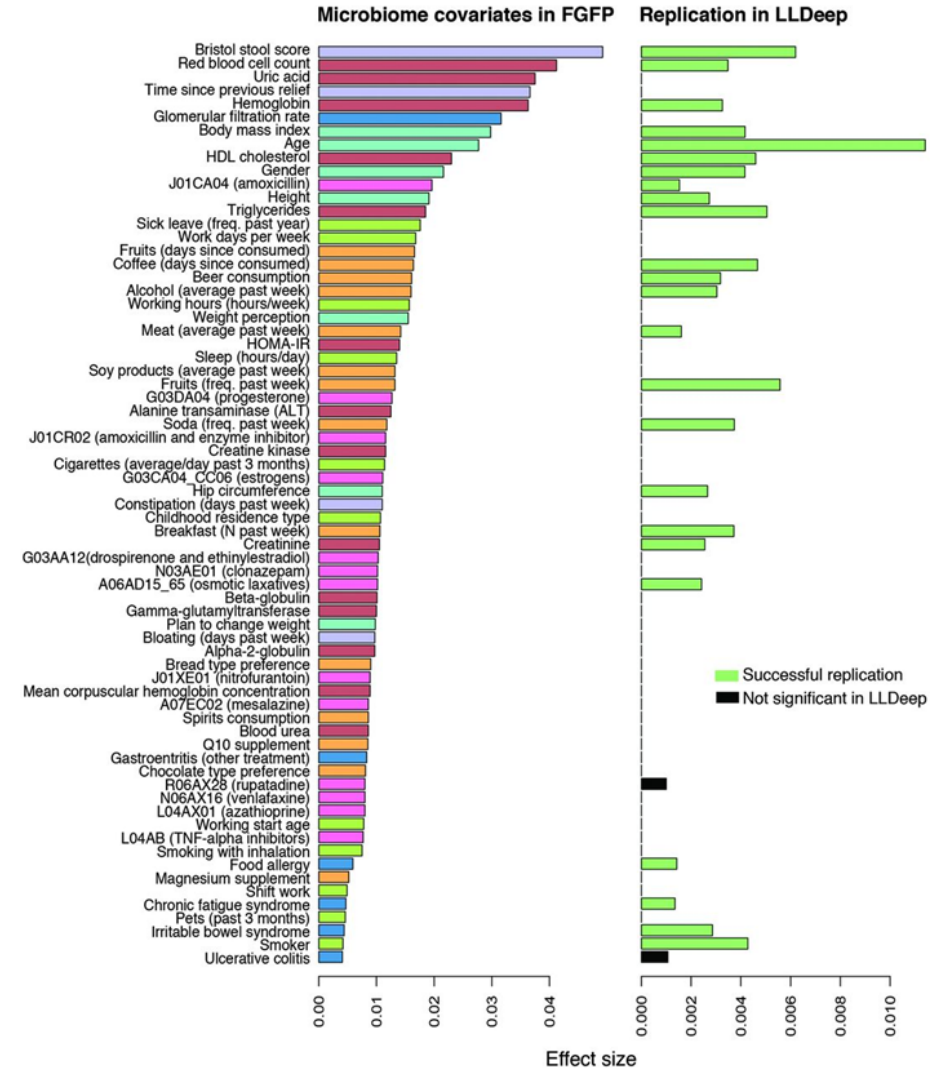
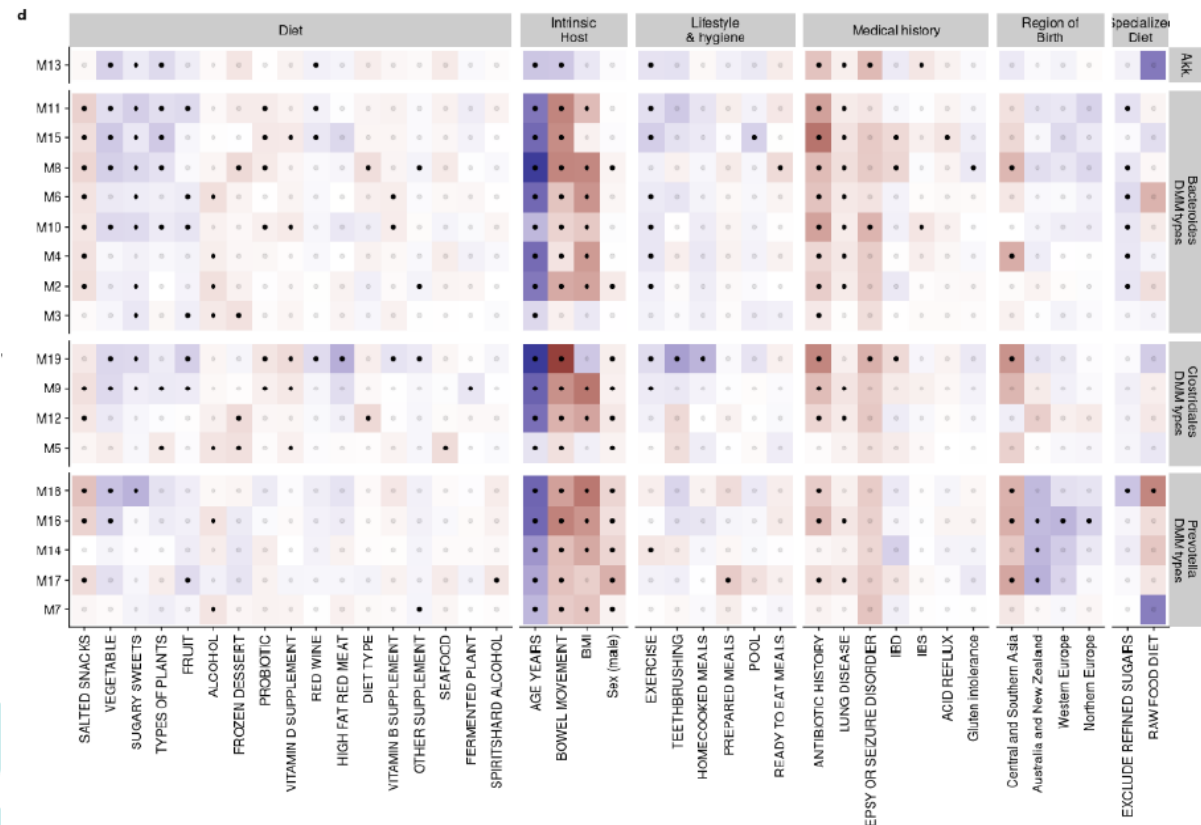
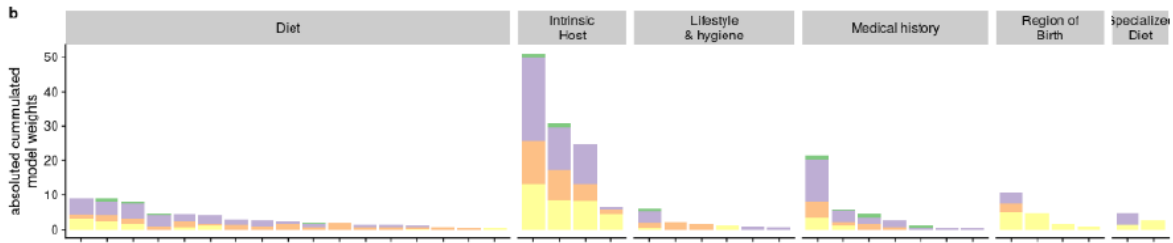


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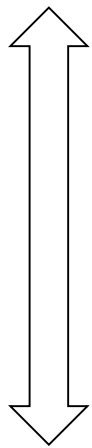
Towards an extended influence of symbiosis?  
24.11.21 / Julien Tap & Béatrice de Montera

Tap et al., Nature Comm. 2023

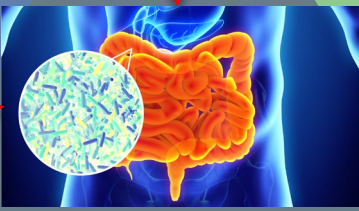
# > A large fraction of the total variation in human gut microbiota remains unexplained by population studies



Mental health



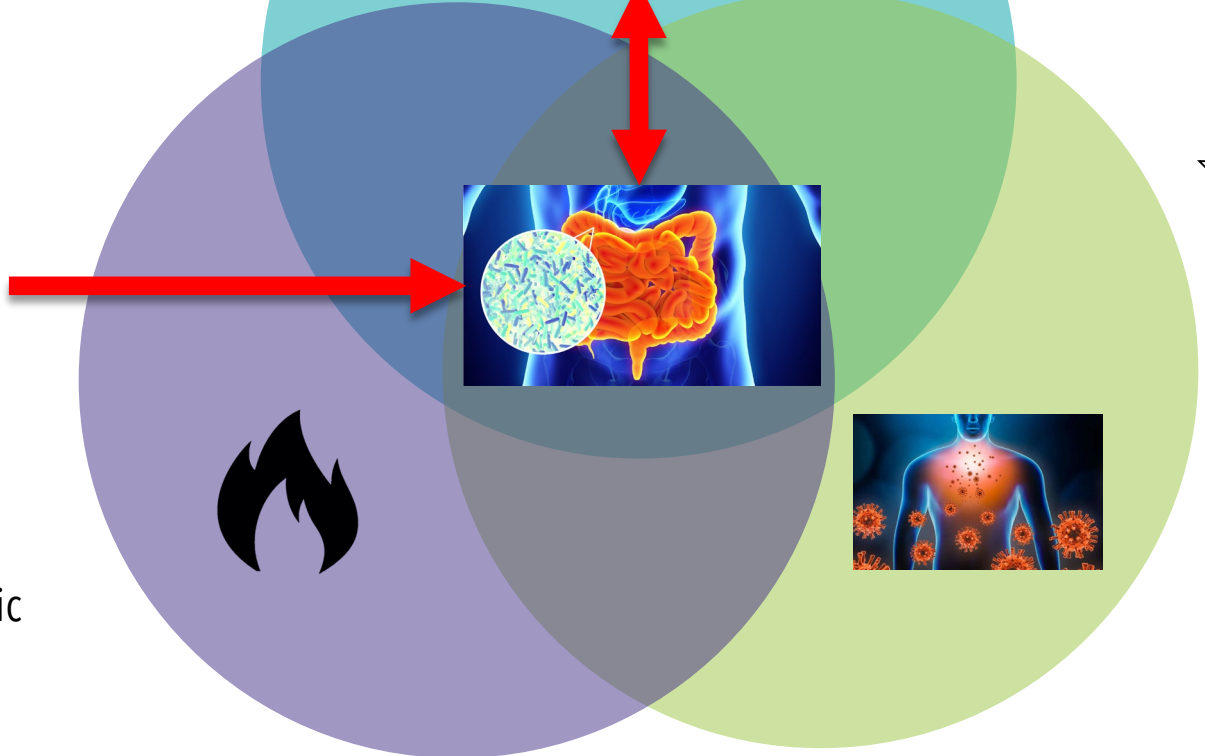
Bi-directional communication network (gut brain axis)



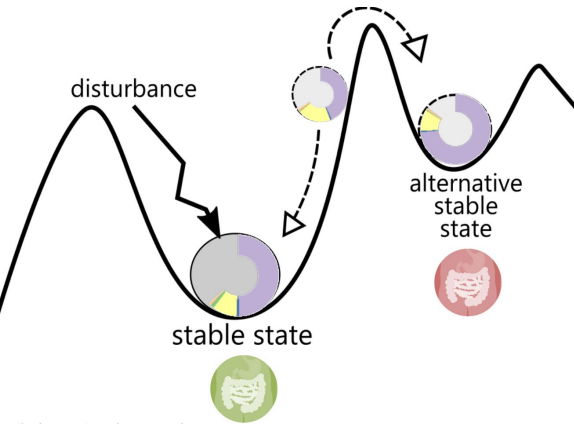
Immunological Health



Metabolic Health



« Gut Microbiome states »



Does individuals having similar microbiome state share similar behaviour?



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# A call for more holistic approaches at the edge of humanities and microbiome sciences



MICALIS – MetaGenoPolis – SayFood – MaIAGE

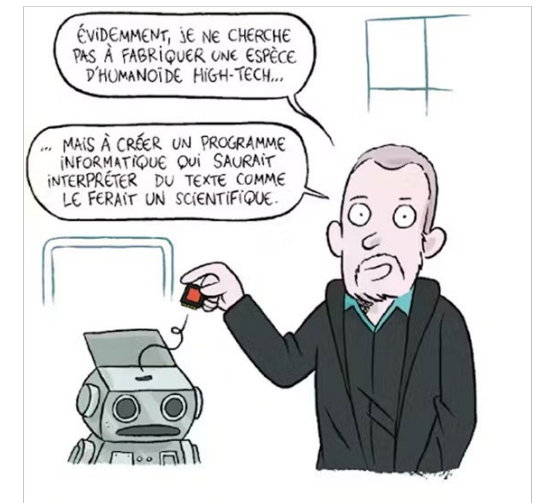
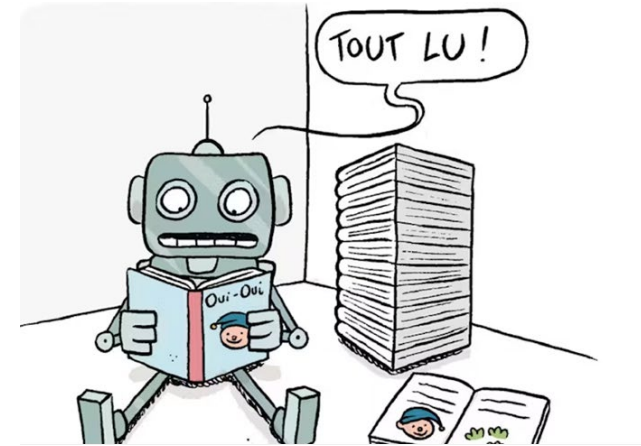


# ➤ INRAE transdisciplinary expertise



**DOMINO • LIVING LAB FRANCE**

Mise en place d'un Living lab  
(Science participative  
du projet Européen DOMINO)



Les grands modèles de langages  
LLMs pour interpréter

Use French Gut participants to raise new questions based on their "microbial states".



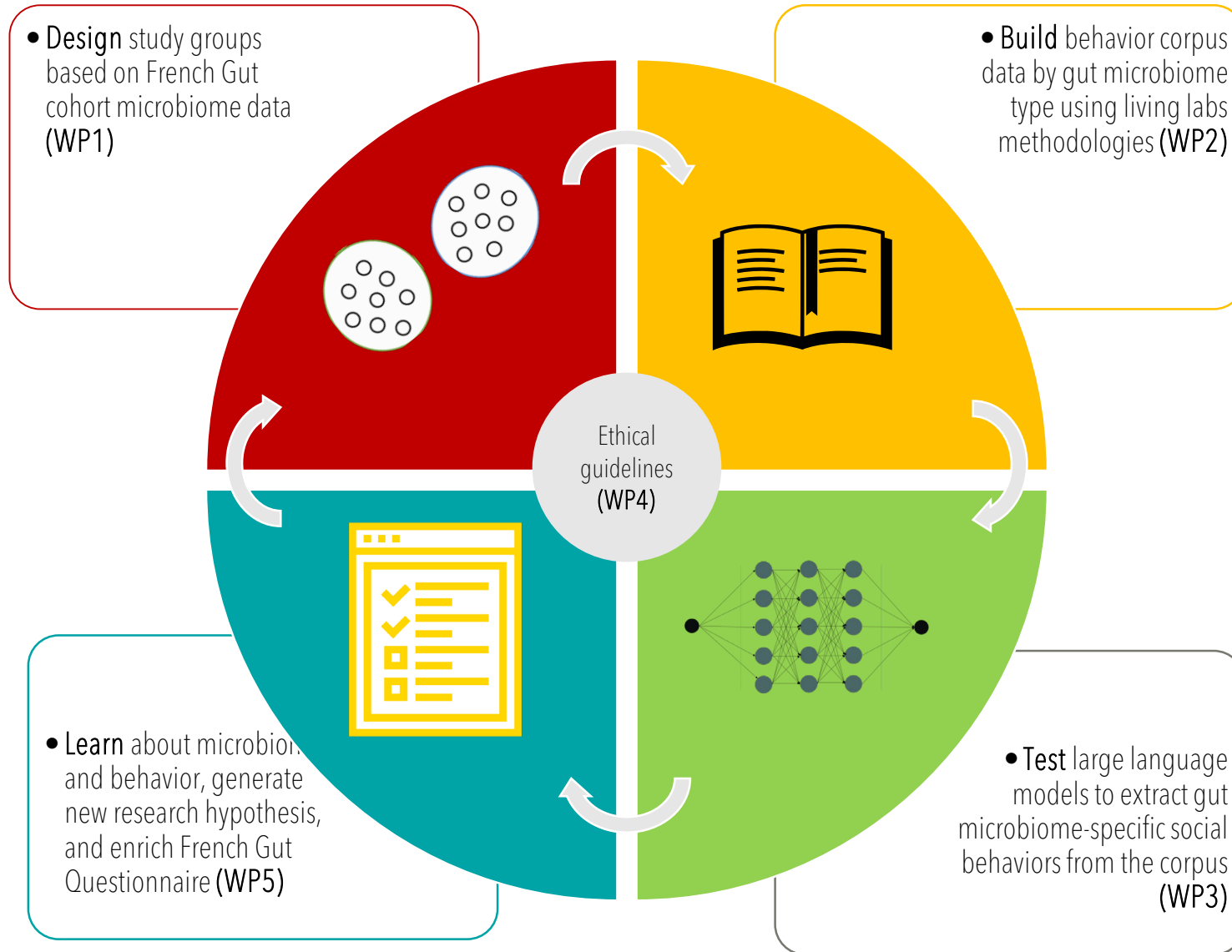
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# LivinGut: a "DBTL" framework

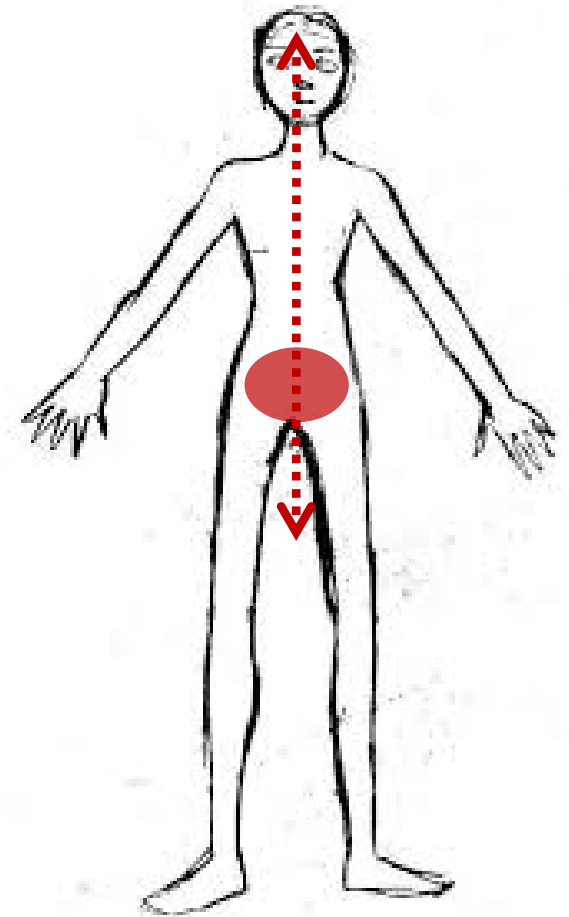




Approche épistémologique et transdisciplinaire  
de ce que l'on ne capture pas par la biologie  
dans la relation humain-microbes

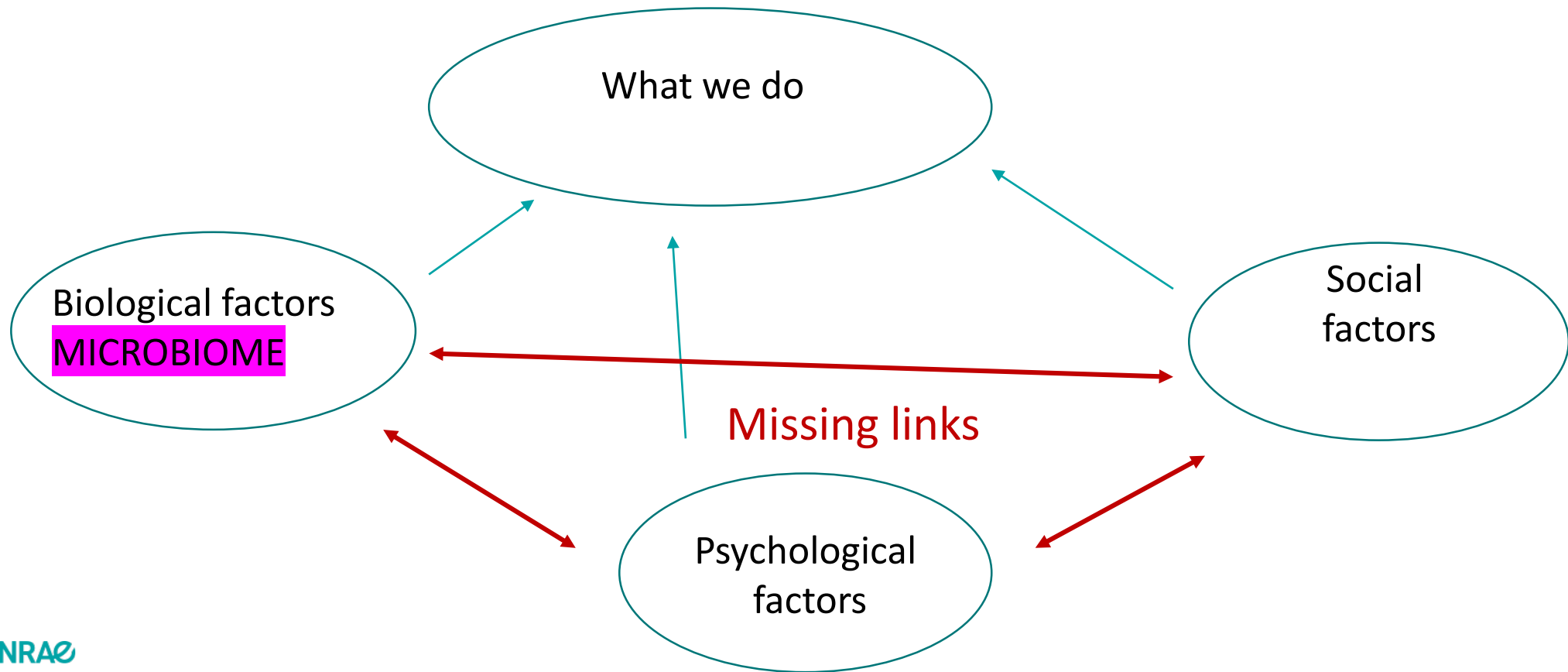
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An epistemological and transdisciplinary  
approach to what biology cannot capture in the  
human-microbe relationship



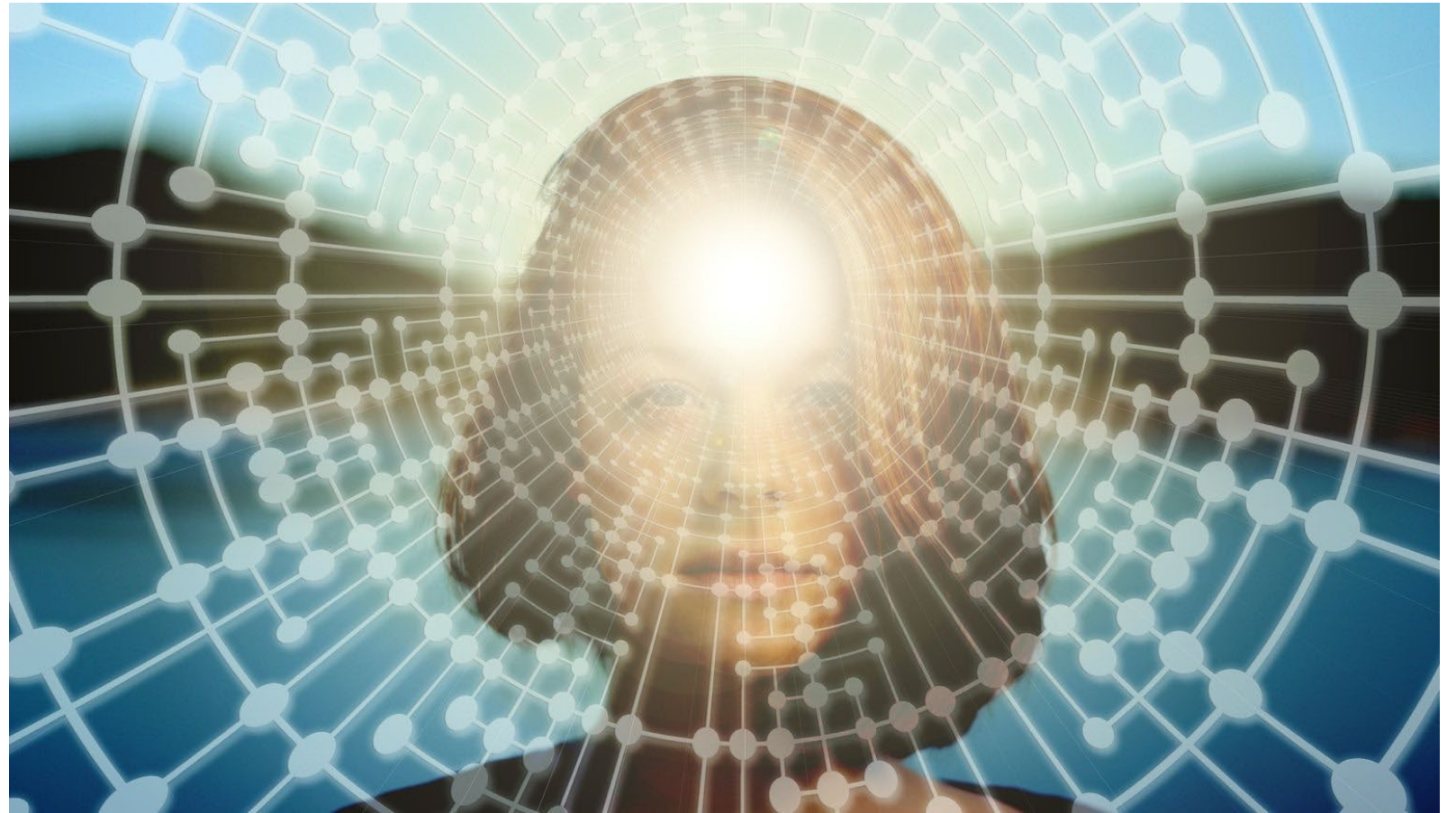
# Determinisms

human actions are linked and determined by the chain of previous events.



The missing part in human decisions and behavior:

**Freedom and Complexity**



<https://dailyscience.be/18/05/2020/les-neurosciences-relancent-le-debat-sur-la-question-du-libre-arbitre/>



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## Setting limits to reductionism?

Taking on a methodological reductionism, but not an ontological reductionism!

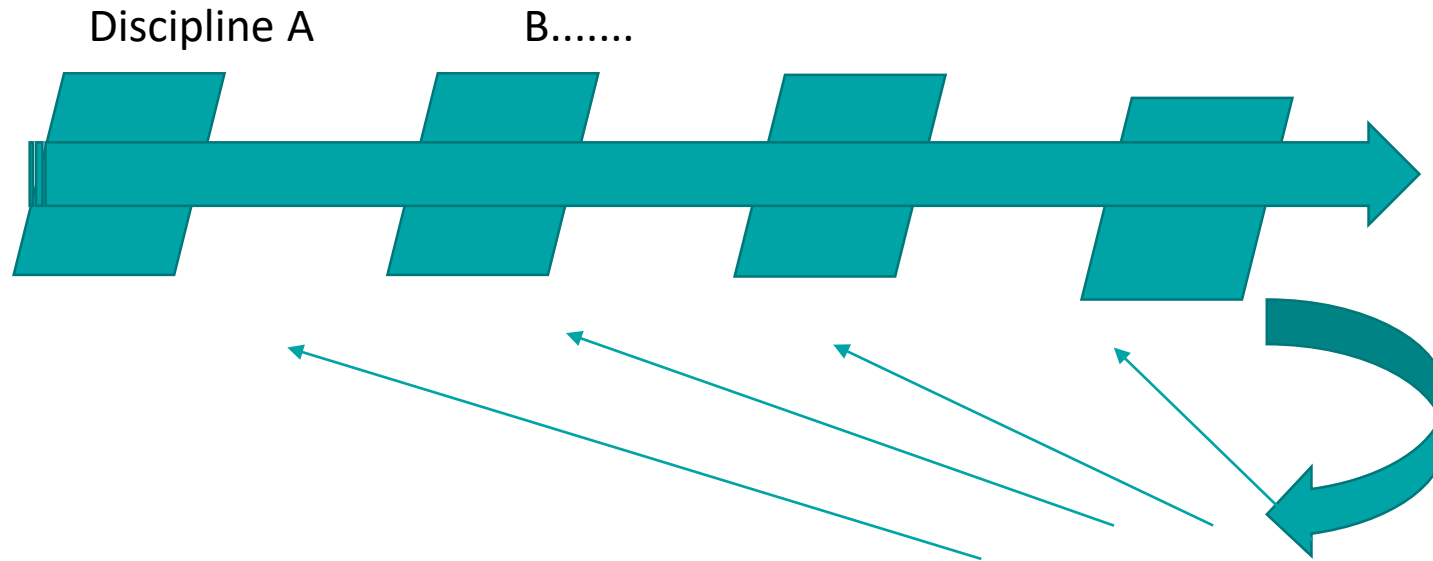


## Transrationality

“we defend the possibility of a *transdisciplinary approach* including not only the subjectivity inherent to methods but to all secretions due to the production process, from the lab researcher to her biotechnological productions. What we propose here is an empirical phenomenology where **there is no need to oppose scientific and social practices**. On the contrary, this empirical phenomenology is dedicated both to biology and to local bio-technical matters but also to the anthropological and psychological matters(…).”  
(de Montera, Substance, 2017)



## A Transdisciplinary method



de Montera B., 2022

<https://theses.hal.science/tel-04127138/document>

## How to deal with ideology and reduce bias?

**“The definition of ideology** by Canguilhem in *Idéologie et Rationalité dans les sciences de la vie* (1977) can help us in this respect: “it is the ignorance that a critical knowledge of its project and of its object, is first achieved thanks to a distance towards its already established object” (my translation). To avoid ideology, the relevant points are as follows: which distance is relevant, to which observer and for what “already established object”? The question is first, how to elaborate the definition of objects? Bachelard, in *Le nouvel esprit scientifique* (1934), explains that science does not take into account the philosophical definition of object, but rather binds together the concept of doubt and the concept of *datum* into a process of objectification. Analyzing Bachelard’s epistemology, Dominique Lecourt (1969), explains that the objectivity of the scientific knowledge is guaranteed by its discursivity. That means there is both an intuitive value and a discursive value in the construction of object. The object, therefore, appears no longer like a simple result of objectification but as an instrument that “operates phenomena,” emerging during the research process.”

(de Montera, Substance, 2017)



## Towards an extended concept of Symbiosis dealing with extended norms

- Microbiome norms
- Social norms
- Ethics values

→ Continuity between human-microbes symbiosis ' norms and social and ethical behavior ?

→ A case study : Nutrition

→ Is it possible to observe a synergy between heterogeneous norms?



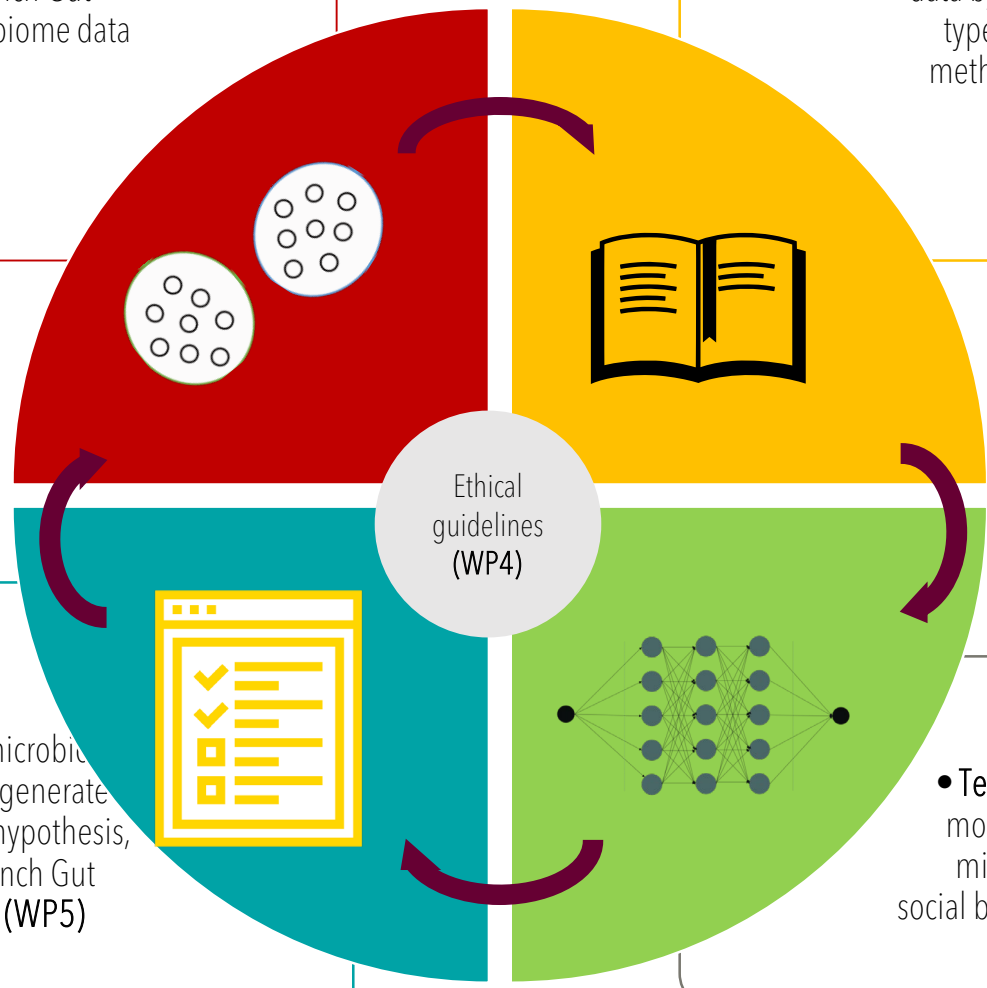
# LivingGut: a "DBTL" : powered by a transdisciplinary approach

- Ask questions « at the frontier of Science » (Foucauld)
- Add pixels to the picture by adding transrationality
- Build new epistemologically-driven hypotheses about the 4 entities : Microbiome, Human, the symbiotic relation, the « associated Medium » (Simondon)

• Design study groups based on French Gut cohort microbiome data (WP1)

• Build behavior corpus data by gut microbiome type using living labs methodologies (WP2)

Qualitative Interviews giving Anthropological material for qualitative analysis in Philosophy, Sociology, Ethics



• Learn about microbiome and behavior, generate new research hypothesis, and enrich French Gut Questionnaire (WP5)

• Test large language models to extract gut microbiome-specific social behaviors from the corpus (WP3)

Compare LLM model analysis and qualitative analysis to identify the « missing part »



Thank you for your questions and reactions



## > Acknowledgments

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- Lucia Brisset
- Anne Saint-Eve
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- Louise Deleger
- Mathieu Almeida
- Magali Berland
- Nicolas Pons
- Sylvie Dequin



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