

The background of the slide is a stylized illustration of a mammalian gut. At the bottom, there is a layer of pink epithelial cells with blue nuclei and a wavy apical surface. Above this, a light green layer represents the mucus lining. The top half of the image is the lumen, filled with various colorful bacteria: purple chains, yellow clusters, orange zig-zags, red rods, and green clusters. The text is centered in the lumen area.

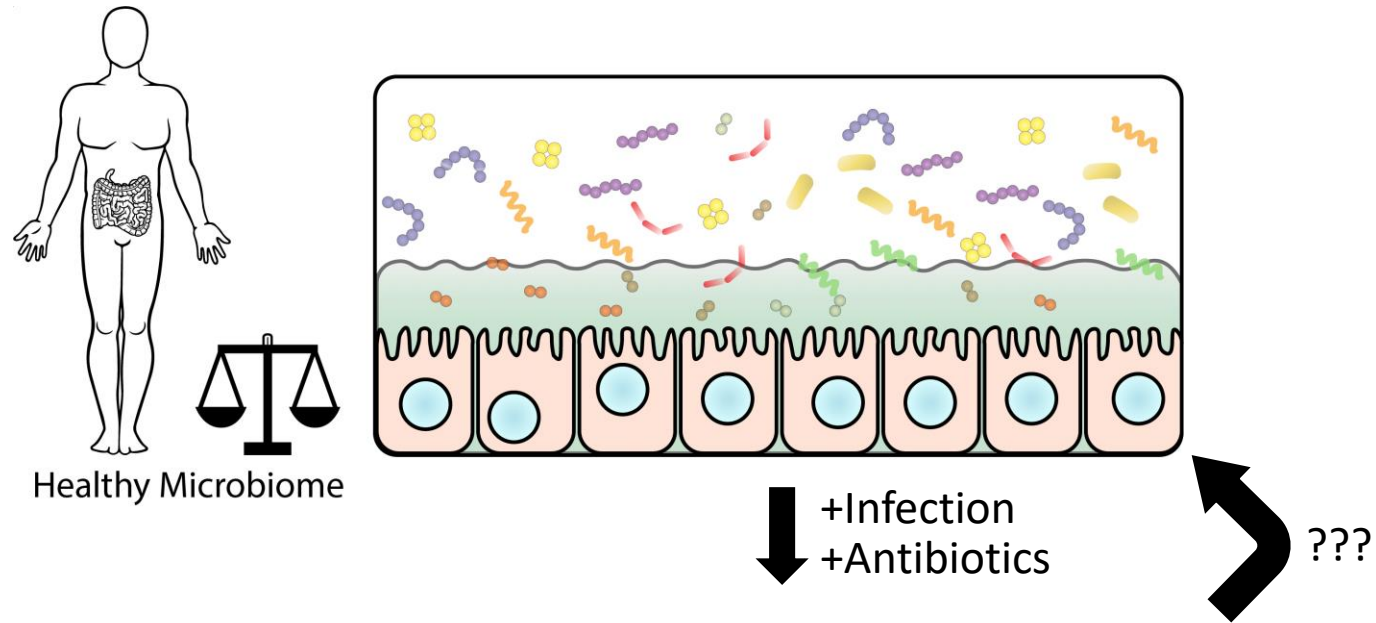
# **Spatiotemporal dynamics during niche remodeling by super-colonizing bacteria in the mammalian gut**

**Guillaume Urtecho  
Columbia University  
Laboratory of Dr. Harris Wang**

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# Gut dysbiosis leads to various chronic disorders



# Fecal Microbiota Transplantation (FMT) is the current standard for treating dysbiosis



Ge Hong, 283 A.D.  
"yellow soup" to treat diarrhea

葛洪

"Handy Therapies  
for Emergencies"



ESTABLISHED IN 1812      JANUARY 31, 2013      VOL. 368 NO. 5

## Duodenal Infusion of Donor Feces for Recurrent *Clostridium difficile*

Els van Nood, M.D., Anne Vrieze, M.D., Max Nieuwdorp, M.D., Ph.D., Susana Fuentes, Ph.D.,  
Erwin G. Zoetendal, Ph.D., Willem M. de Vos, Ph.D., Caroline E. Visser, M.D., Ph.D., Ed J. Kuijper, M.D., Ph.D.,  
Joep F.W.M. Bartelsman, M.D., Jan G.P. Tijssen, Ph.D., Peter Speelman, M.D., Ph.D.,  
Marcel G.W. Dijkgraaf, Ph.D., and Josbert J. Keller, M.D., Ph.D.

## Serendipity in Refractory Celiac Disease: Full Recovery of Duodenal Villi and Clinical Symptoms after Fecal Microbiota Transfer

Yvette H. van Beurden, Tom van Gils, Nienke A. van Gils, Zain Kassam, Chris J.J. Mulder, Nieves Aparicio-Pagés

VOL 25 NO 3: SEPTEMBER 2016

SECTION: CASE REPORTS

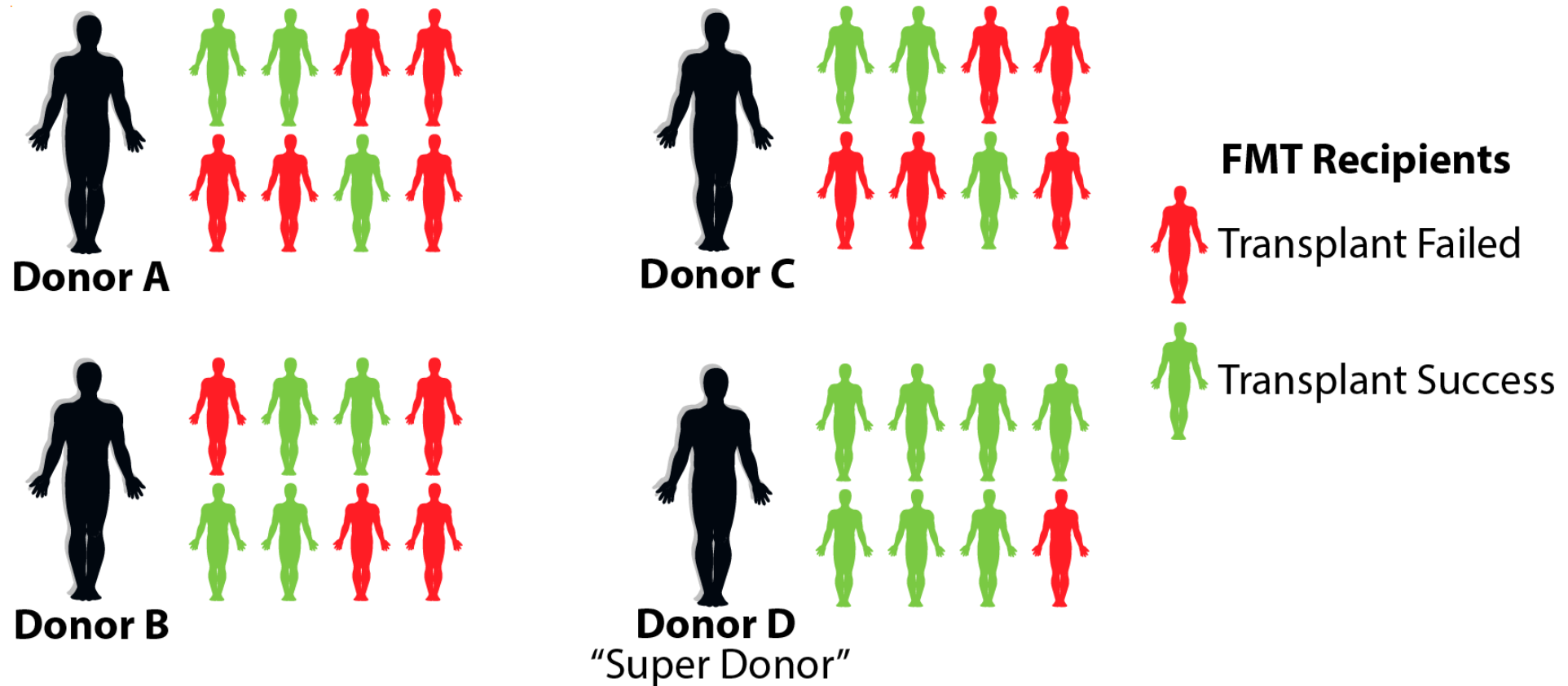
PAGES: 385-388

## Poop transplants are the final frontier in athletic doping

By Michael Blaustein

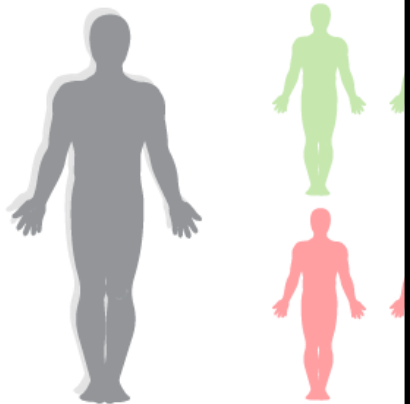
June 28, 2017 | 11:32am

# FMT leads to variable colonization outcomes depending on donor-recipient combinations



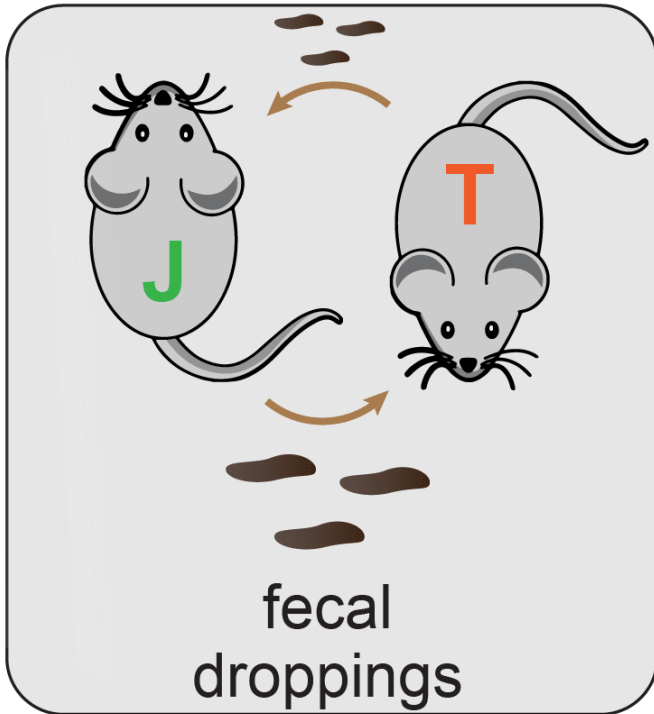
# Outstanding questions to enable

Why does FMT work in some cases but not others?

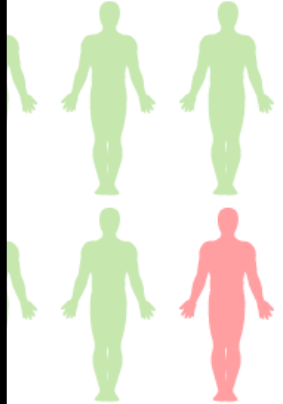


Donor A

## Approach

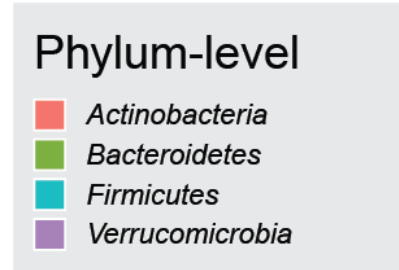
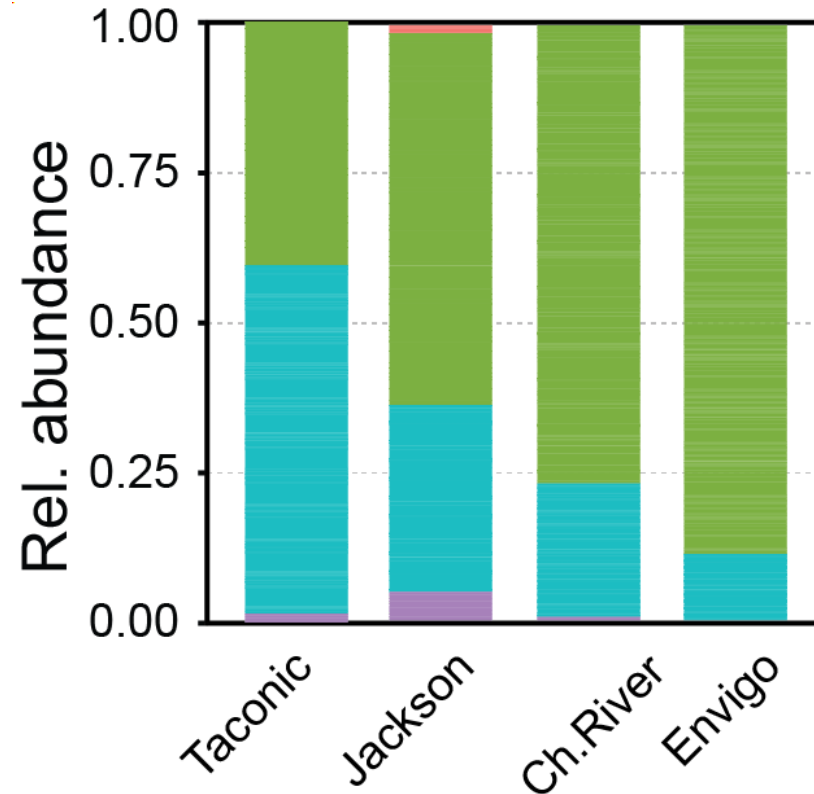
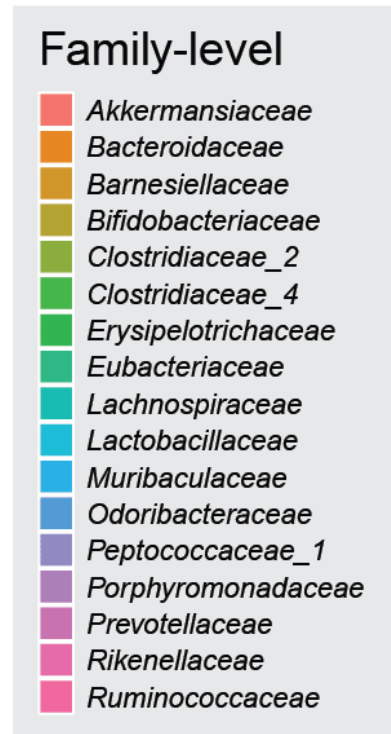
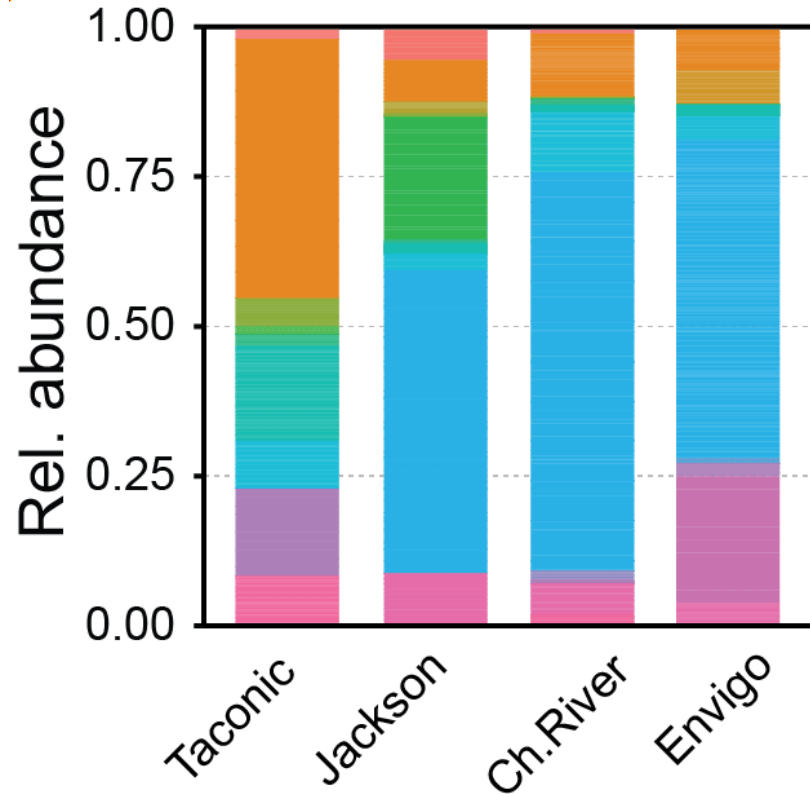


What are the characteristics of a microbial community?

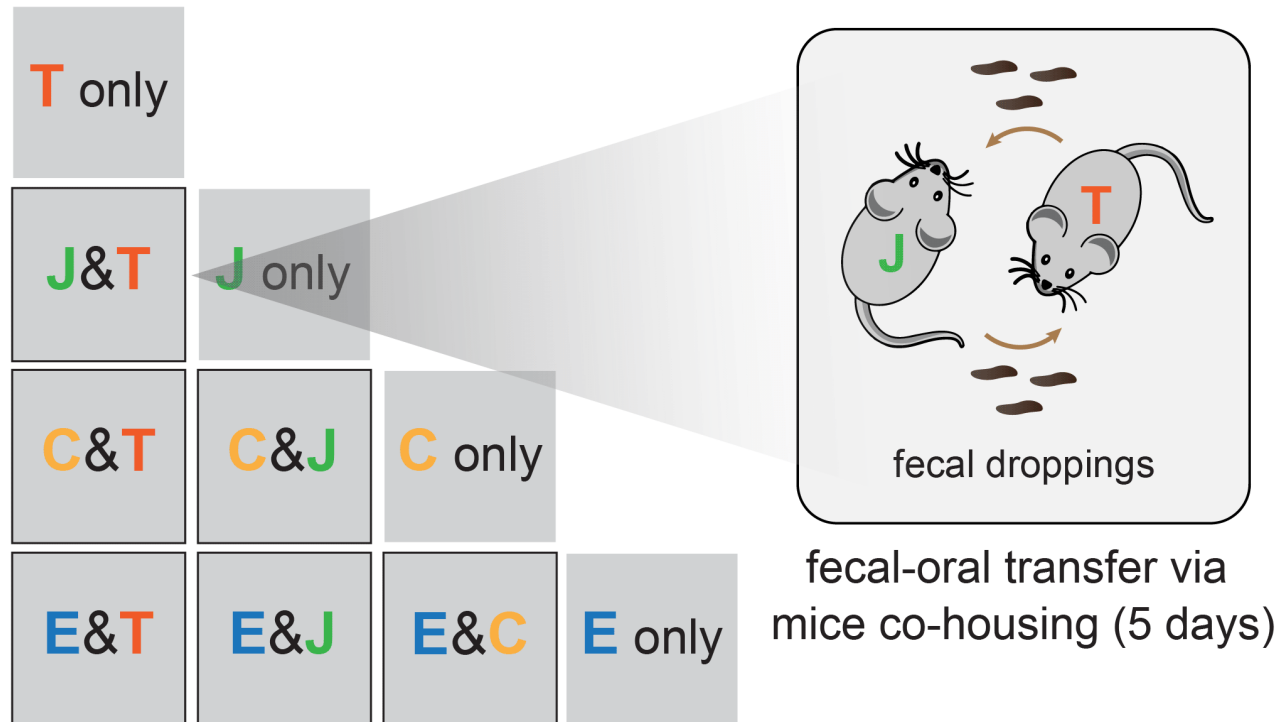


Murine models to study the spatiotemporal dynamics of **microbes** during FMT

# Mouse microbiomes vary between commercial vendors

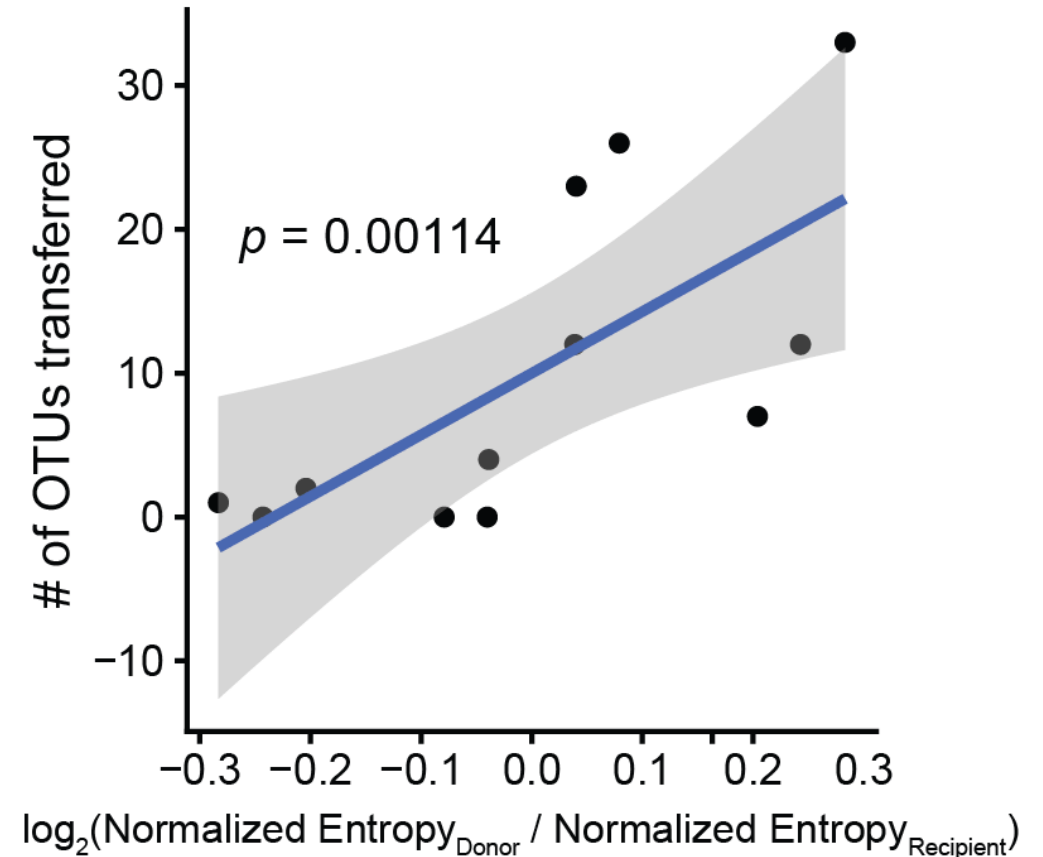
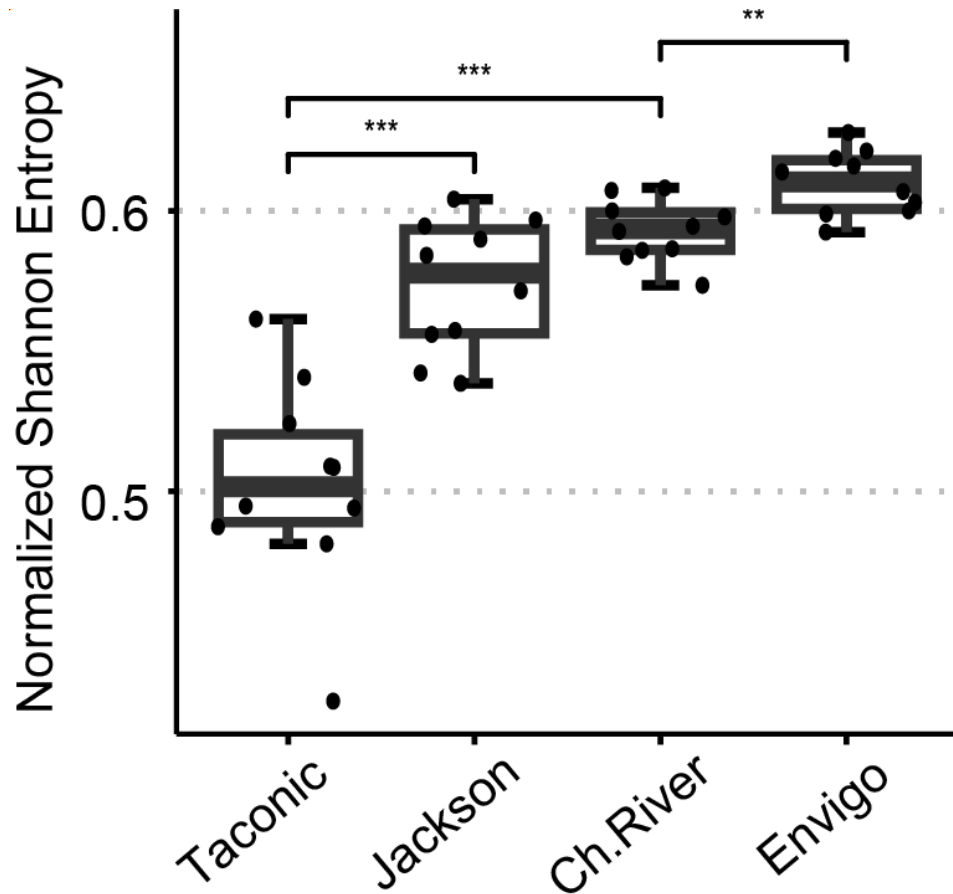


# FMT via co-housing identifies Envigo 'Super Donor'





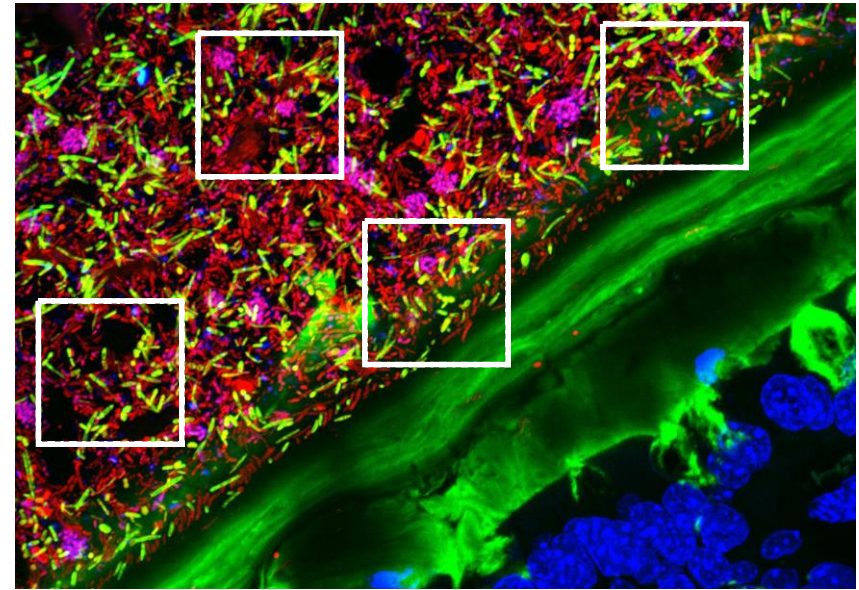
# Donor:Recipient entropy correlates with FMT outcomes



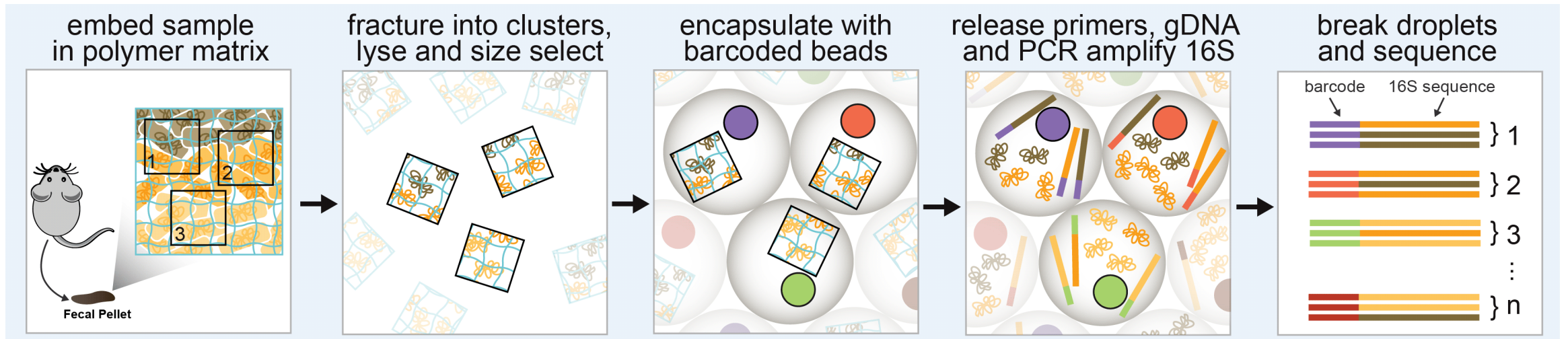
# MaPS-seq: Micron-scale ecological surveys



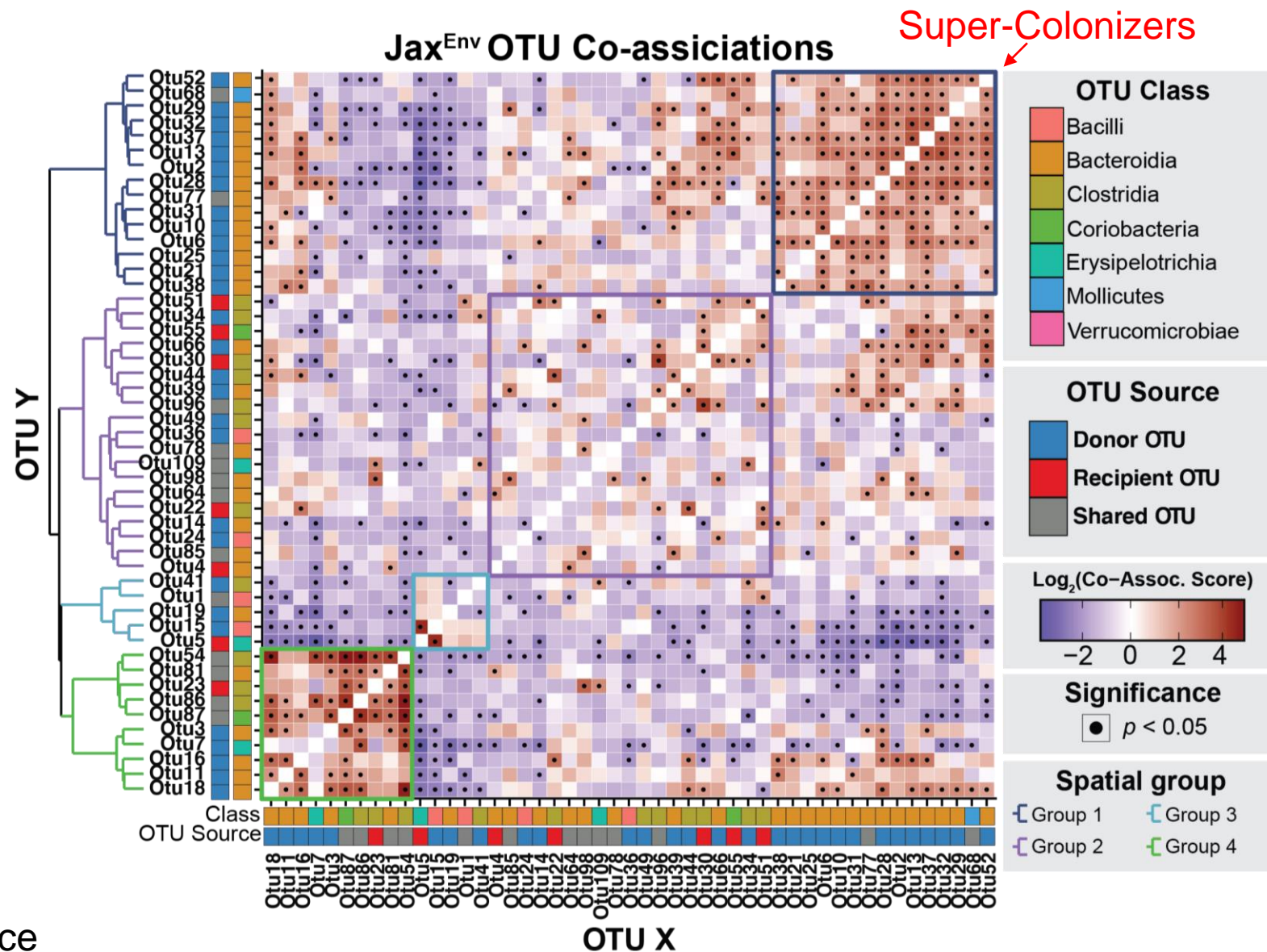
Quadrat Sampling



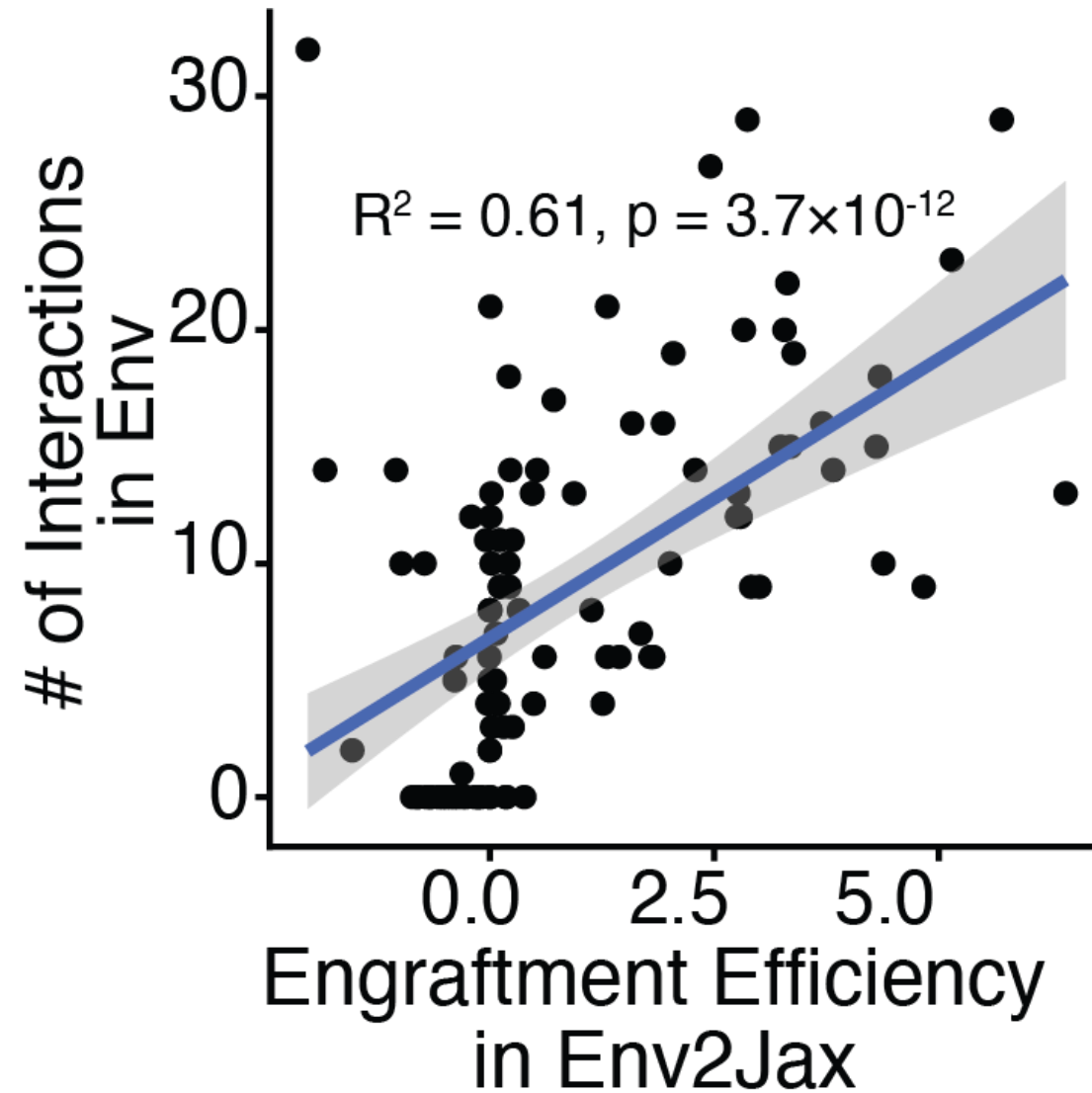
Kristen Earle. Photomicrography competition. 2015.



# Super-Colonizing Bacteria form Spatial Associations in FMT Recipients

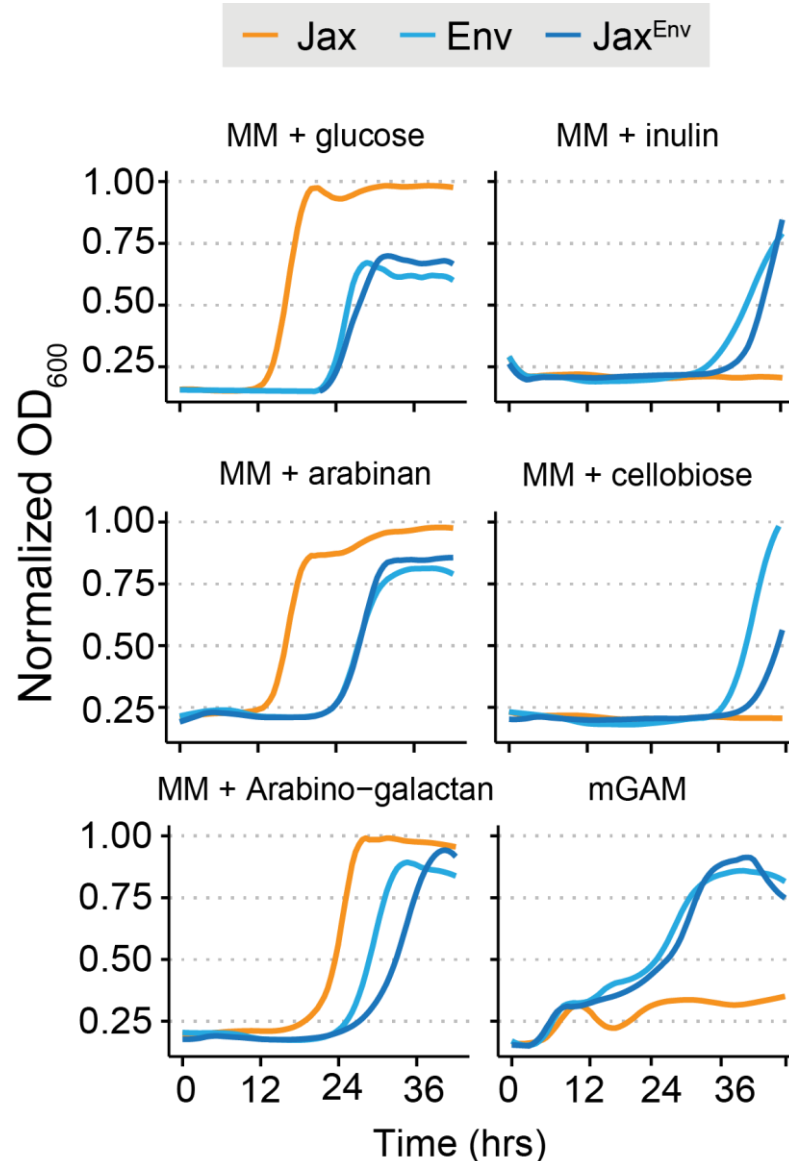
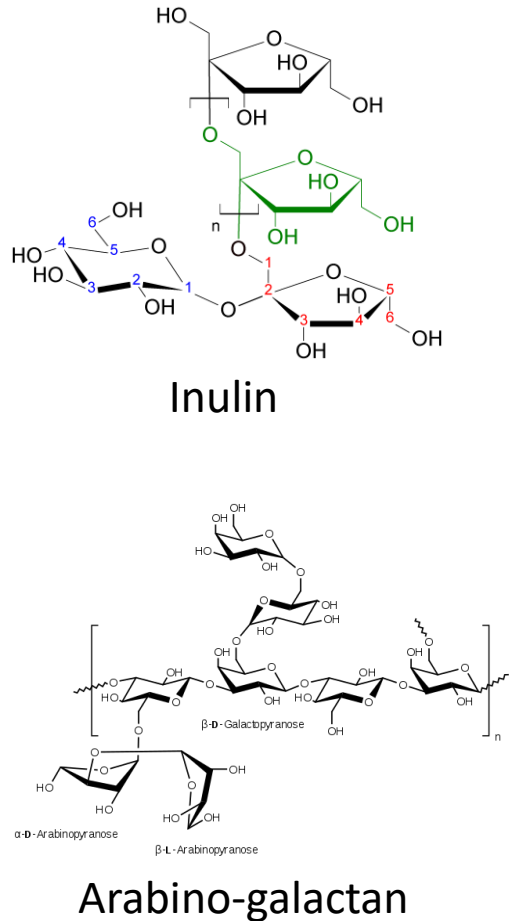


# Interactions within donor microbiome correlate with engraftment in recipient



Env = Donor  
Env2Jax = Post FMT mice

# 'Super Colonizers' metabolize broad sources of nutrients

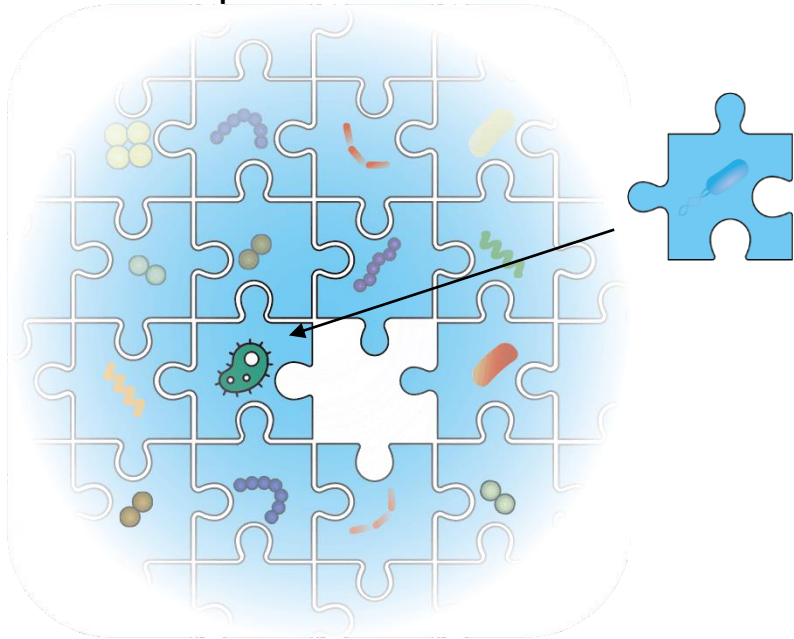


Key idea:  
 'Super Colonizers' access unused **nutrient niches** within the host

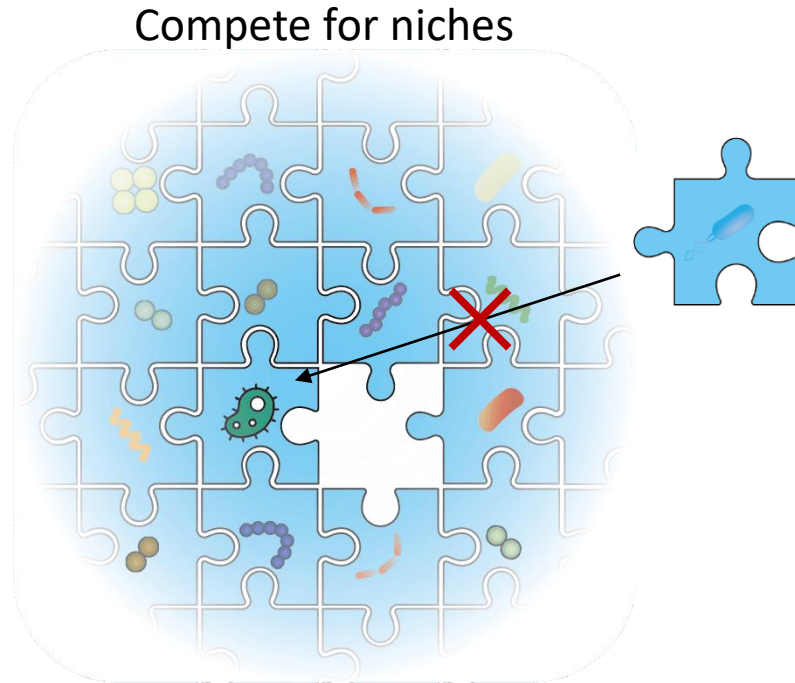
Jax<sup>Env</sup> = Post FMT mice

# Niche accession dictates colonization

Compete for niches

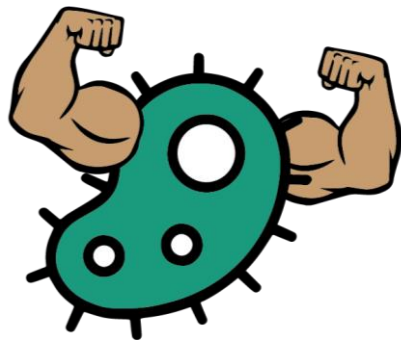
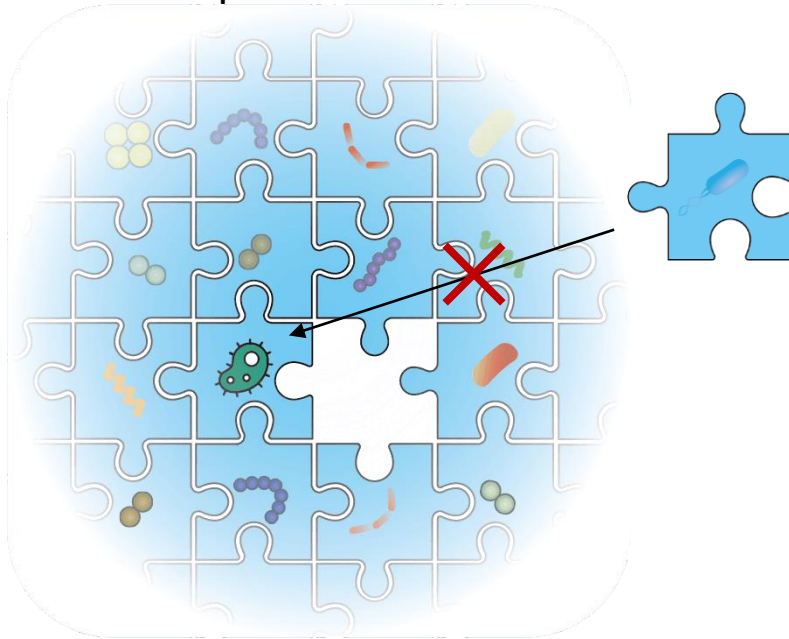


# Niche accession dictates colonization

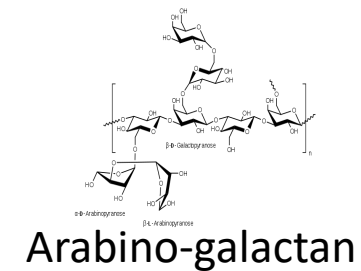
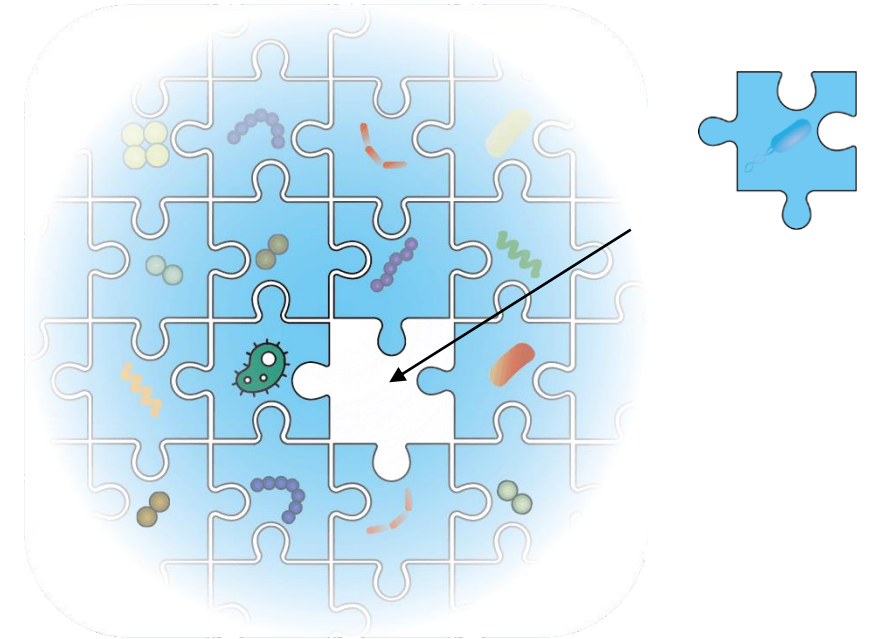


# Niche accession dictates colonization

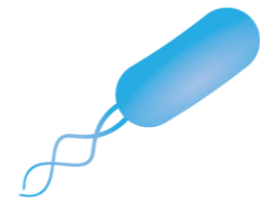
Compete for niches



Access unused niches



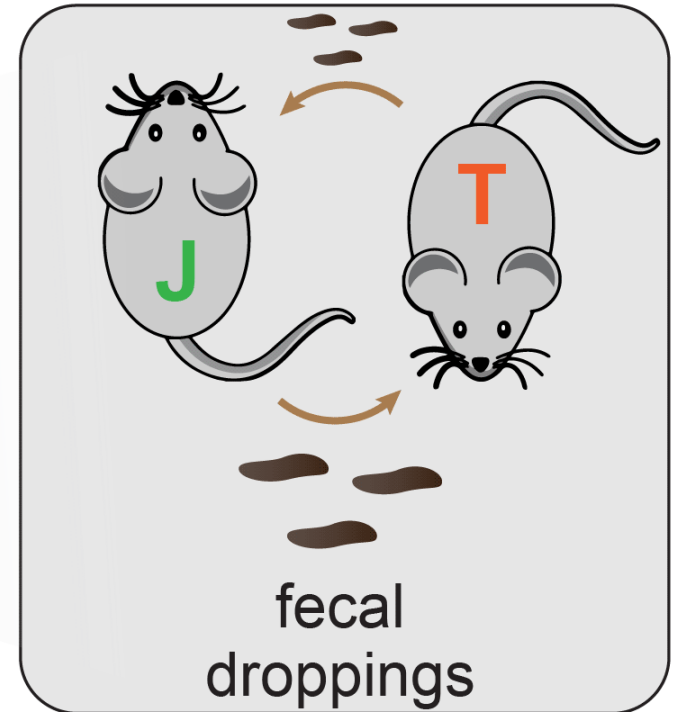
Arabino-galactan





# Summary & Conclusions

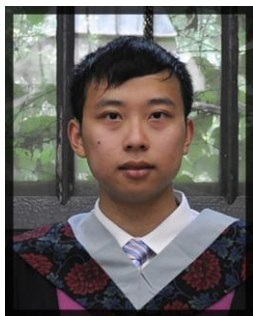
- **Super colonization** is associated with higher diversity & spatial associations
- Spatially-associating communities may **cooperatively access unused nutrients** to promote colonization
- Microbiome **niche complementarity** should be a guiding principle in FMT therapies



# Acknowledgements & Questions



Thomas Moody



Yiming  
Huang



Mouse  
cohort



Wang Lab



Florencia  
Velez-Cortes

## Collaborators

Georg K. Gerber (HMS)  
Travis E. Gibson (HMS)  
Thaiss Lab (U Penn)



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Richardson



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