

The Evolution of Human and Ape Gut Microbiomes

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- van Leeuwenhoek - Drapeau
- looking at fabric

- saw book by Robert Hooke

- started building better microscopes

- Letters to Royal Society

- then found single-celled organisms

- Royal Society didn't believe it

- sent Robert Hooke

- eventually whole field started

- New Era of Leeuwenhoek-esque cataloging

- Human Microbiome project

- many possible/known functions

- Big questions

- which co-evolve w/ humans

- genetic basis of relationship

- how alter evolution

} but no
answers
so will talk
about related
work

1) How has composition of gut microbiota Δ d during human evolution

2) Have gut bacteria co-speciated w/ humans + apes

3)

Great apes harbor clues about ancestral states

@ what lineages found in Apes

100s of Apes across Africa

- chimps, gorillas,
- fecal samples

- rRNA PCR \rightarrow relative abundances

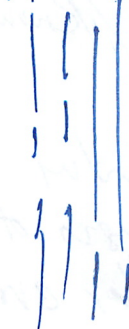
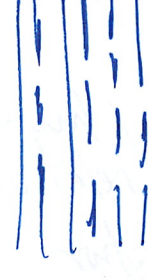
- everything from my ptd in one slide

Gorillas

Bonobos

Chimps

HMP

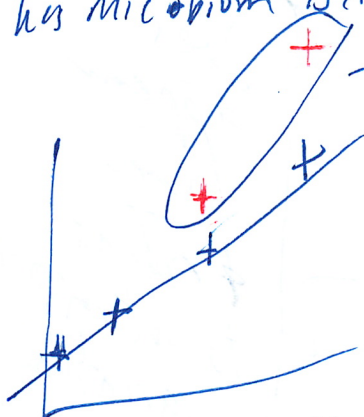


PCA



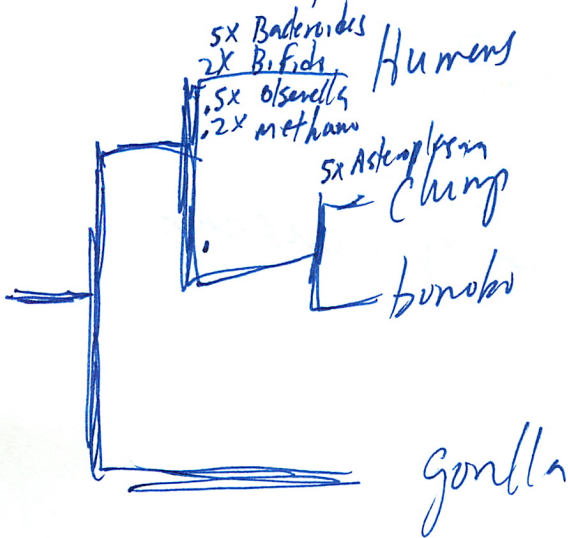
How has microbiome β d over host evolution

Bray Curtis



- humans in US more divergent than expected

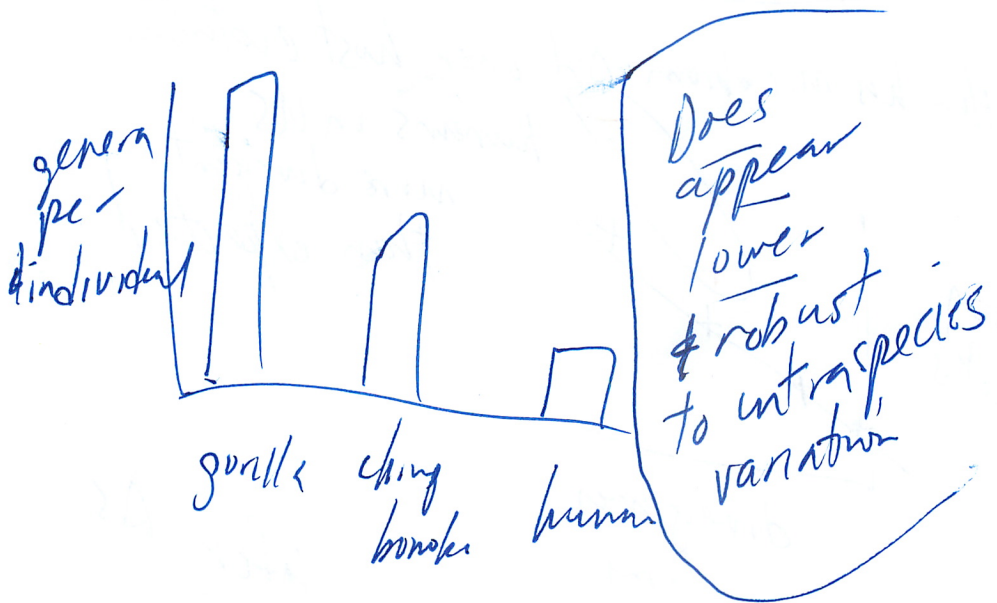
divergence from



infer β d using Parsimony

Have humans lost microbial diversity?

Some propose this → Blaxter can test this.



But unclear why?

• don't appear to be due to geography, lifestyle, disease status

2. Have gut bacteria cospeciated w/ humans + apes

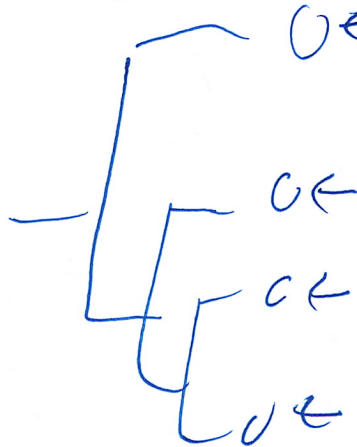
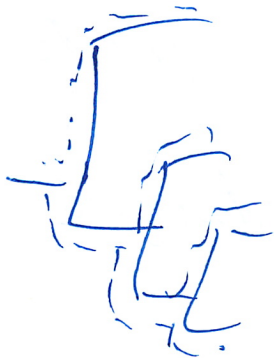
Refs Moran
+ Sloan

Figure

Plus Bu 2015

cospeciation

separate assembly



can't resolve w/
16S sequencing
so switch to gyrase B
family specific primers

- Bact. / Bifido - topologues
microv host phylogeny

w/ one exception of a
Bifido that may have
moved betw. hosts

• some lineages missing from
humans but in every other
primate

∴ some gut bacteria in
humans can trace back to primate
ancestors

• predicts that dates of divergence
should match up

• ~~They appear to match up~~
Lachnospiraceae do NOT
parallel host phylogeny well
• may be related to
spore formation

How are bacteria maintained within host lineage over evolutionary timescales?

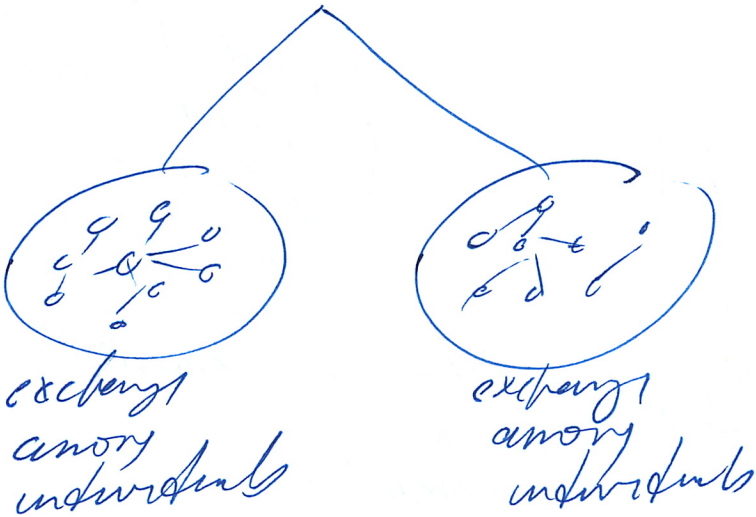
① one possibility - vertical transmission

- e.g. aphid - Buchnera

- does this happen in primates?

^{unclear...}
- development is complex process in humans

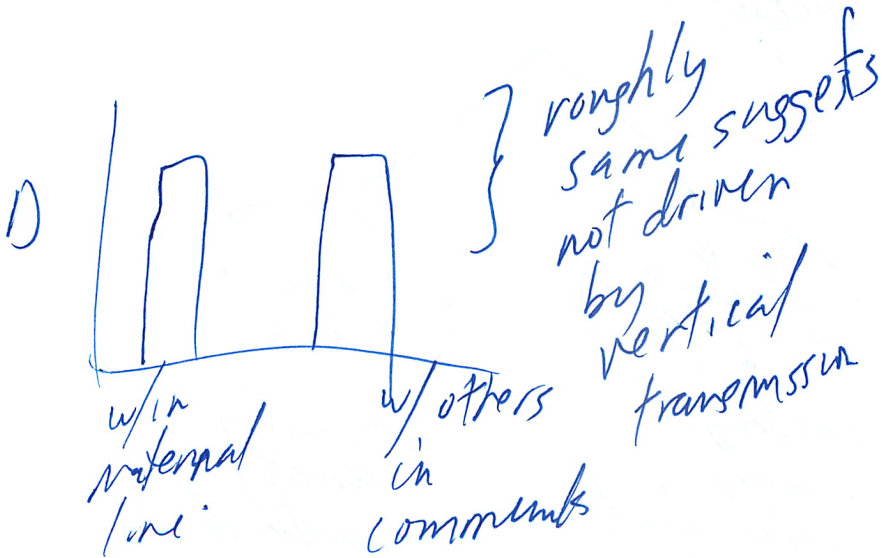
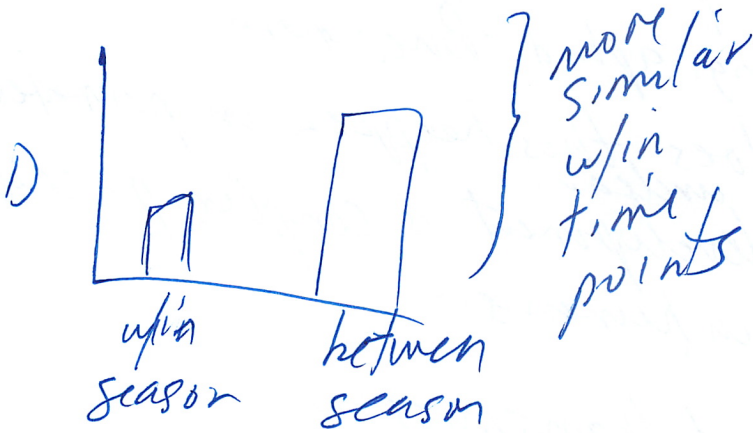
② social transmission

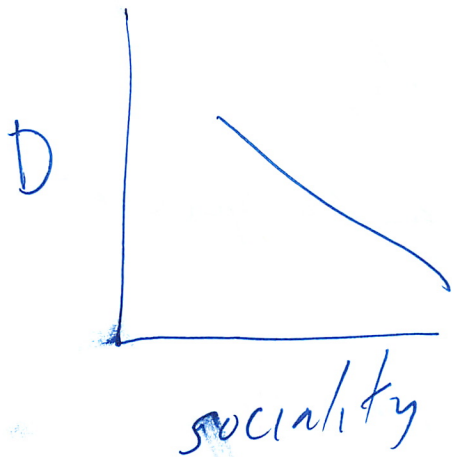


Degnan et al 2012

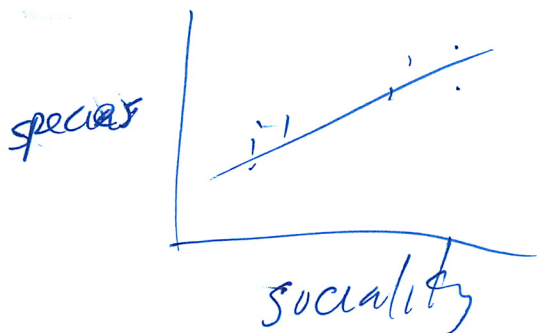
moeller et al sciences advances 2011

composition in chimp communities
shift in parallel over time





when more
social the
diversity
are less



social transmission plays
a big role in microbion

Also similar pattern in eLife
study by Tung et al 2015
of baboons.
Socially structured bacteria
tend to be non spore forming.

Conclusion

- ① Ancestral microbiomes can be reconstructed
- ② Gut bacteria can co-speciate w/ hosts
- ③ Social behaviors may be essential to maintain diversity