

# Docent: Transforming personal intuitions to scientific hypotheses through content learning and process training

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# Worldwide, people use online health fora to share insights and look for answers

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I've discovered that **finding relief from IBS** is like finding a needle in a haystack. I am still searching. **My faith is what is getting me through each day. I am listing all the things that I have done or tried.** Maybe it will be someones needle in the haystack: **Upper GI, Colonoscopy, Vaginal ultrasound, Gluten and food allergy test, Gallbladder ultrasound, Stomache scoped, Abdominal CT scan, Dicyclomine, Pro-biotics, Colestipol... Gluten Free Diet and Specal Carb Diet. Let me know if any of these help you.**

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# Scientists and people can learn from and help each other

Historical Perspectives

Allen B. Weisse, MD


## Self-Experimentation and Its Role in Medical Research

Although experimentation involving human volunteers has attracted intense study, the matter of self-experimentation among medical researchers has received much less attention. Many questions have been answered only in part, or have been left unanswered. How common is this practice? Is it more common among certain nationalities? What have been the predominant medical fields in which self-experimentation has occurred? How dangerous an act has this proved to be? What have been the trends over time? What is the future likely to bring?


From the available literature, I identified and analyzed 465 documented instances of this practice, performed over the course of the past 2 centuries. Most instances occurred in the United States. The peak of self-experimentation occurred in the first half of the 20th century. Eight deaths were recorded. A number of the investigators enjoyed successful careers, including the receipt of Nobel Prizes. Although self-experimentation by physicians and other biological scientists appears to be in decline, the courage of those involved and the benefits to society cannot be denied. **(Tex Heart Inst J 2012;39(1):51-4)**

Article

**Cell**  
Noninvasive Deep Brain Stimulation via Temporally Interfering Electric Fields



COMMUNITY DETAILS

 r/tDCS

10.7k  
Subscribers

33  
Online

A subreddit for discussing the science, technology, construction, and use of noninvasive brain stimulators.

SUBSCRIBE

CREATE POST

People’s insights can help scientists discover novel ideas

Scientific research can better inform people’s discussions



# Understanding the human microbiome requires insights into people's lifestyles

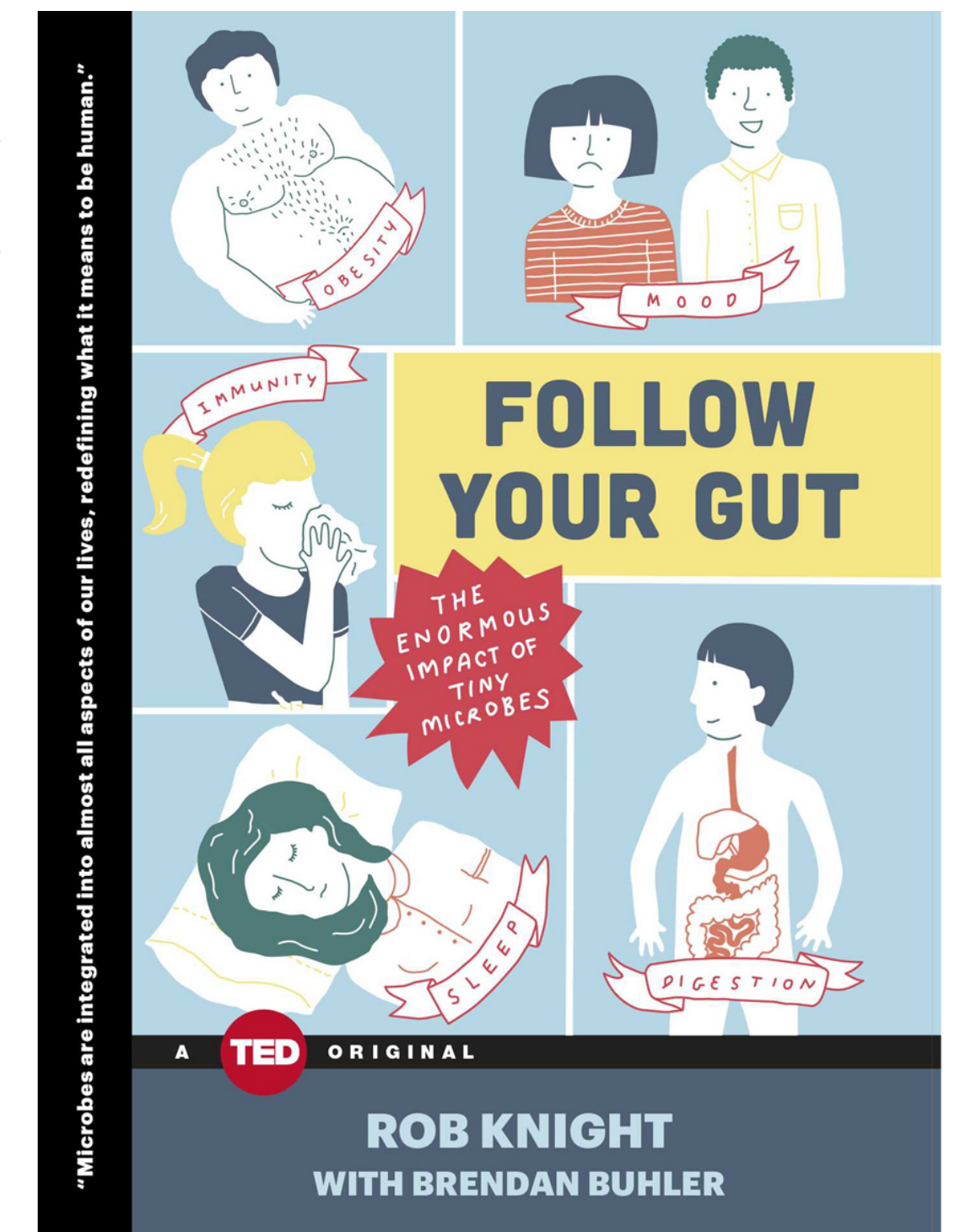
## *A Baffling Brain Defect Is Linked to Gut Bacteria,*

By GINA KOLATA MAY 10, 2017



## Are Pets the New Probiotic?

By RICHARD SCHIFFMAN JUNE 6, 2017



[Flegr et al. 1996] Induction of changes in human behaviour by the parasitic protozoan *Toxoplasma gondii*. Flegr J1, Zitková S, Kodym P, Frynta D. Parasitology 1996.



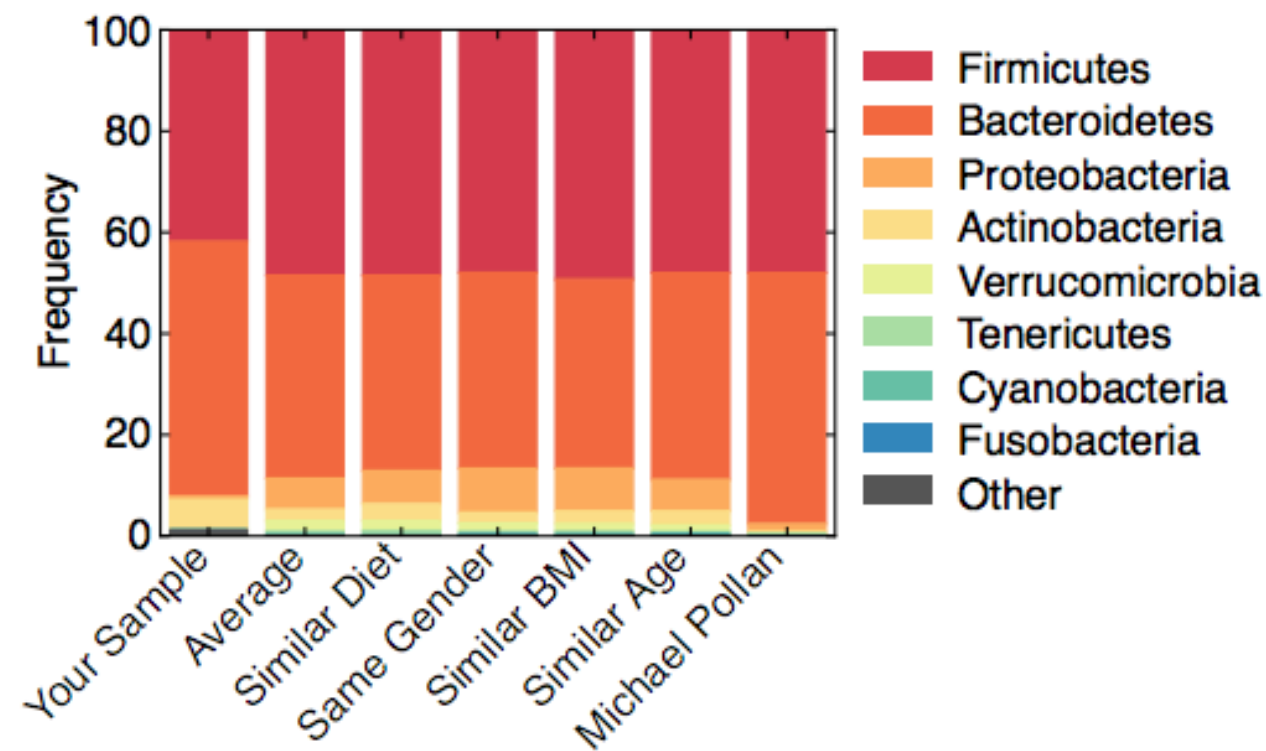


# YOUR AMERICAN GUT SAMPLE

americangut.org

## VINEET PANDEY

What's in your American Gut sample?



Your most abundant microbes:

Taxonomy	Sample
Genus <i>Prevotella</i>	50.1%
Family Lachnospiraceae	12.0%
Family Ruminococcaceae	6.4%
Genus <i>Faecalibacterium</i>	5.8%

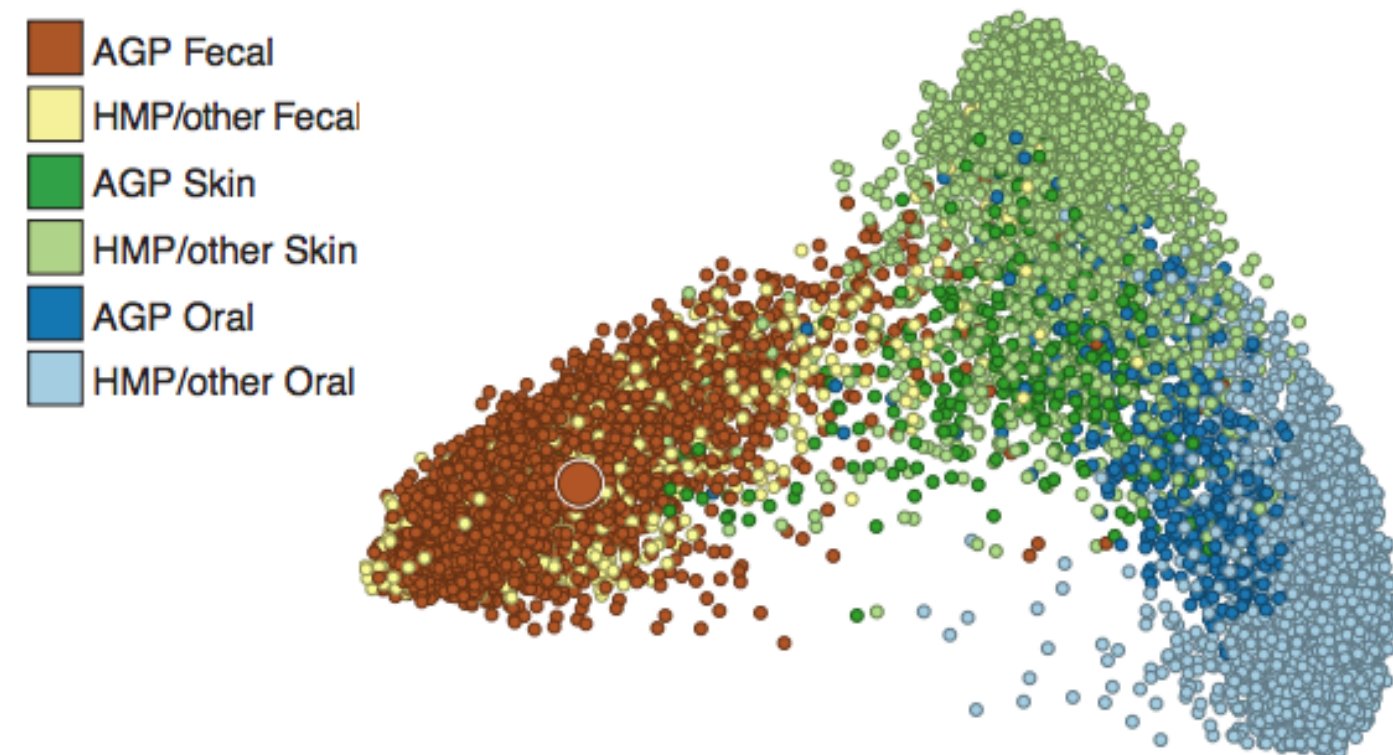
Your most enriched microbes:

Taxonomy	Sample	Population	Fold
Genus <i>Slackia</i>	0.09%	0.01%	9x
Family Victivallaceae	1.04%	0.02%	60x
Family Lachnospiraceae	12.00%	6.98%	2x
cont. Genus <i>Eubacterium</i>	1.02%	0.28%	4x

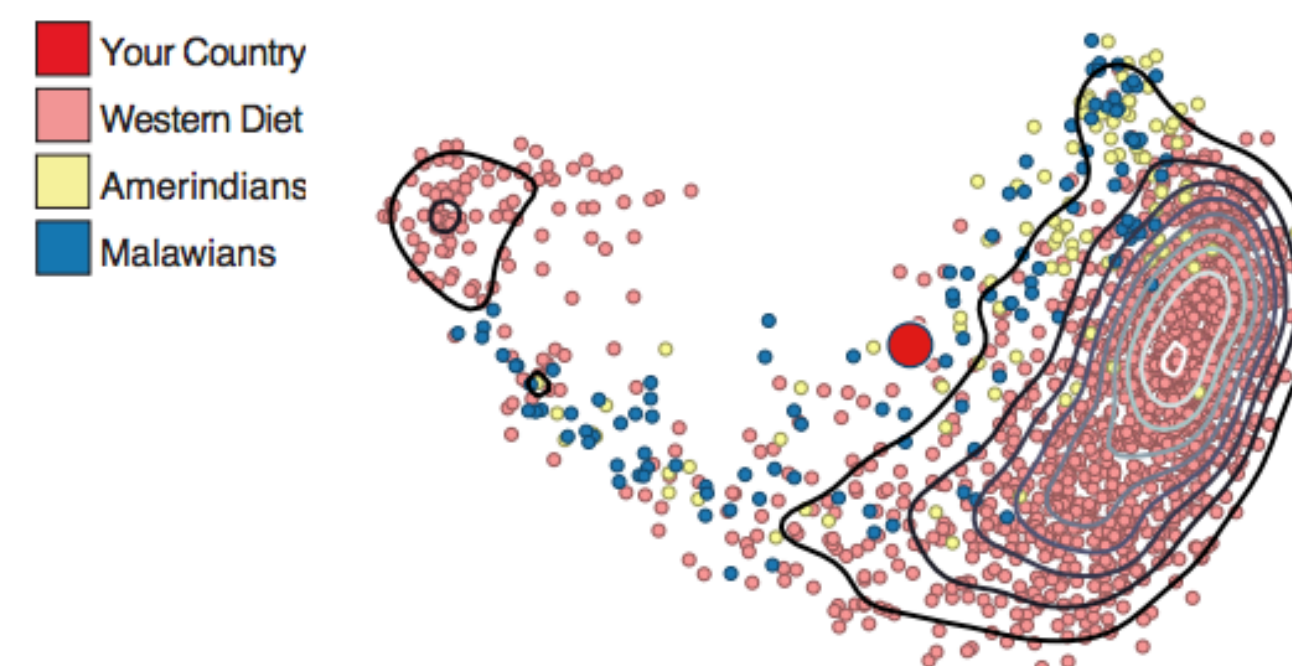
Your sample contained the following rare taxa: Unclassified Family Microbacteriaceae, Genus *Pseudoclavibacter*.

How do your gut microbes compare to others?

● Your sample is here ● Others ● Unspecified



Different Body Sites



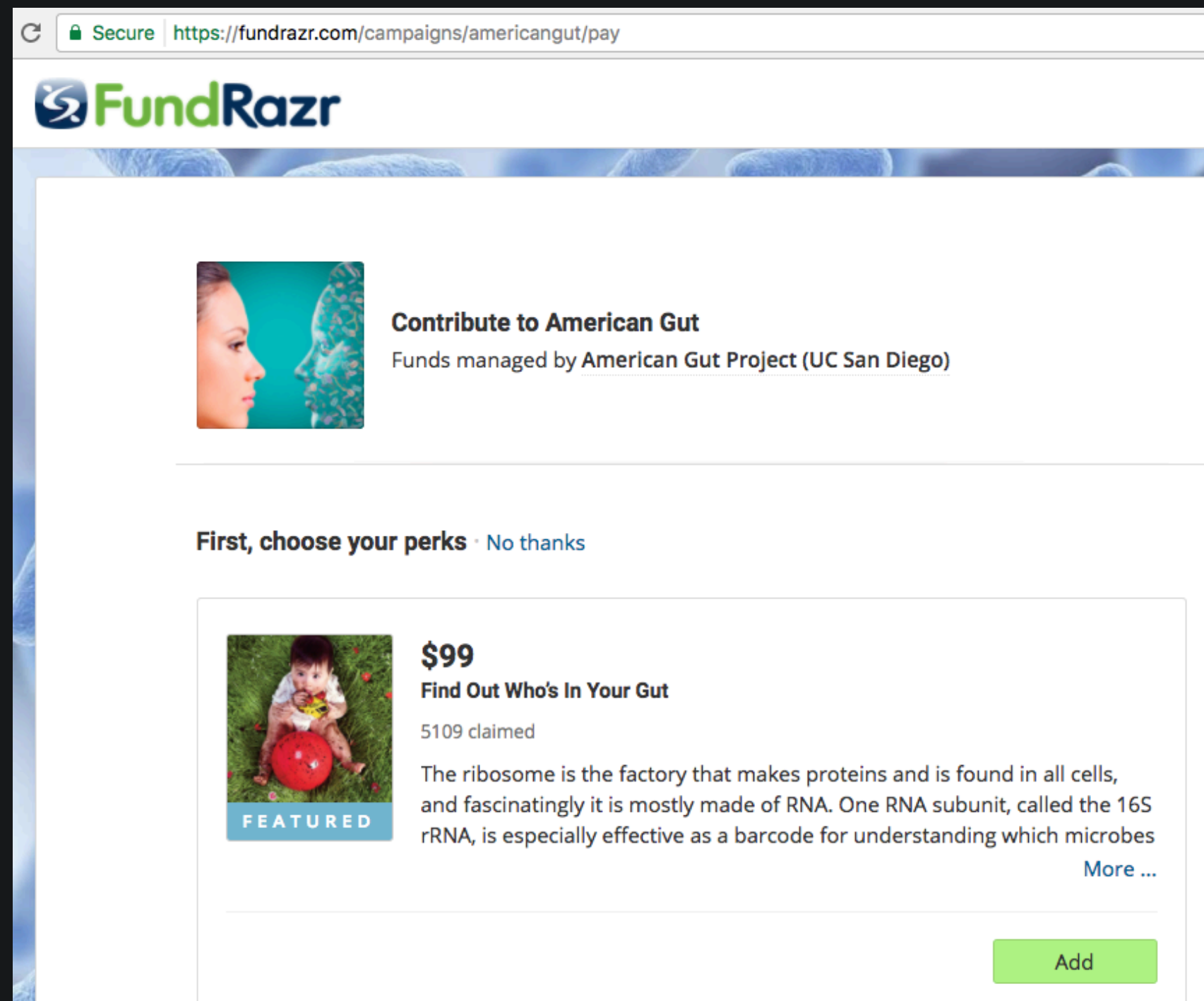
Different Nationalities



The American Gut Population



# UC San Diego's American Gut is the world's largest microbiome citizen science project



**1: Create an online account and support the project**



**2: Send in your fecal/oral/skin samples using AGP provided swabs**

**americangut.org**

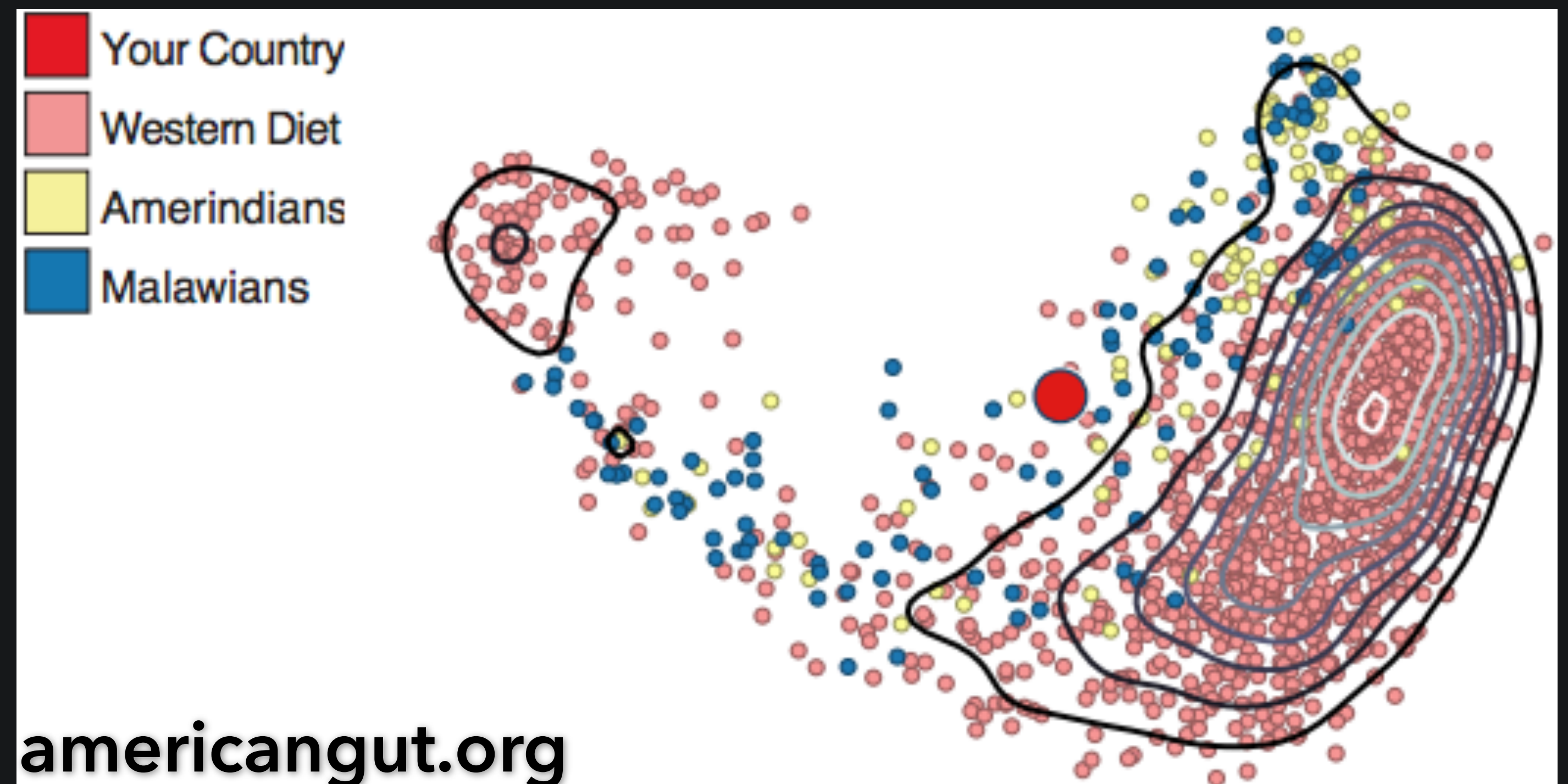


# Participants generate hypotheses by looking at the data



Is my data point unique because

1. My diet is vegetarian?
2. I am of Indian descent?
3. I grew up in India?





# Scientists and people can learn from and help each other (microbiome edition)

## *Antibiotics Weren't Used to Cure These Patients. Fecal Bacteria Were.*

In a small study, doctors used so-called fecal transplants to treat a serious gut infection in patients. The transplants, from healthy donors, were as effective as antibiotics.

By Gina Kolata

June 2, 2018



**Fecal transplants help improve C.Difficile condition**

<https://www.nytimes.com/2018/06/02/health/fecal-transplants-bacteria-antibiotics.html>

## TECH & SCIENCE

## DIY FECAL TRANSPLANTS ARE DANGEROUS AND COULD TRANSMIT HIV, DOCTORS WARN

BY MELISSA MATTHEWS ON 2/17/18 AT 8:00 AM

## Sham Poo Washes Out

A bacterial pill that tried to duplicate the benefits of a fecal transplant has failed a clinical trial. What does that mean for the microbiome field?

ED YONG | AUG 1, 2016 | SCIENCE

**Ill-advised fecal transplants can do long-term harm**

<http://www.newsweek.com/diy-fecal-transplants-are-dangerous-and-could-transmit-hiv-doctors-warn-810003>



# Personalized medicine at scale needs insights from people's lived experiences

Scientific domains that are

**Nascent** Experts know little

**Contextual** Huge individual differences

**Motivating** People care

**Genomics**  
*23andme*



**Microbiome**  
*American Gut*





# How might people's situated knowledge supplement ivory-tower science? One instance: Misophonia genetic markers



23andmeforums.com/discussion/comment/19190#Comment\_19190

I didn't realize I had this until a friend pointed me to this website: [misophonia.com/](https://misophonia.com/). Turns out my dad has the same condition. We both can not stand, with a sure hatred, when we hear food noises (crunching, chewing, slurping, gulping, etc.)

Does anyone else have this condition? If so, do you find it is exaggerated when you are sleep deprived?

3 Like Flag

**1. Crowds share unique observations**

Q chew

Showing 1-1 of 1

☒ Does the sound of other people **chewing** fill you with rage?

☐ Yes

☐ No

☐ I'm not sure

**2. Scientists add this to the survey**

23andMe @23andMe Follow

Do you suffer from feelings of rage from hearing other people chew? Misophonia might be in your genes.

We found a genetic marker associated with misophonia on chromosome 5

rs2937573 associated with misophonia

TENM2 gene  
Brain development

\*Findings based on responses from 23andMe research participants.

RETWEETS 36 LIKES 53

**3. Scientists unearth novel knowledge**



**Vision: Enable internet-scale personally-meaningful scientific work by building online learning systems**

**Domain-specific knowledge improves work quality**

**+ Summarize current research**

**+ Focus on novel ideas**



# Vision: Enable internet-scale personally-meaningful scientific work by building online learning systems

## Domain-specific knowledge improves work quality

- + Summarize current research
- + Focus on novel ideas

## Diversity and scale improve odds of success

- + Guard against individual shortcomings
- + Mitigate against groupthink



**Vision: Enable internet-scale personally-meaningful scientific work by building online learning systems**

From intuitions/folk theories.. (*CHI 2017*)

..to hypotheses (***Docent: Learn-Train-Ask: L@S 2018***)

..to experiments (***Galileo: Self-organized crowd expts***)



# Step 1: Learn about probiotics + the microbiome

gutinstinct-ucsd.org/personal/probiotics

Confused? Add more questions! Topics Guide GutBoard Notifications

## Understand your Gut

To help you relate the learning material to your lifestyle, please answer the following questions!

Why do you use probiotics?

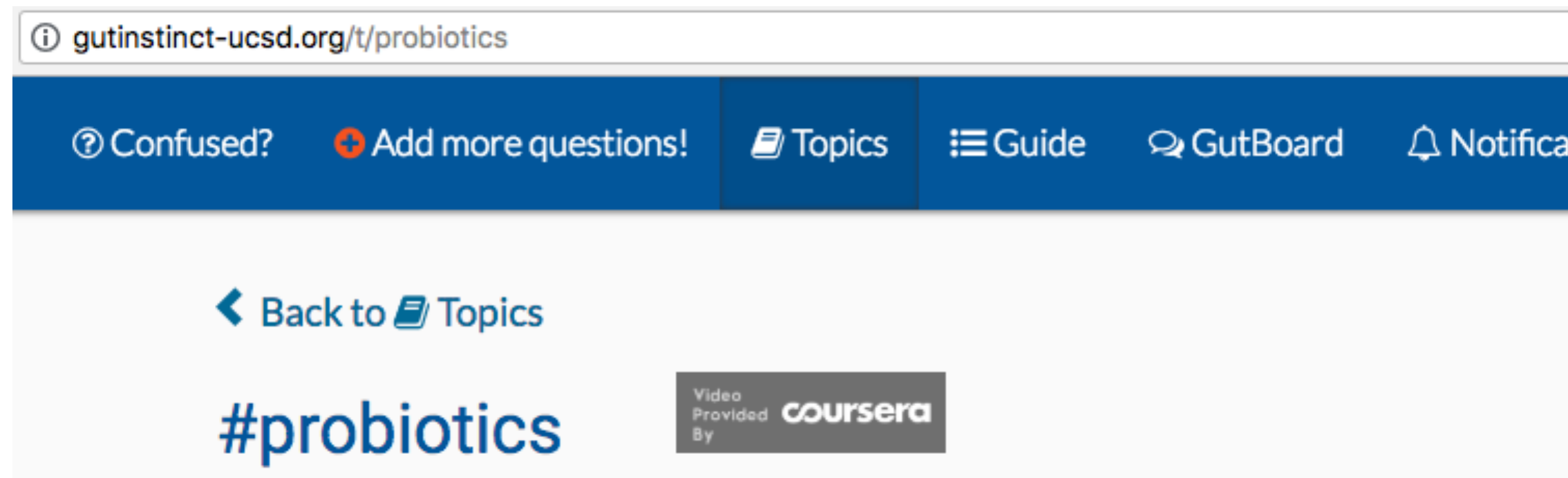
- ☐ To cure upset stomach
- ☐ Promote healthy gut flora
- ☐ Boost my immunity
- ☐ To alleviate constipation
- ☐ i dont
- ☐ Add your own option

Which probiotics do you use?

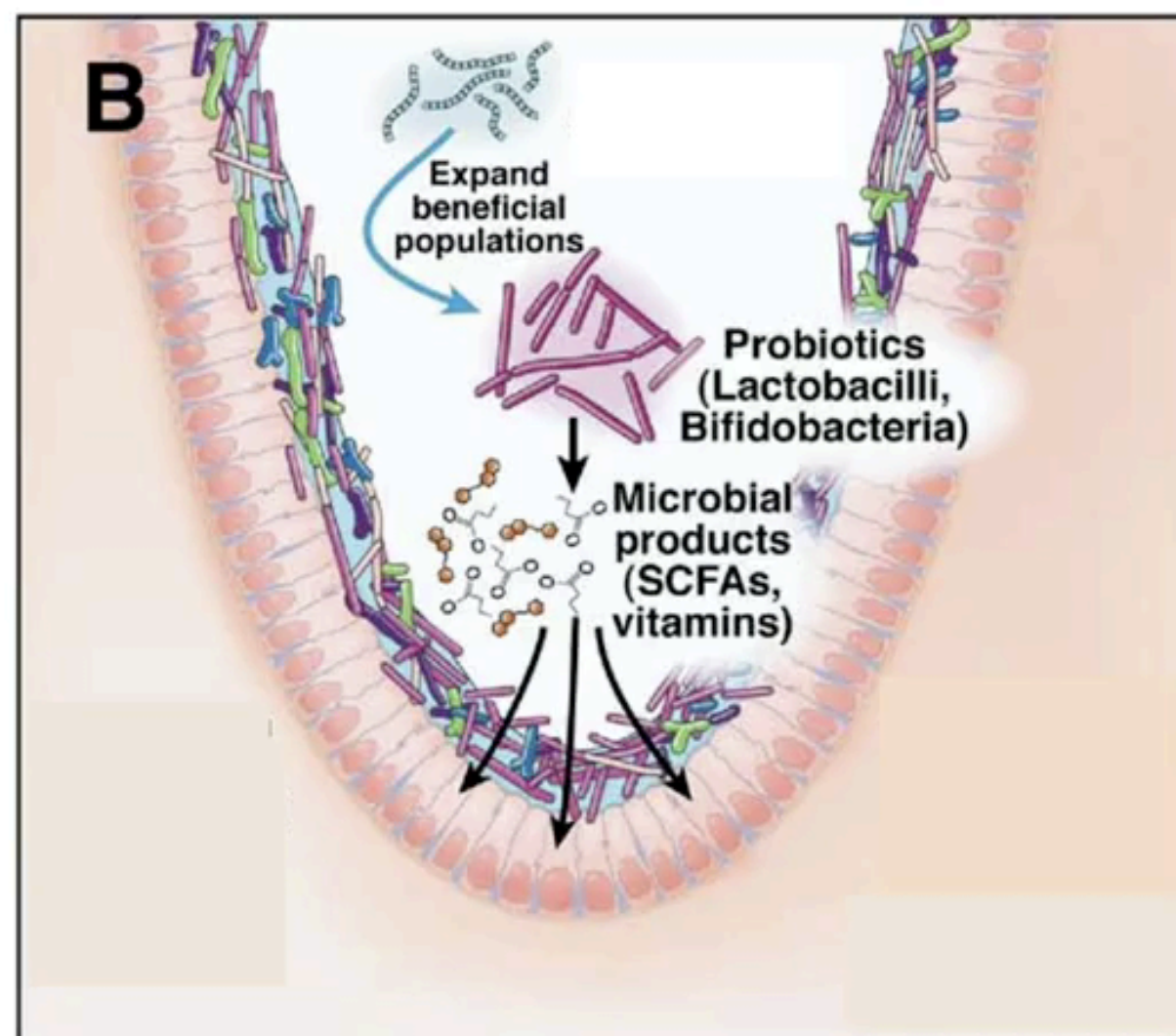
**Reflect on lifestyle by  
answering basic questions  
about probiotics use**



# Step 1: Learn about probiotics + the microbiome



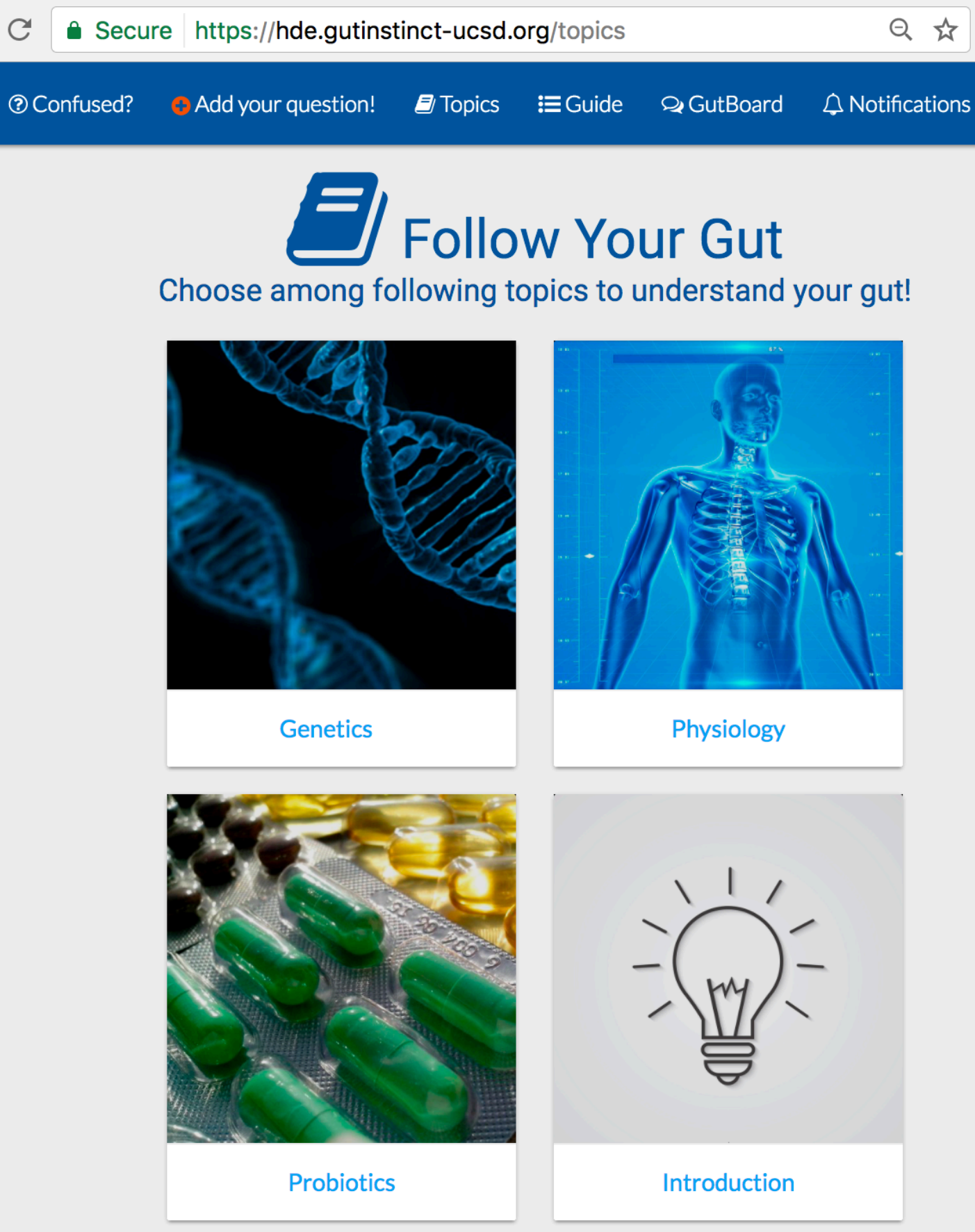
**Watch a 4-minute lecture  
that synthesize current  
research about probiotics**



Preidis and Versalovic 2009, Gastroenterology

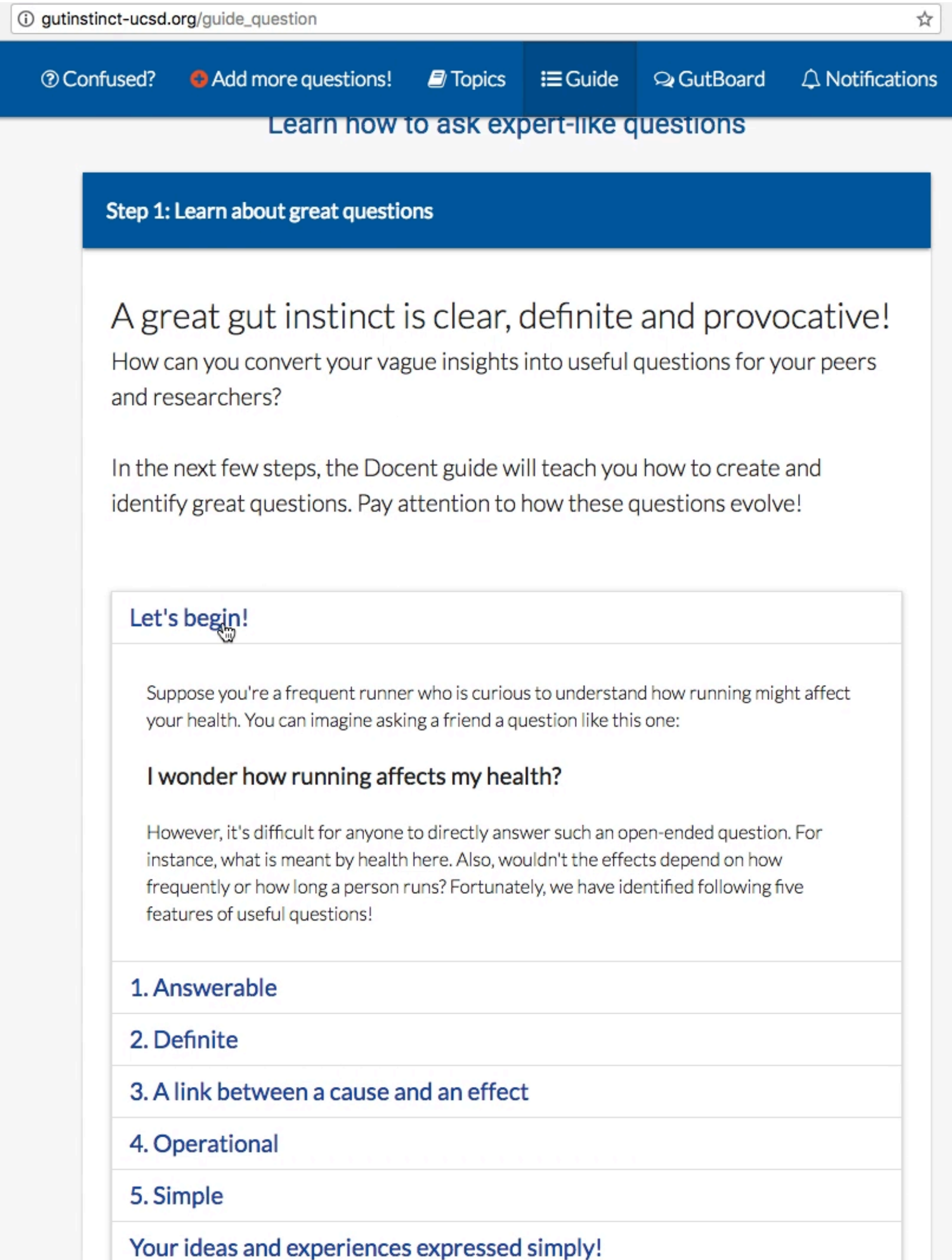


# Step 2: Train to frame useful questions



Learn

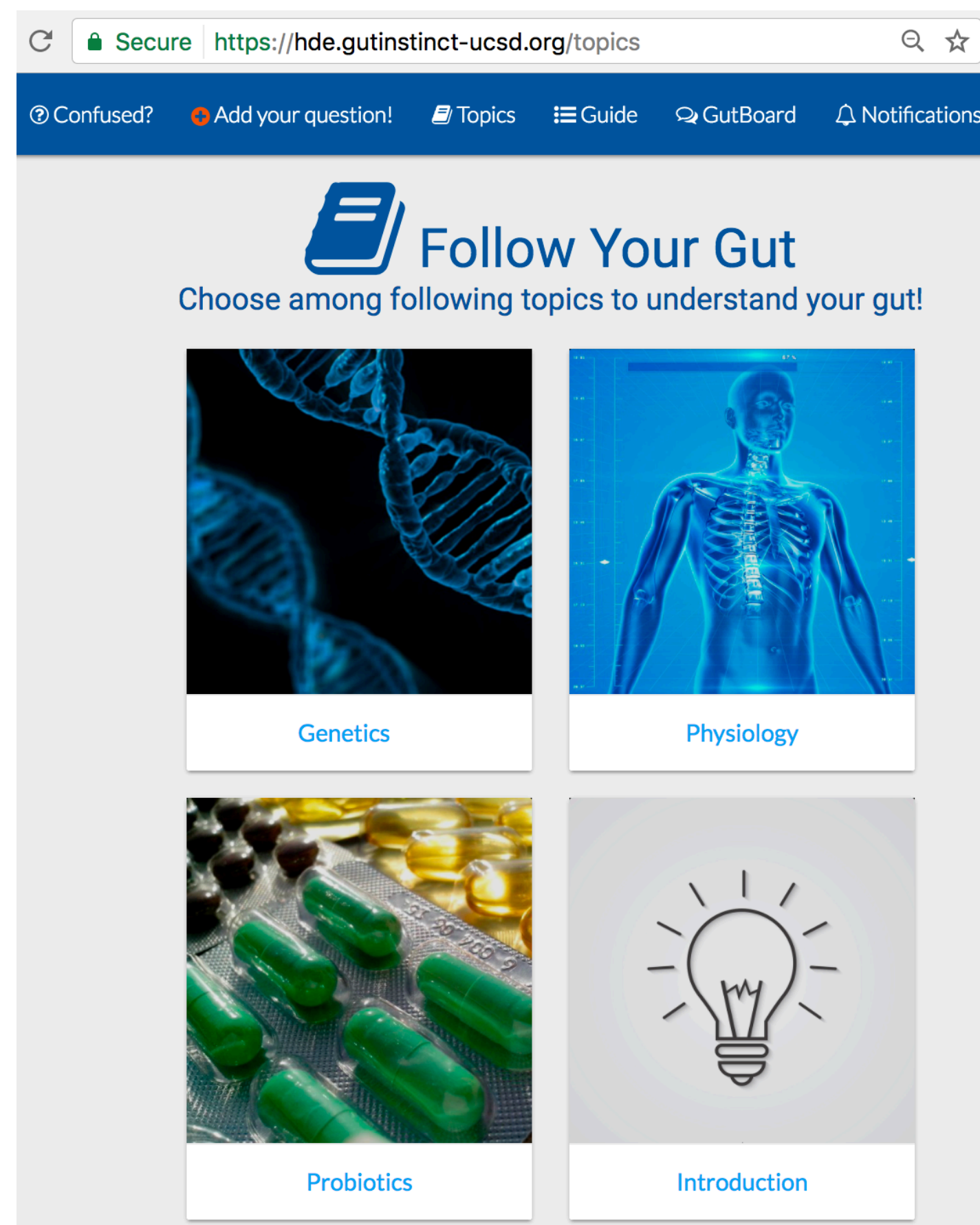
16



Understand what makes a question useful

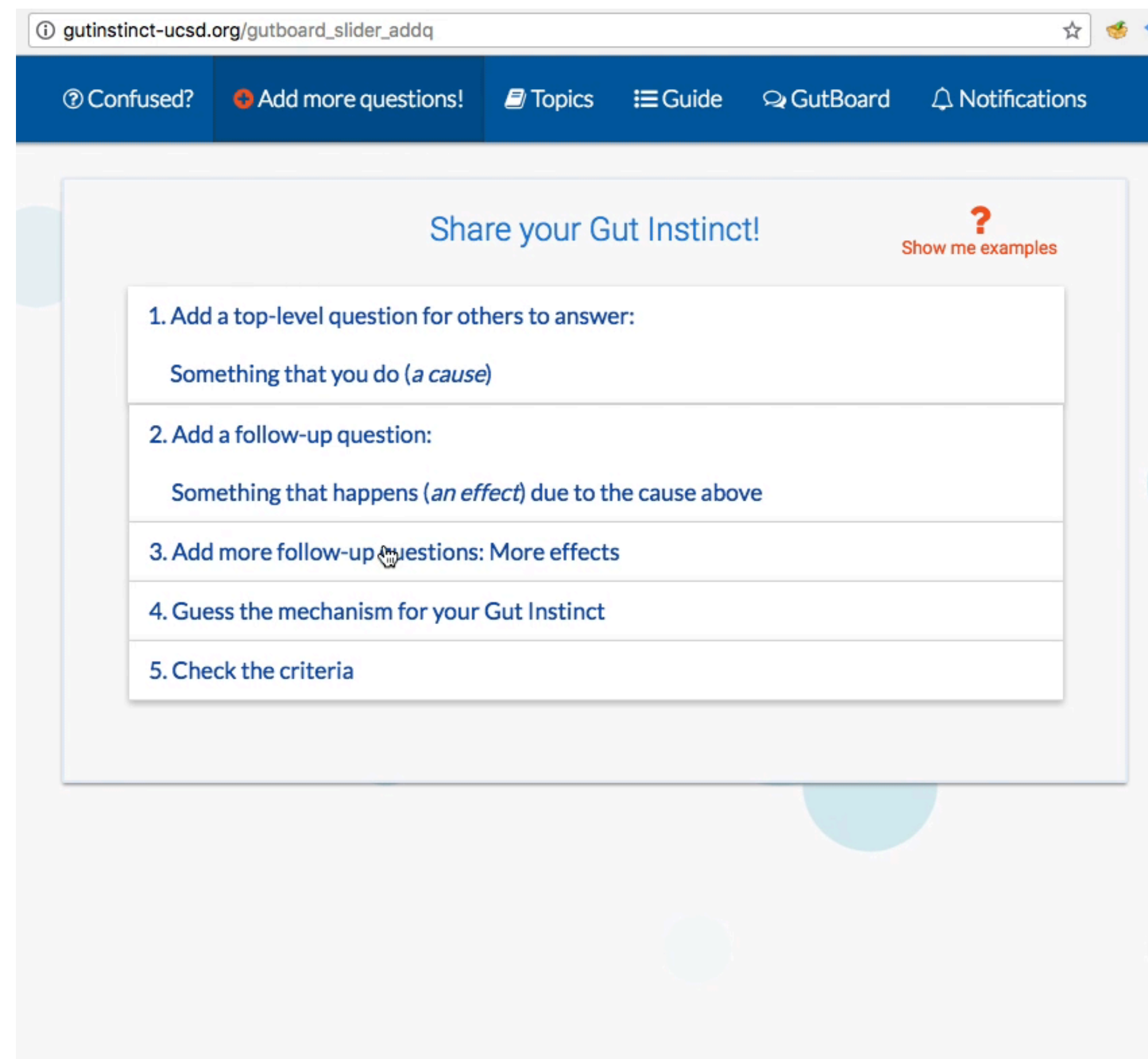


# Step 2: Train to frame useful questions



**Learn**

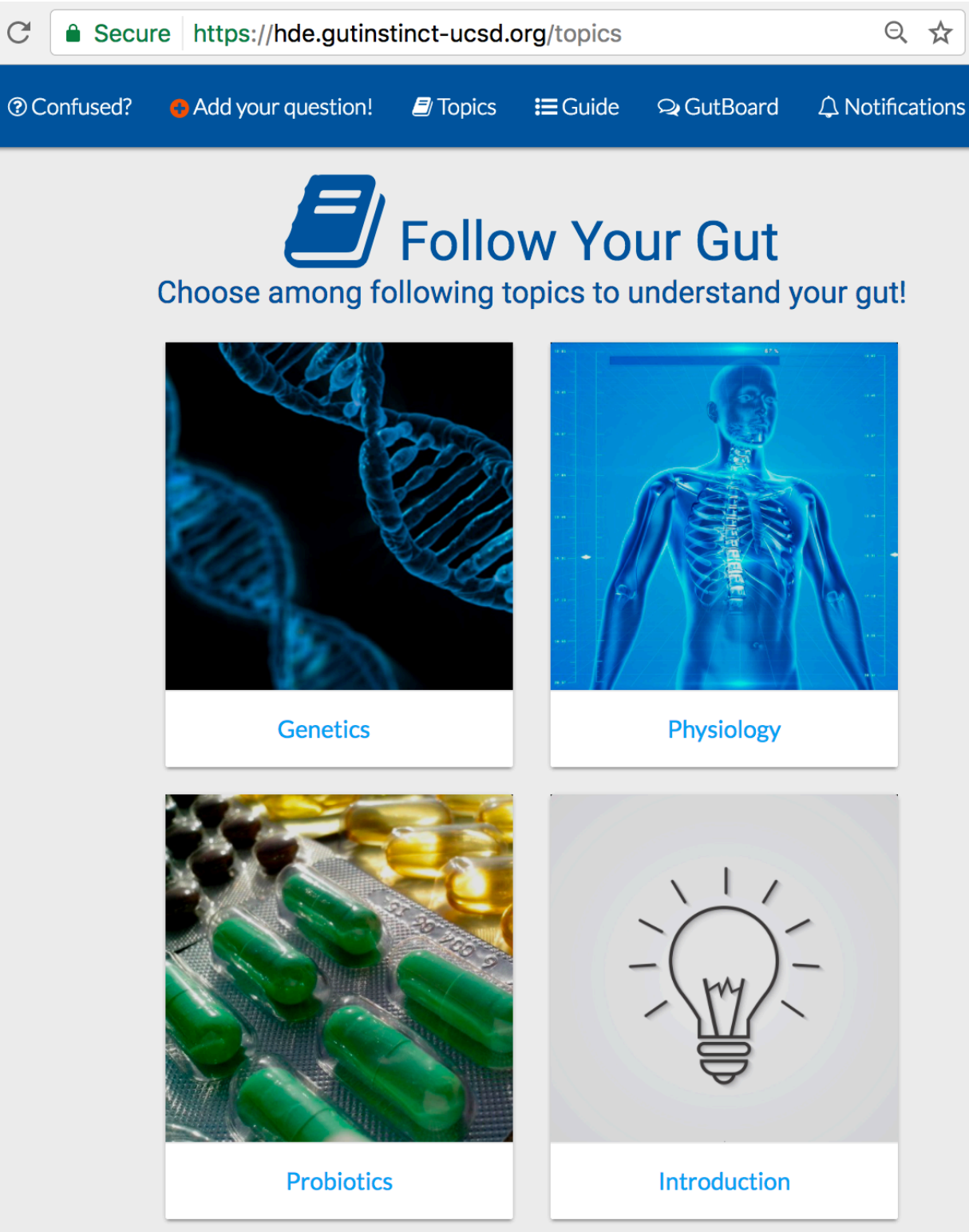
17



**Use the  
criteria when  
adding a  
question**



# Step 3: Ask questions of people



Learn

18

## 5. Check the criteria

Make sure that the combination of your top-level and follow-up questions meets the Gut Instinct criteria!

- ☐ Answerable?  
Others should be able to answer your question
- ☐ Definite?  
A good question includes a clear timeframe
- ☐ Links a cause with an effect?  
Your question should attempt to link an activity with a specific result, allowing others to agree/disagree and share their insights
- ☐ Operational?  
Your question should avoid ambiguous terms that might be difficult to understand for most people
- ☐ Simple?  
A good question is simple to read, to understand, and to answer

Train

Dive deeper with these follow-up questions!

What type of alcoholic drinks (ex wine, beer, liquor, mixed with sugar) affect your bowel movements?

- ☐ wine
- ☐ beer
- ☐ liquor
- ☐ sugary mixed drinks
- ☐ Add my option

Save my choice(s) Skip

How many drinks does it take to notice a difference in your bowel movements?

- ☐ 1-2
- ☐ 3-4
- ☐ 5+
- ☐ Add my option

Save my choice(s) Skip

Ask



# Gut Instinct enables different contribution mechanisms

Dive deeper with these follow-up questions!

What type of alcoholic drinks (ex wine, beer, liquor, mixed with sugar) affect your bowel movements?

- ☐ wine
- ☐ beer
- ☐ liquor
- ☐ sugary mixed drinks
- ☐ [Add my option](#)

Save my choice(s)

Skip

How many drinks does it take to notice a difference in your bowel movements?

- ☐ 1-2
- ☐ 3-4
- ☐ 5+
- ☐ [Add my option](#)

Save my choice(s)

Skip

by [phenylalanine](#) 14 days ago

0 Upvotes  | 0 Downvotes 


How much popcorn are you eating? How salty is it? Do you drink enough water with it to stay hydrated? I rarely have issues with constipation/BMs and I've never noticed any food-related changes except if I do something extreme such as eating an entire jar of hot peppers or drinking a jar of pickle juice (just .... a bad idea. don't do it.)

by [Cangussumicrobiome](#) 18 days ago

0 Upvotes  | 0 Downvotes 

I believe the problem here is the type or quantity of fiber in popcorn.

**Receive feedback to learn about relevant science**

Feedback from scientific material (?) 

Updated 24 days ago  Edit

Hi DND, intriguing question! The topic video about gut-brain-axis might provide some basic information about how our microbiome

state might be linked - [gutinstinct.ucsd.edu/topics](https://gutinstinct.ucsd.edu/topics) Please keep sharing your gut instincts, these are helpful!

Add follow-on questions<sup>19</sup>

Discuss questions and responses

Receive scientific feedback



# Method

## Between-subjects experiment (N=344)

### for Learn and Train w/ 2x2 factorial study

H1 Access to learning  
improves  
question's content

H2 Just-in-time  
training improves  
question's structure

	Train	Both
	<div><div><div>✓ Answerable? Others should be able to answer your question</div><div>✓ Definite? A good question includes a clear timeframe</div></div><div>What type of alcoholic drinks (with sugar) affect your bowel r <input type="checkbox"/> wine <input type="checkbox"/> beer <input type="checkbox"/> liquor <input type="checkbox"/> sugary mixed drinks</div></div>	<div><div><div>✓ Answerable? Others should be able to answer your question</div><div>✓ Definite? A good question includes a clear timeframe</div></div><div>What type of alcoholic drinks (with sugar) affect your bowel r <input type="checkbox"/> wine <input type="checkbox"/> beer <input type="checkbox"/> liquor <input type="checkbox"/> sugary mixed drinks</div></div> <div></div>
	<div>What type of alcoholic drinks (with sugar) affect your bowel r <input type="checkbox"/> wine <input type="checkbox"/> beer <input type="checkbox"/> liquor <input type="checkbox"/> sugary mixed drinks</div> <div>Neither</div>	<div>What type of alcoholic drinks (with sugar) affect your bowel r <input type="checkbox"/> wine <input type="checkbox"/> beer <input type="checkbox"/> liquor <input type="checkbox"/> sugary mixed drinks</div> <div>Learn</div>



# Measures

Question quality coded by blind, independent raters with microbiome expertise (max 5 points)



## Content

**Insightful:** *Does the question & discussion link to existing knowledge of the microbiome?*

**Novel:** *Is there a chance the world will learn something?*

## Structure

**Answerable:** *Is it a question about the participant?*

**Specific:** *Does it ask about only one topic?*

## Creativity

**Is it reasonably interesting/ creative?**



# Measures

## Question quality coded by blind, independent raters with microbiome expertise (max 5 points)

### *High-Quality*

Have you ever eaten raw pumpkin seeds to eliminate parasites?  
(Content: 1, Structure: 2, Creativity: 1)

### *Medium-quality*

Do you get constipated when stressed? (Content: 0.5, Structure: 2, Creativity: 0.5)

### *Low-quality*

Does day of the week influence good vs. bad microbiota? (Content: 0, Structure: 1, Creativity: 0)

### *Content*

**Insightful:** *Does the question & discussion link to existing knowledge of the microbiome?*

**Novel:** *Is there a chance the world will learn something?*

### *Structure*

**Answerable:** *Is it a question about the participant?*

**Specific:** *Does it ask about only one topic?*

### *Creativity*

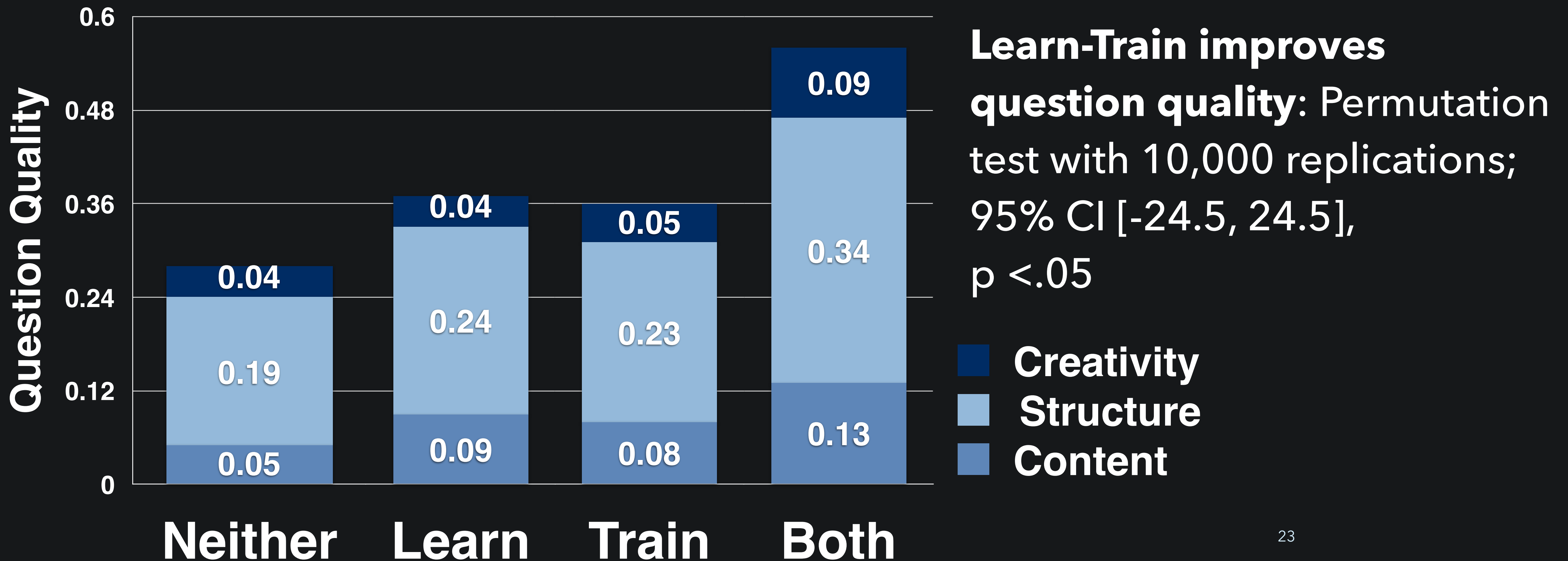
**Is it reasonably interesting/ creative?**

<https://github.com/vineetp13/docent-las2018-data-scripts>



# Results

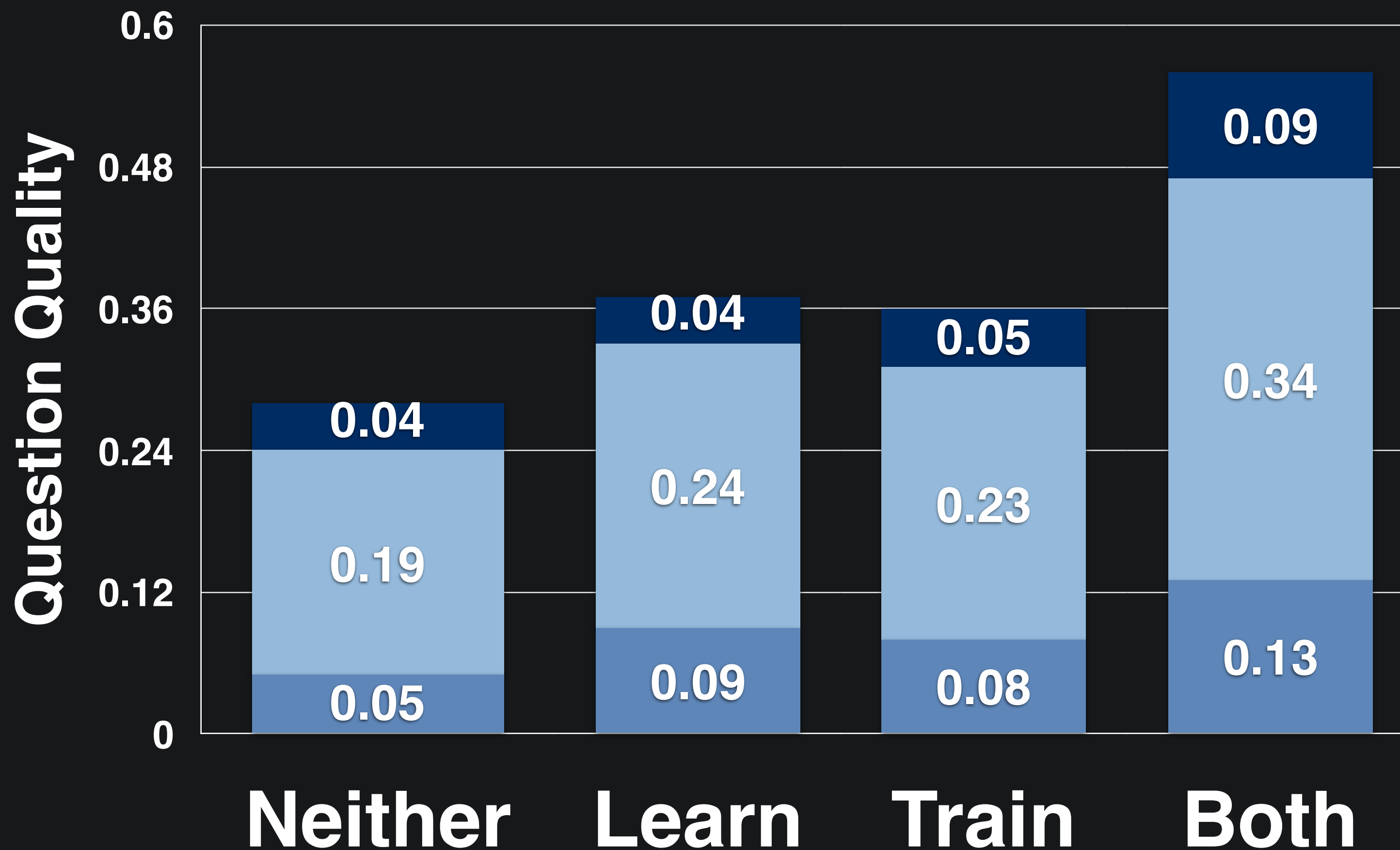
The combined Learn-Train condition produces better questions (N=344)





# Results

The combined Learn-Train condition produces better questions (N=344)



**Learning improves content:**

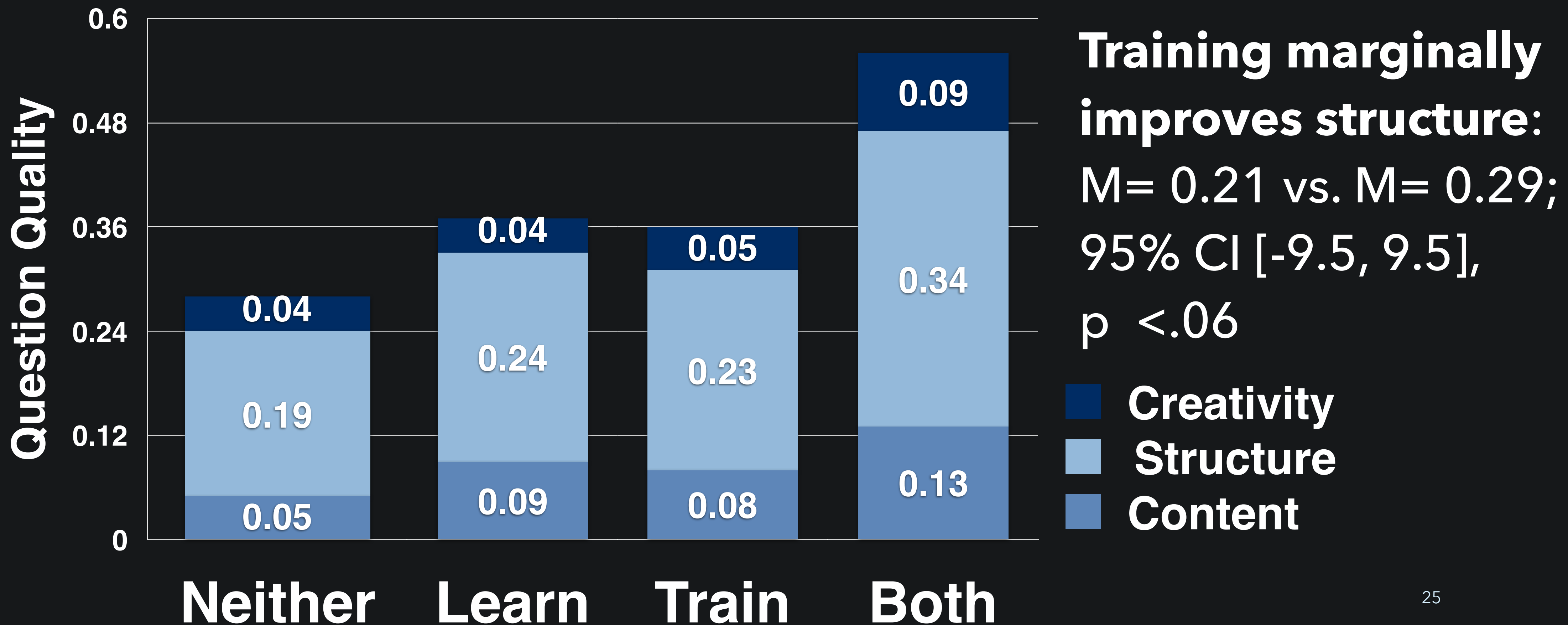
M=0.06 vs. M=0.11;  
95% CI [-9, 9],  $p < .05$

■ Creativity  
■ Structure  
■ Content



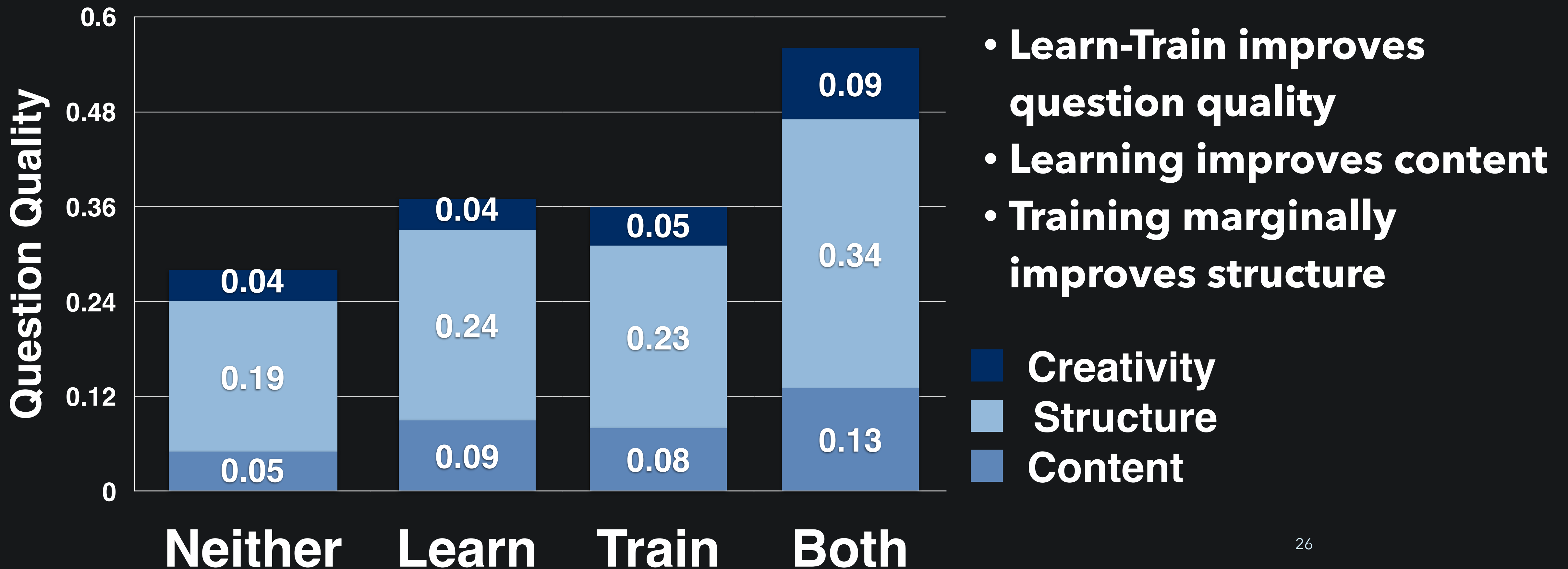
# Results

The combined Learn-Train condition produces better questions (N=344)



# Results

The combined Learn-Train condition produces better questions (N=344)





# Why did Learning and Training help?

- Content learning engaged people
  - more time -> more questions
  - more ideas -> more questions
- Tight integration of training with question asking
  - reminder of the goal (focus on one topic + answerable)
  - makes it easy to edit in-place



# 399 hypotheses, 75 considered novel by experts; Lead users are best with need-intensive problems

*Personal Insights provide Novel Hypotheses*

**Does consuming probiotics** *reduce your sugar cravings?*

**How often to do you consume bone broth? Do you have better bowel movements?**

**Is yogurt better for your gut** *at room temperature?*

*Most Questions contained Known Facts*

**How often do you consume fermented foods?**

**Have you ever tried doing** intermittent fasting?

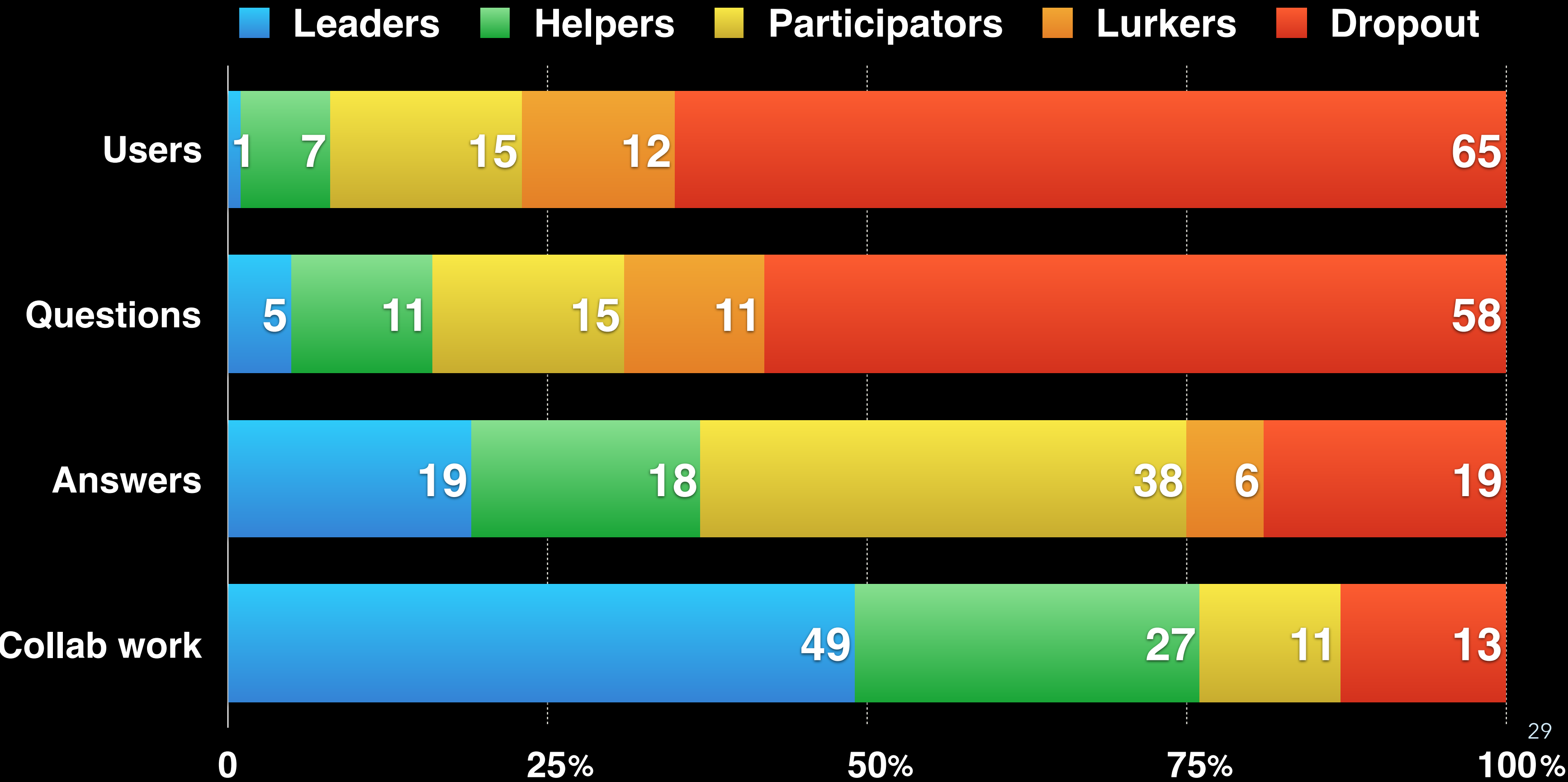
*Common themes*





# Diversity in roles: technical interventions are scalable, social interventions are powerful

*Role and Actions*  
**Leader:** Add questions, answer & edit others' questions, add follow-ups, discuss  
**Helper:** Add & answer questions, add follow-ups  
**Participant:** Answer questions  
**Lurker:** Add questions but no collaborative work  
**Dropout:** Add a question; never return

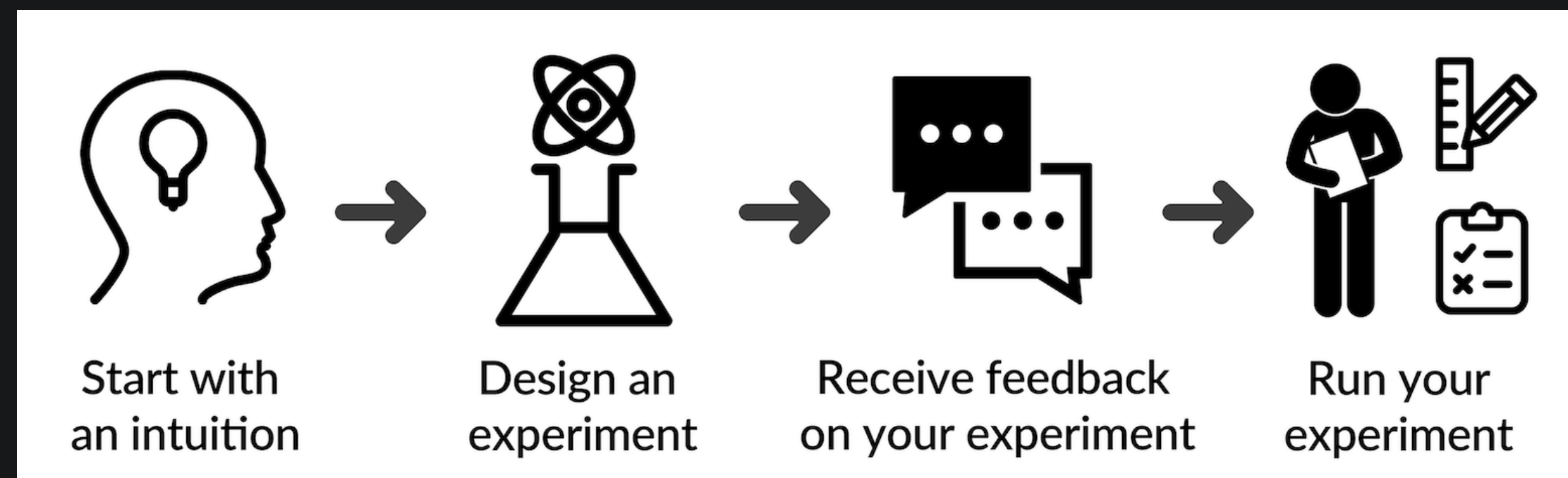


# Vision: Enable internet-scale personally-meaningful scientific work by building online learning systems

From intuitions/folk theories.. (*CHI 2017*)

..to hypotheses (**Docent**: *Learn-Train-Ask: L@S 2018*)

..to experiments (**Galileo**: *Self-organized crowd expts*)





# Gut Instinct now supports community designed-review-run experiments to test intuitions!

Hypothesis: **Drinking lassi decreases bloatedness** 

All participants will provide data about the cause ( **Drinking lassi** ) and the effect ( **bloatedness** ) every day for the duration of the experiment. At what **daily fixed time** should people receive an automated text message reminder?

Send all participants a reminder to provide  
**Absence/Presence** of **Drinking lassi** at



Pick a time 

Send all participants a reminder to provide **Rating** of  
**bloatedness** at






Pick a time 

BACK

Step 2. Provide experimental steps for your participants

 Example 

Add steps for the Control group : **Participants don't drink lassi**

- × **DO NOT** consume any caffeinated drink throughout the day 
- × Continue performing your daily activities as usual 
- × Measure effect: in the evening, write down how bloated you feel on a scale c 
- × Send your measurements to Gut Instinct through sms 
- × Repeat steps for the next 7 days 

ADD STEPS FOR THE EXPERIMENTAL GROUP

# Gut Instinct now supports community designed-review-run experiments to test intuitions!

## Experiment Design Summary

Hypothesis: [Drinking lassi decreases bloatedness](#) 

Cause	Relation	Effect
Drinking lassi	decreases	bloatedness

Mechanism:

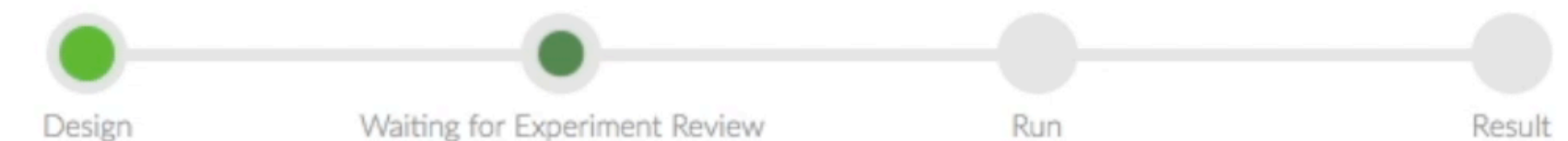
How is [Drinking lassi](#) manipulated? 

- Participants measure [Absence/Presence](#) of [Drinking lassi](#)
- Reminder sent every day at [8 pm](#) with

How is [bloatedness](#) measured? 

- Participants measure [Rating](#) of [bloatedness](#) on a scale of 1 to 5 (1 being no bloatedness and 5 being

## Experiment Status



What you've achieved so far:

- ✓ Designed your experiment
- ✓ Your experiment is now open for review

What's next:

To move ahead, you need to get at least 2 people to **review** your experiment!

**Anyone** with an internet access can review your experiment design in **5 mins!**



# How might we crystallize intuitions to create personally-meaningful scientific knowledge?

System



[gutinstinct.ucsd.edu](http://gutinstinct.ucsd.edu)

Technique

Learn-Train-Ask

Key Result

**Integrating conceptual learning with task-specific training improves question quality**