

# Creating Scientific Theories with Online Communities

CSCI 499: Computing for Social Good  
University of Southern California  
Apr 24 2019

Vineet Pandey  
UC San Diego  
The Design Lab

# People design, build, and track to better understand and improve their health



**Dana Lewis**  
Created DIY Pancreas

# People design, build, and track to better understand and improve their health



Created DIY Pancreas



Pebble watch with glucose monitoring

<https://openaps.org> [github.com/openaps](https://github.com/openaps)

A screenshot of a GitHub repository page for "openaps / openaps". The page shows basic repository statistics: 360 commits, 7 branches, 34 releases, and 12 contributors. The MIT license is displayed. Below the stats, a list of recent commits is shown, all made by "scottleibrand" and "egirard". The commits are dated from 10 days ago to 16 days ago. The commits include updates to CONTRIBUTING.md, bin, openaps, tests, .gitignore, .travis.yml, and Makefile, along with fixes for install problems and updates to README and MANIFEST.in.

Code on Github

## OpenAPS Design Details

### Medical device communication

OpenAPS periodically (i.e. every 5 minutes) reads new data from the CGM as it becomes available. It also periodically (every few minutes) queries the insulin pump for current settings and recent activity, such as current (scheduled or temporary) and maximum basal rates, recent boluses, IOB (if available), ISF, DIA, carb ratio, BG target/range, etc. If that query is successful, OpenAPS updates its bolus wizard calculations (detailed below) and determines whether any action is required (canceling or issuing a temporary basal).

If action is required, OpenAPS issues the appropriate insulin dosing command to the pump, confirms that it was received and acknowledged by the pump, and then performs another query for recent activity to make sure any new temporary basal successfully took effect.

### Algorithms

#### Basic overnight operation (oref0)

Design with algorithm details at OpenAPS blog

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

---

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, Probiotics, Colestipol...Glutten Free Diet and Special Carb Diet.** Let me know if any of these help you.

---

# People draw ideas from current research by reading and discussing papers

[Researchers Invent New Method for Non-Invasive Deep Brain Stimulation](#) (spectrum.ieee.org)

14 submitted 3 days ago by DIYtDCS

3 comments share

all 3 comments

sorted by: best ▾

[-] DIYtDCS [S] 3 points 3 days ago

And their research paper: [Noninvasive Deep Brain Stimulation via Temporally Interfering Electric Fields](#)

permalink embed

[-] malo5tak 2 points 3 days ago

Tldr

Neurons typically don't respond to high frequency electric signals. But they do respond to low frequency signals. Boyden and Grossman hypothesized that if they sent to a deep brain target two high frequency signals that differed by a small amount, the signals would pass through the more superficial tissues of the brain. When these signals interfered with each other at the target, they would create a field with an amplitude that oscillates at a frequency equal to the small difference between the two high frequency signals. That electrical wave would be low enough to engage neurons.

## Lithium delays progression of amyotrophic lateral sclerosis

Francesco Fornai<sup>\*†‡</sup>, Patrizia Longone<sup>§</sup>, Luisa Cafaro<sup>†</sup>, Olga Kastsiuchenka<sup>\*</sup>, Michela Ferrucci<sup>\*</sup>, Maria Laura Manca<sup>¶</sup>, Gloria Lazzeri<sup>\*</sup>, Alida Spalloni<sup>§</sup>, Natascia Bellio<sup>||</sup>, Paola Lenzi<sup>\*</sup>, Nicola Modugno<sup>†</sup>, Gabriele Siciliano<sup>¶</sup>, Ciro Isidoro<sup>¶</sup>, Luigi Murri<sup>¶</sup>, Stefano Ruggieri<sup>†</sup>, and Antonio Paparelli<sup>\*</sup>

<sup>\*</sup>Department of Human Morphology and Applied Biology, and <sup>†</sup>Department of Neuroscience, Clinical Neurology, University of Pisa 56100 Pisa, Italy; <sup>‡</sup>Istituto Neurologico Mediterraneo, Istituto Di Ricovero e Cura a Carattere Scientifico Neuromed, 86077 Pozzilli (IS), Italy; <sup>§</sup>Molecular Neurobiology Unit, Santa Lucia Foundation, 00179 Rome, Italy; and <sup>¶</sup>Department of Medical Sciences, University of Novara, 28100 Novara, Italy

Edited by Thomas C. Südhof, University of Texas Southwestern Medical Center, Dallas, TX, and approved December 21, 2007 (received for review August 24, 2007)

Letter to the Editor

## Real-World Use of Open Source Artificial Pancreas Systems

Dana Lewis<sup>1</sup>, Scott Leibrand<sup>1</sup>, and the #OpenAPS Community

Keywords

artificial pancreas, APS, OpenAPS, #WeAreNotWaiting, closed loop, DIY diabetes technology

American Diabetes Association 77<sup>TH</sup> SCIENTIFIC SESSIONS EXPERIENCE NEW HORIZONS IN DIABETES SAN DIEGO, CA JUNE 9-13, 2017

← American Diabetes Association - 77th Scientific Sessions Home

Session LB-01 - Late Breaking Poster Session

### 127-LB / 127 - Automatic Estimation of Basals, ISF, and Carb Ratio for Sensor-Augmented Pump and Hybrid Closed-Loop Therapy

June 11, 2017, 12:00 - 1:00 PM Hall B

Authors DANA M. LEWIS, SCOTT LEIBRAND, Seattle, WA

Disclosures D.M. Lewis: None. S. Leibrand: None.

*Lead users have created different—and in some cases better designs—than experts*



# *Lead users have created different—and in some cases better designs—than experts*



## *Activity#1*

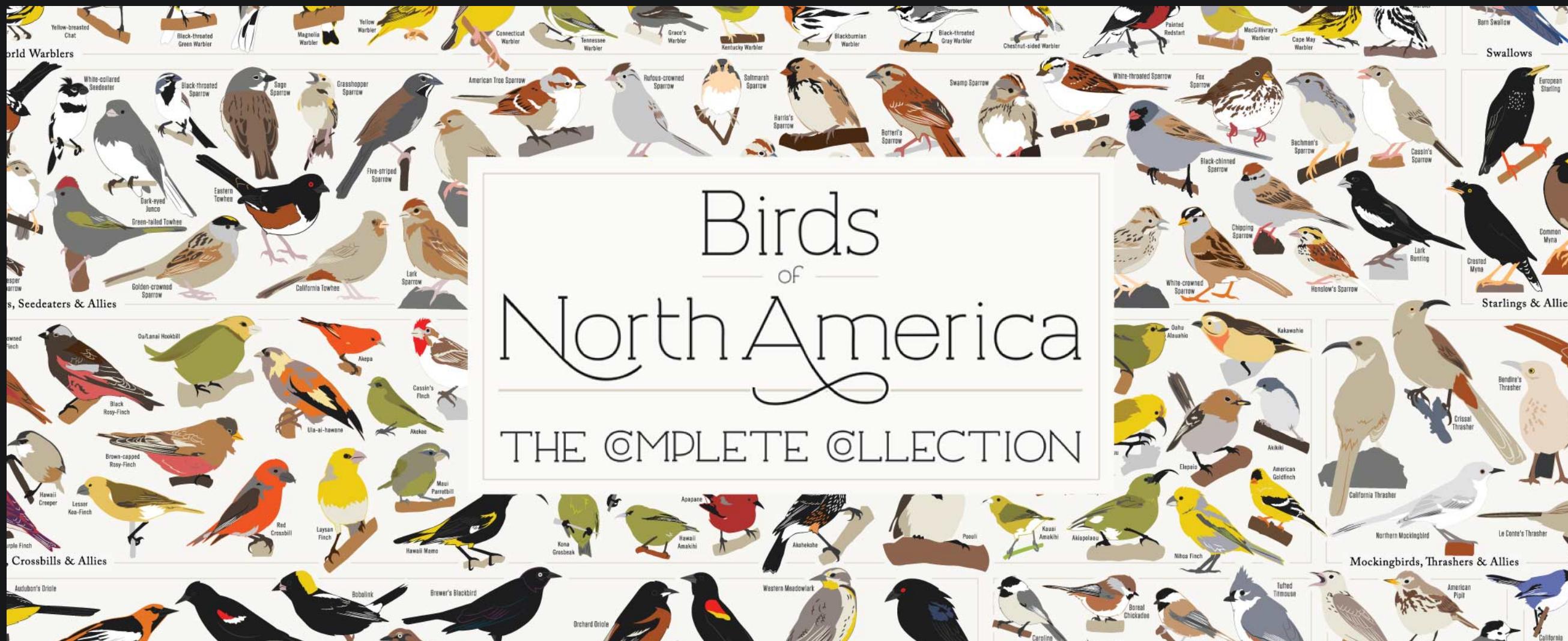
- 1) Which factors enable lead users to perform their work?
  
- 2) What are some examples of lead-user work that you do?

# *Lead users have created different—and in some cases better designs—than experts*



1. Lived experience
2. A tight feedback loop
3. Strong personal motivation

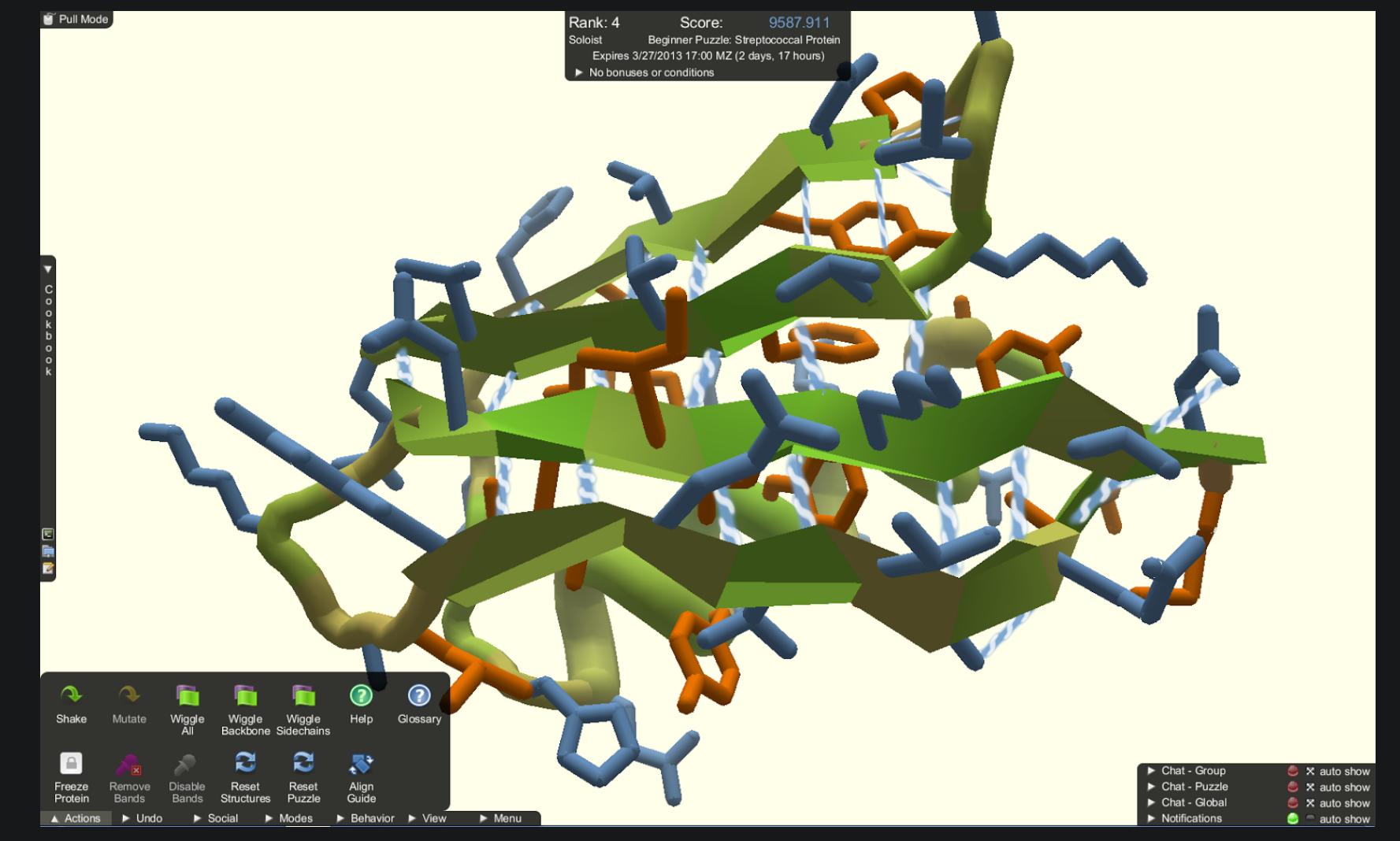
# Citizens have successfully solved expert-defined problems as sensors or algorithms



Tracking bird migration

eBird

eBird: A citizen-based bird observation network in the biological sciences. Brian L. Sullivan \*, Christopher L. Wood, Marshall J. Iliff, Rick E. Bonney, Daniel Fink, Steve Kelling. 9  
Predicting protein structures with a multiplayer online game. Seth Cooper, Firas Khatib, Adrien Treuille. Nature 2010.



Folding proteins

Foldit

# How might citizens design and run experiments?

# How might citizens design and run experiments?



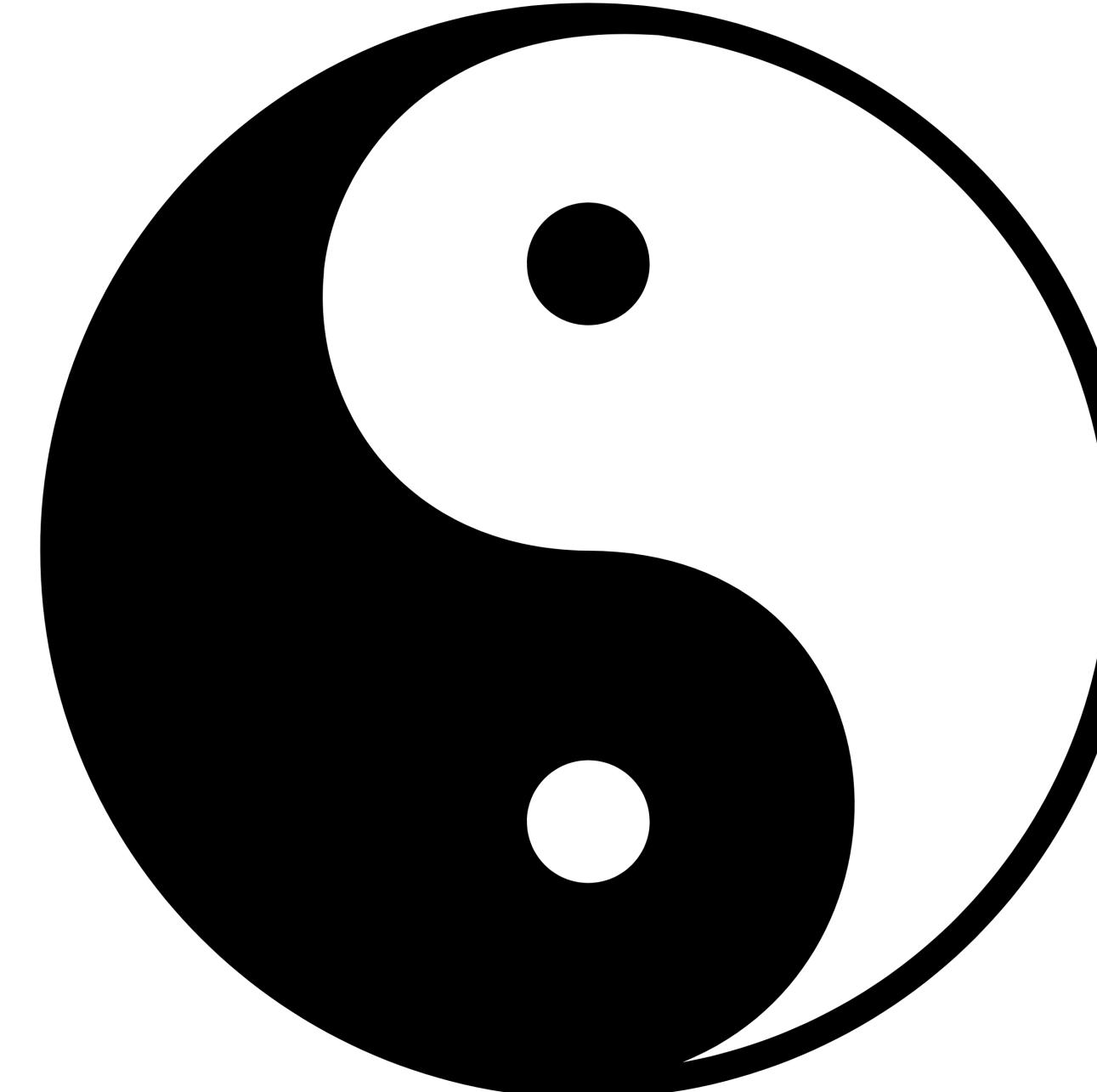
Kombucha bacteria: a gut probiotic?



Adriana: Kombucha producer from Rio

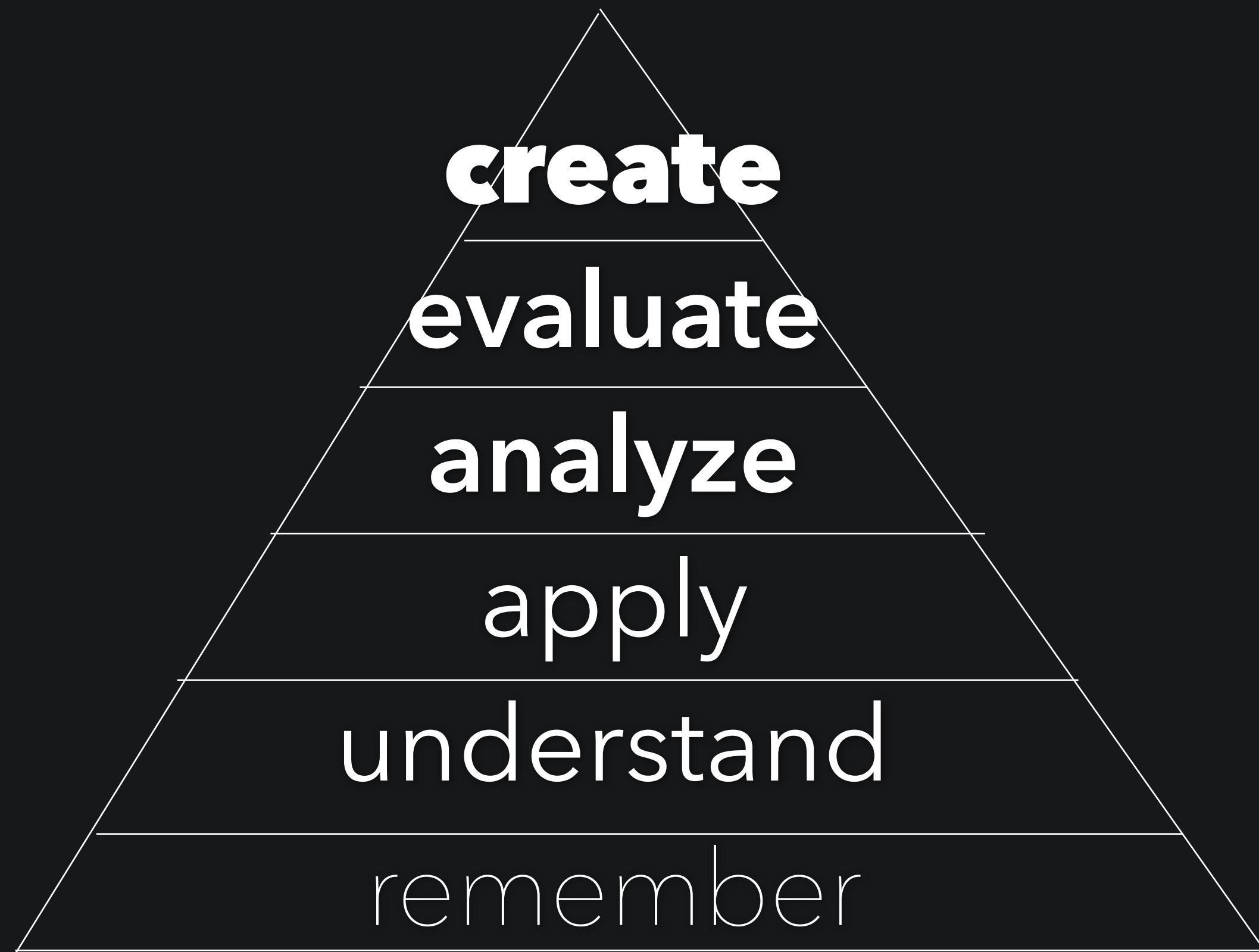
# Problem

**Science can  
answer life-  
relevant  
questions  
but few know  
how to even  
get started**



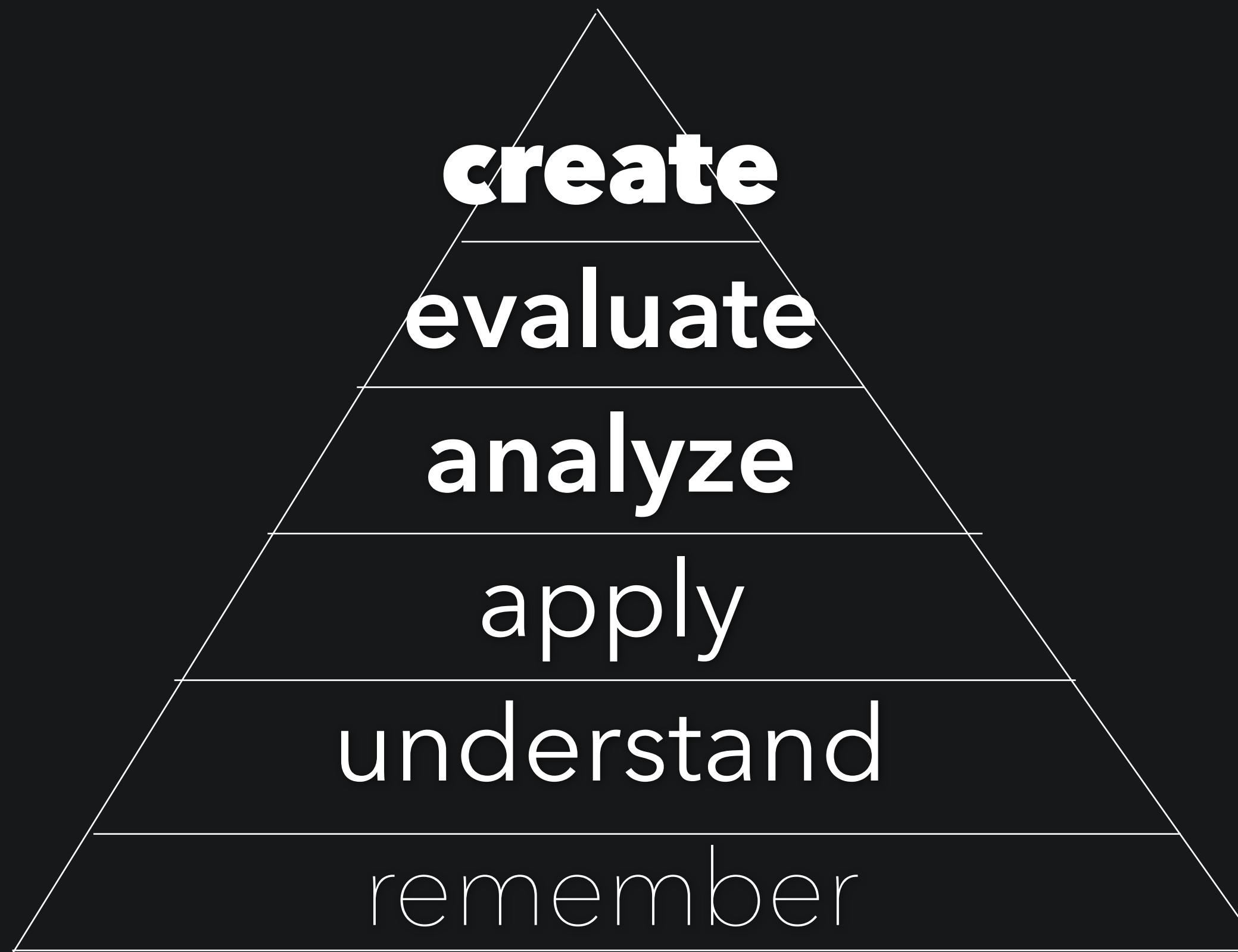
**Institutional  
science  
misses out on  
ideas from  
beyond the  
ivory tower**

# Complex work: learning



*Learning hierarchy (Bloom)*

# Complex work: learning & collaboration

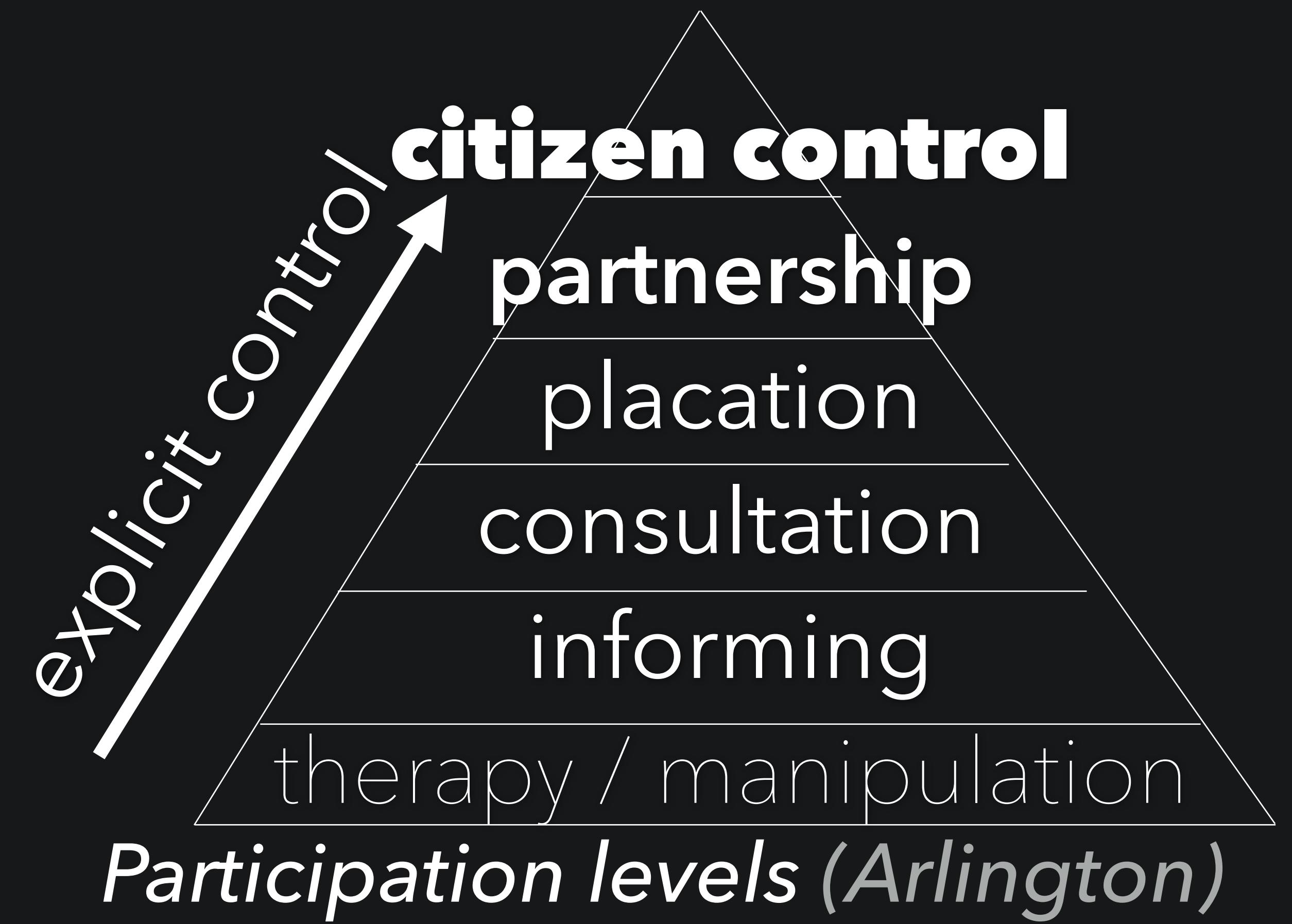
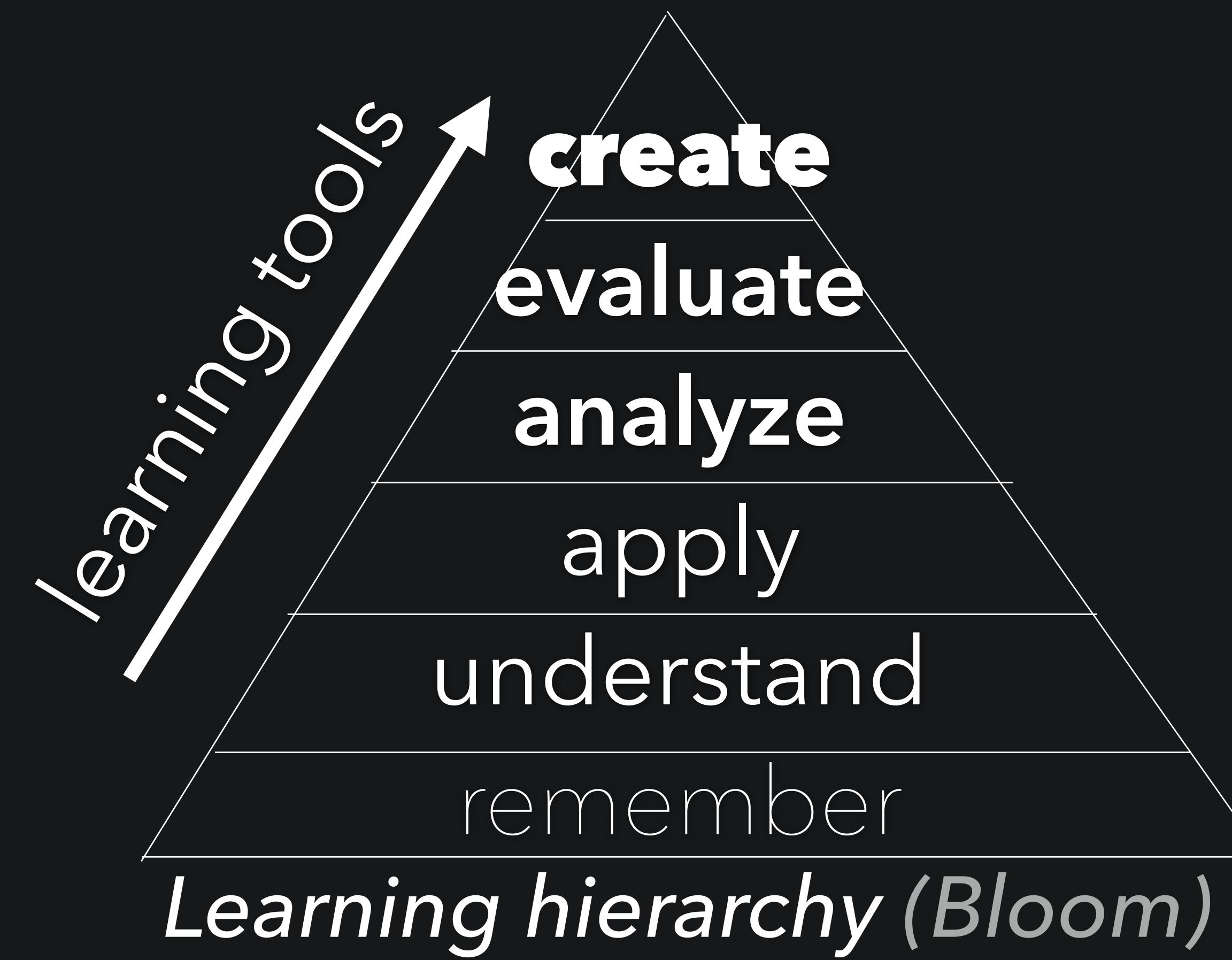


*Learning hierarchy (Bloom)*

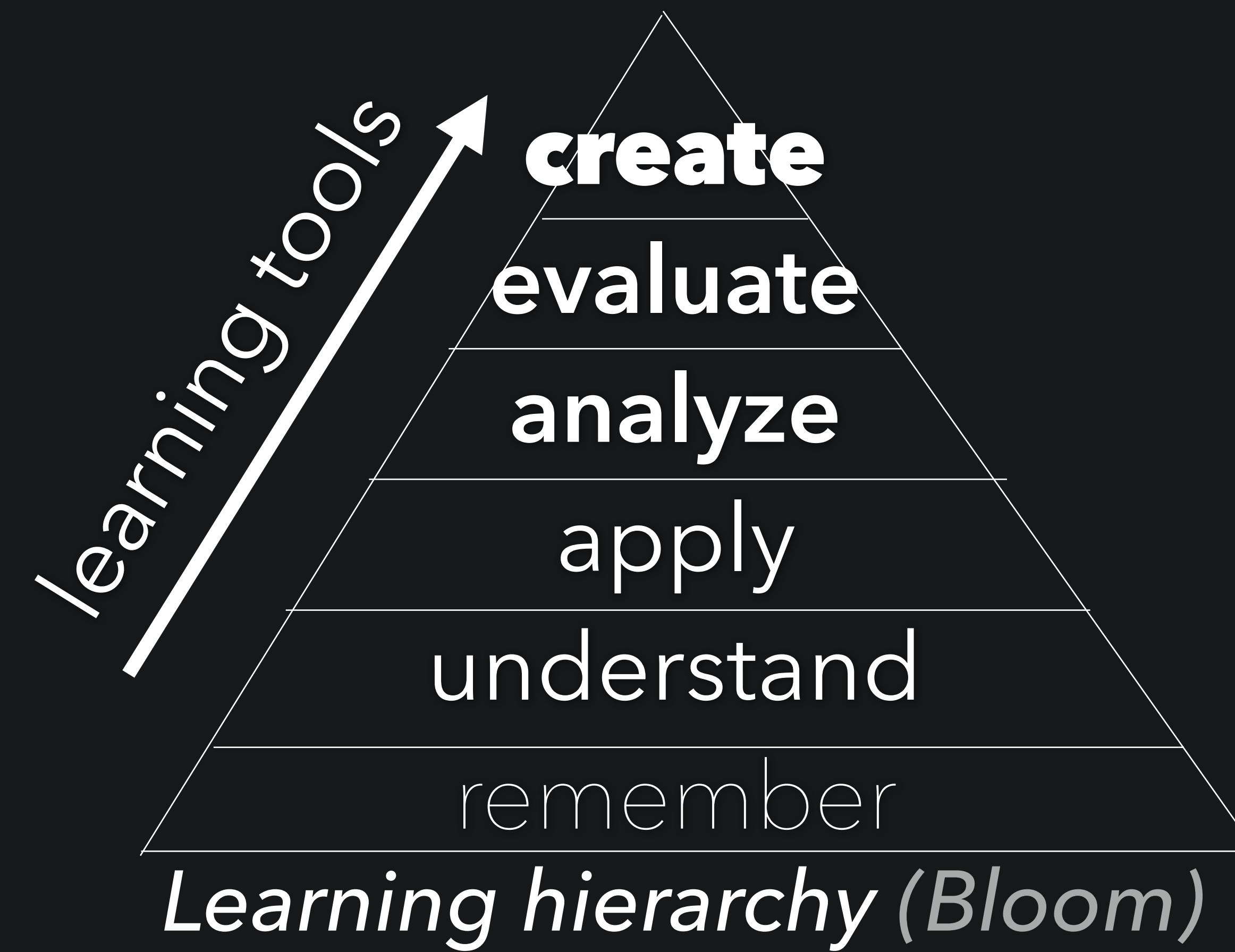


*Participation levels (Arlington)*

# Complex work: learning & collaboration



# *Activity 2: Where do current online platforms show up on these pyramids?*



Goal

**Environments for learning and  
collaboration through complex,  
personally meaningful work**

# 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



***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

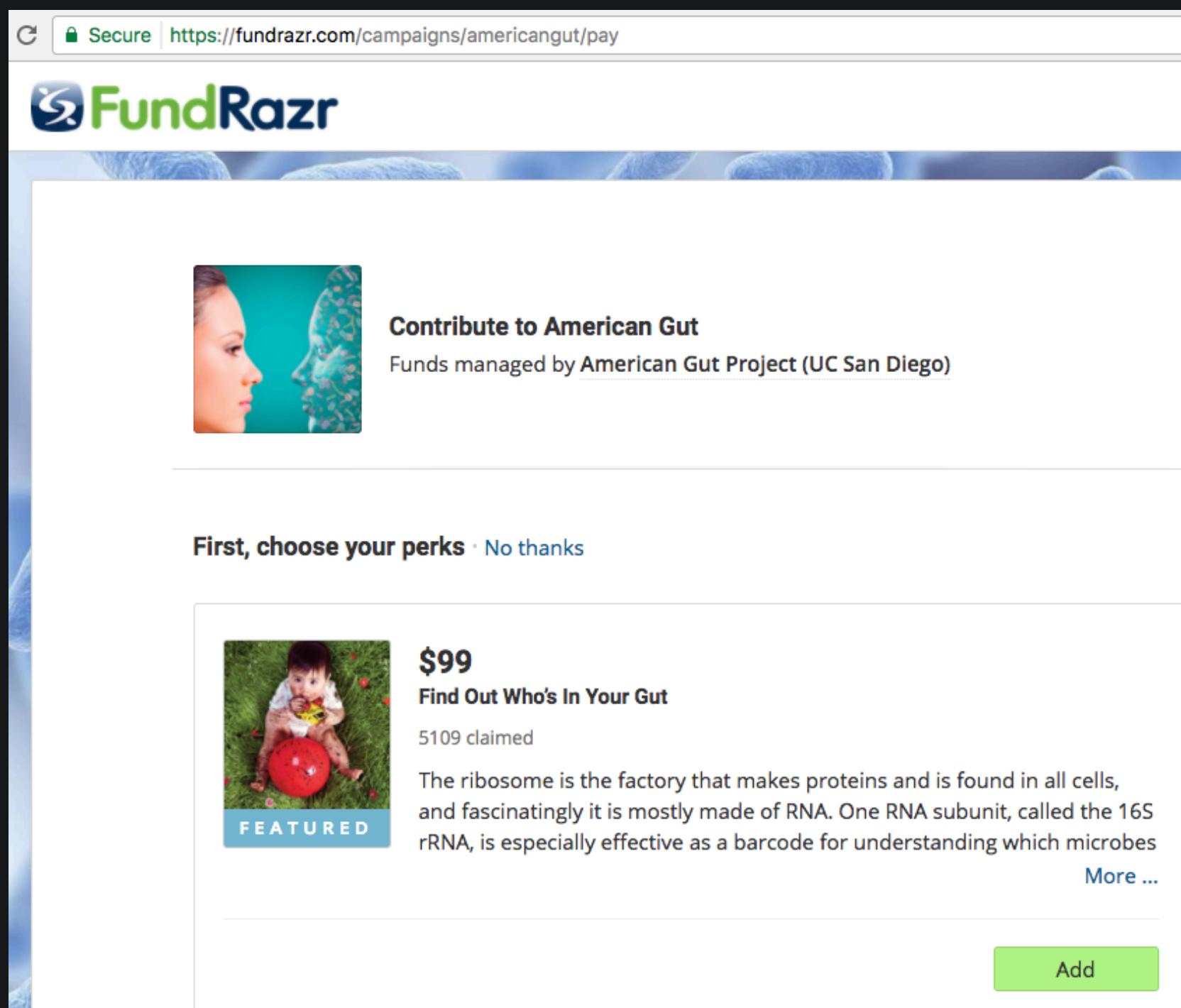
***Are Pets the New Probiotic?***

By RICHARD SCHIFFMAN JUNE 6, 2017



Nascent Experts know little  
Contextual Huge individual differences  
Motivating People care

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



The screenshot shows a FundRazr campaign page for the American Gut Project. At the top, it says "Secure | https://fundrazr.com/campaigns/american gut/pay". The title is "Contribute to American Gut" and it's managed by "American Gut Project (UC San Diego)". Below this, there's a "First, choose your perks" section with a "No thanks" link. A featured perk is shown: "\$99 Find Out Who's In Your Gut" (5109 claimed). It describes the ribosome as a factory for proteins and RNA, mentioning the 16S rRNA barcode. A green "Add" button is at the bottom.

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



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

[americangut.org](http://americangut.org)

# Participants generate hypotheses by looking at the data

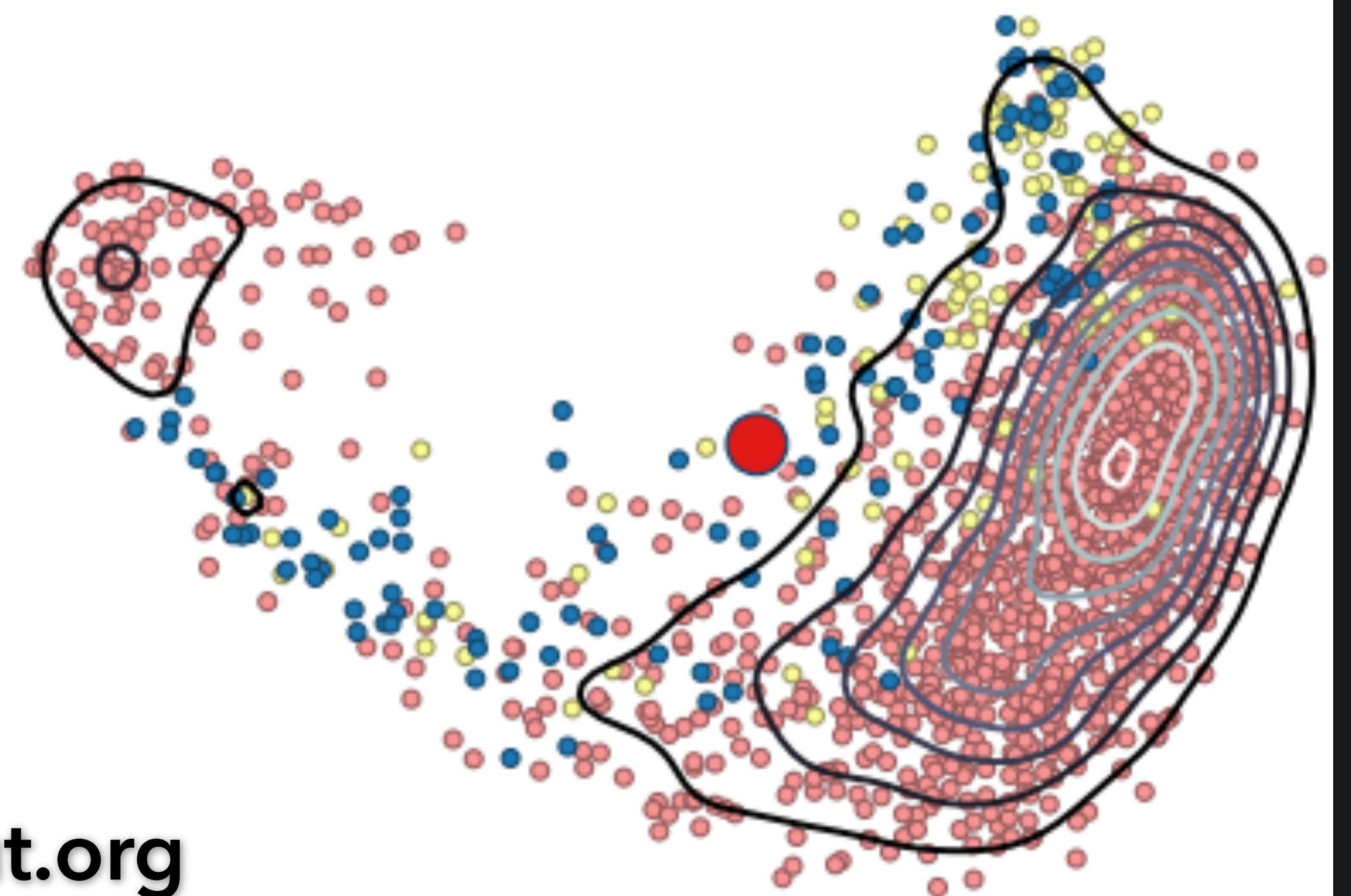


Is my data point unique because

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



[americangut.org](http://americangut.org)



# Participants generate hypotheses by looking at the data

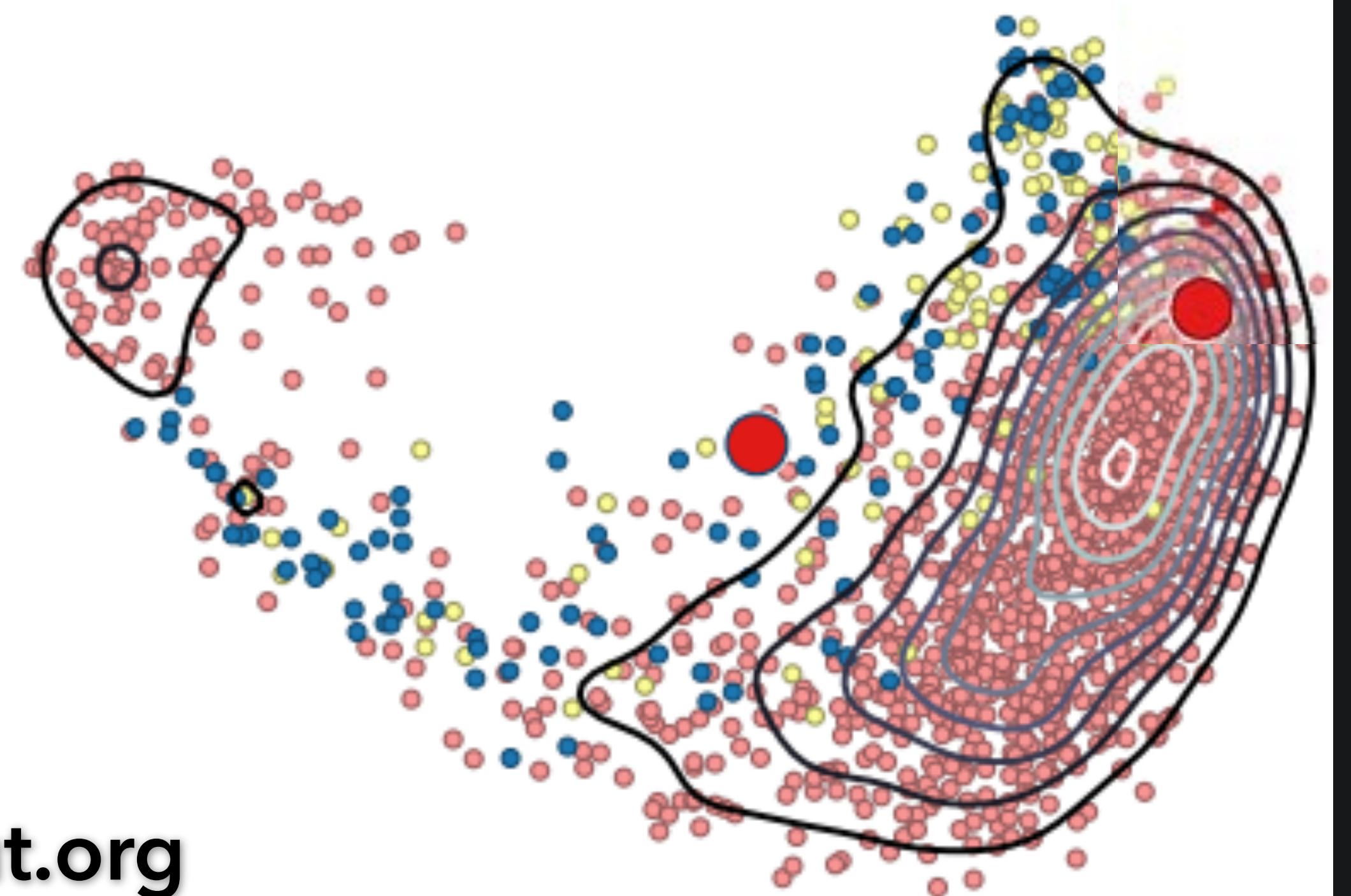


Is my data point unique because

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[americangut.org](http://americangut.org)



# Learn about probiotics + the microbiome

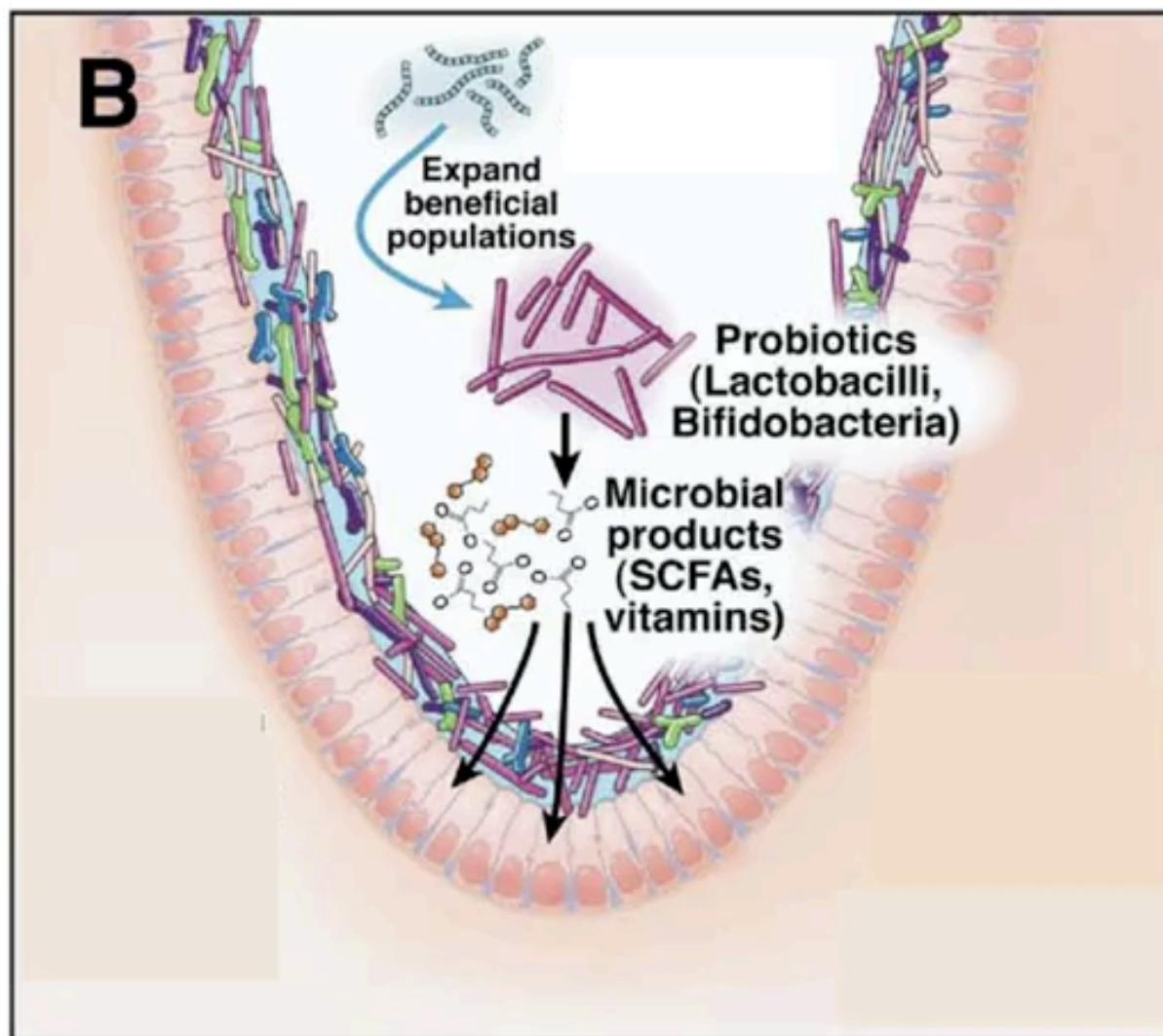
gutinstinct-ucsd.org/t/probiotics

Confused? Add more questions! Topics Guide GutBoard Notifications

Back to Topics

#probiotics

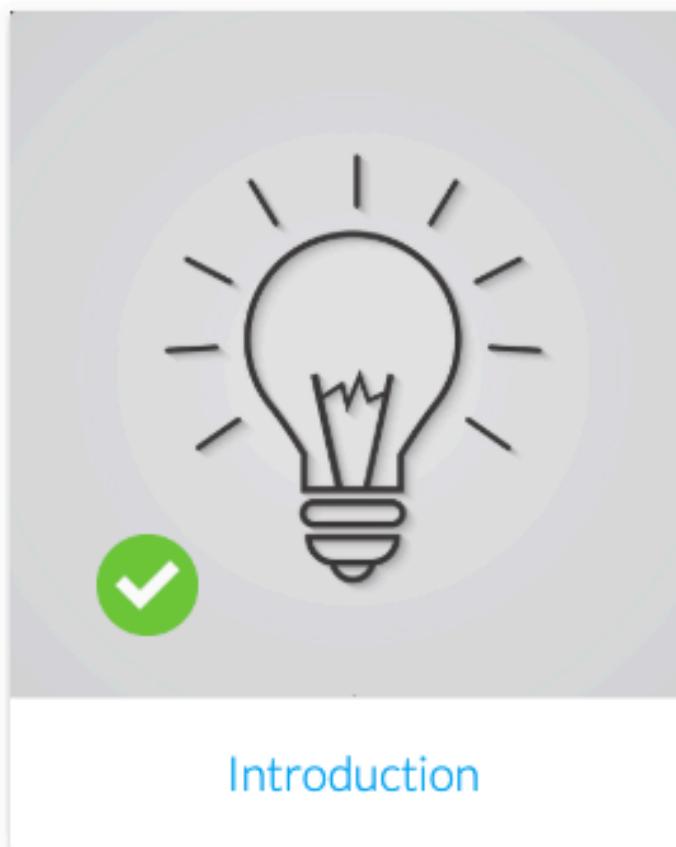
Video  
Provided  
By coursera



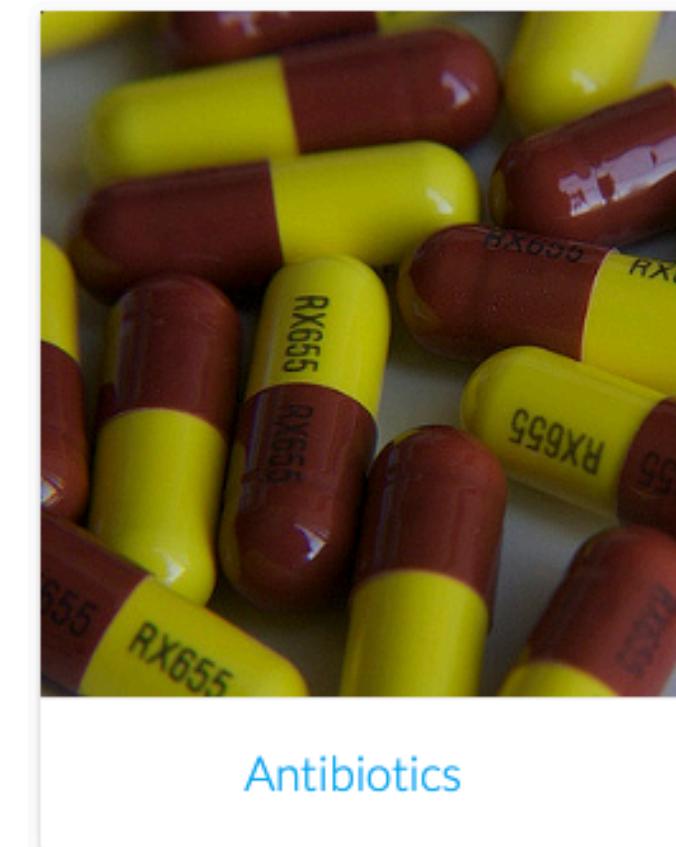
Preidis and Versalovic 2009, Gastroenterology

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

## Basics



Introduction



Antibiotics



Diet



Genetics

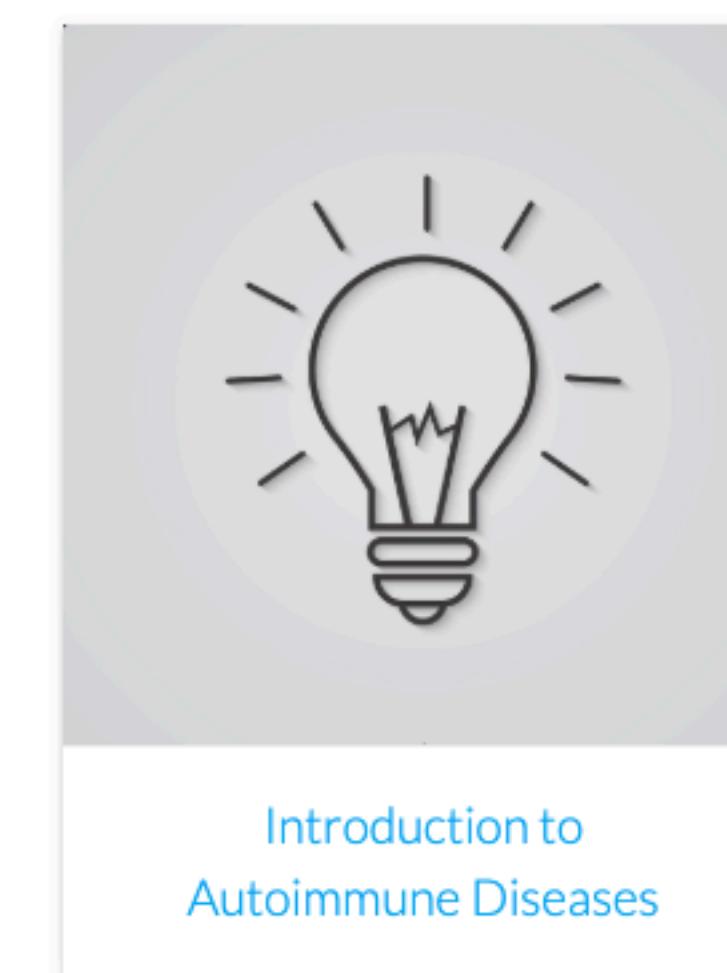


Physiology

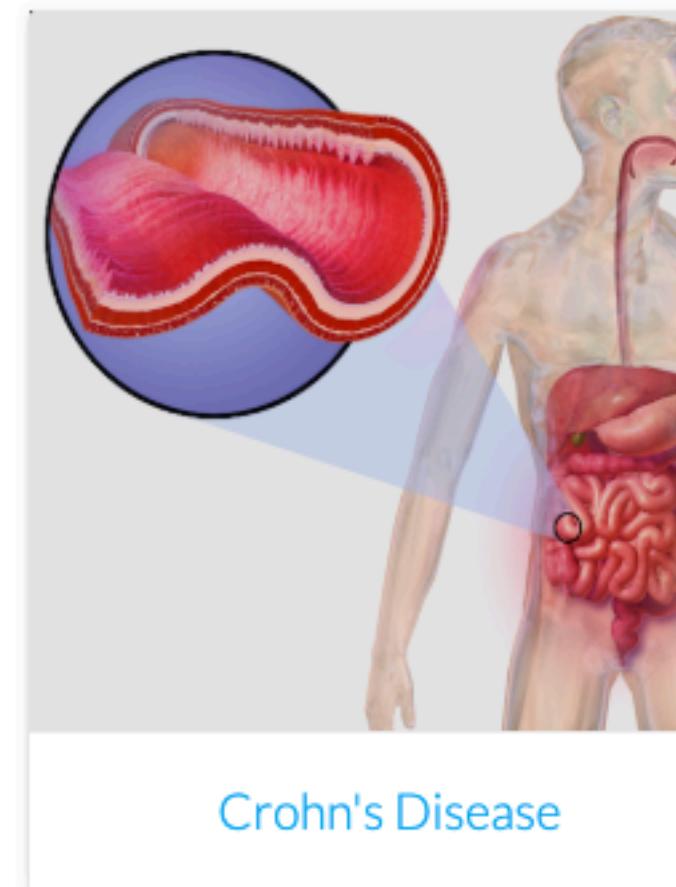


Probiotics

## Autoimmune Diseases

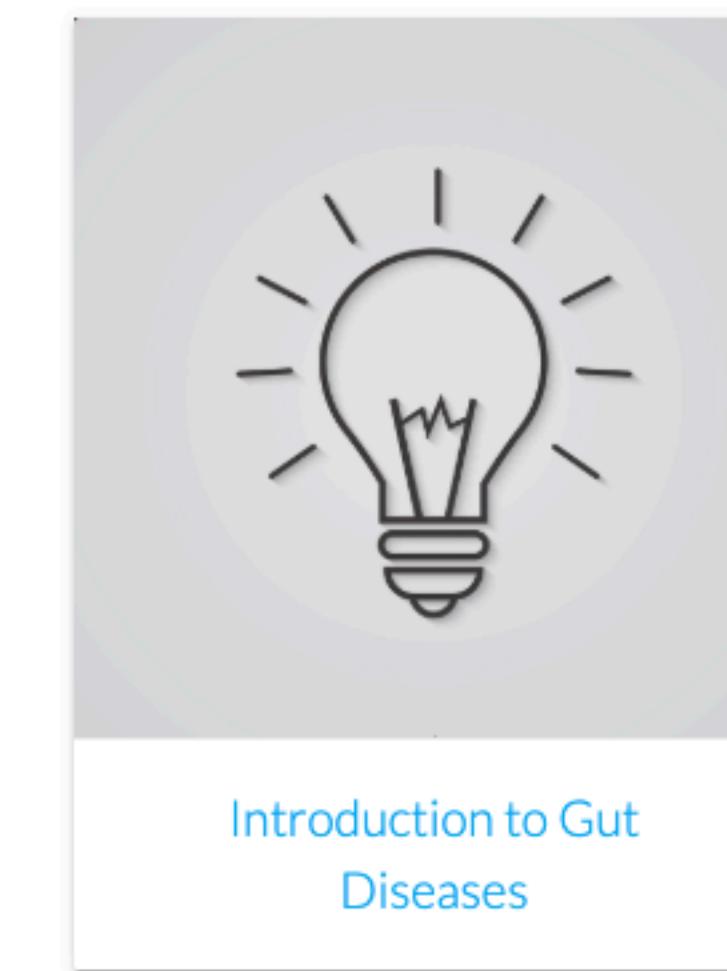


Introduction to  
Autoimmune Diseases

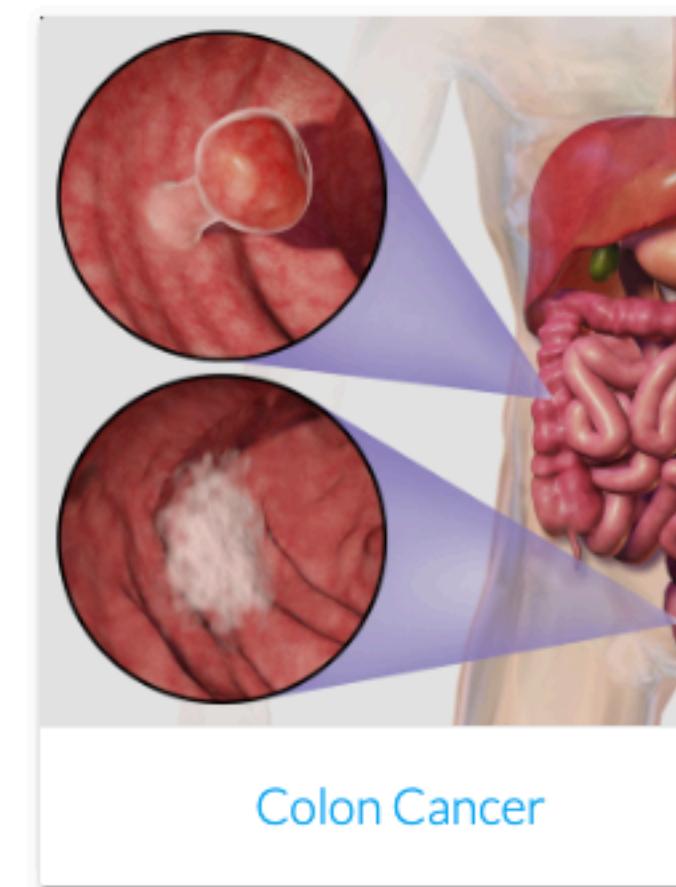


Crohn's Disease

## Gut Diseases



Introduction to Gut  
Diseases



Colon Cancer

Expectation: People will come up with  
crisp intuitions

Like this one:

“I think consuming probiotics reduces  
my sugar cravings”

Reality: People don't structure their intuitions in “useful” ways

Rambling account of anecdotes

Technical details about probiotics

Share general curiosity

# Outcome: Questions were not framed as hypotheses

4 days ago • Added by: CITIZEN SCIENTISTS [a033]

Is the frequency of Bowel movements related to the gut biome

- Is this related to diet? 1 Answer(s) / 100%
- Is it related to age? 0 Answer(s) / 0%
- [Add my option](#)

Saved

regularity,

diet,



Dive deeper with these follow-up questions!

- If so can it be changed?
- If so, can it be changed?
- [Add my option](#)

Save my choice(s)

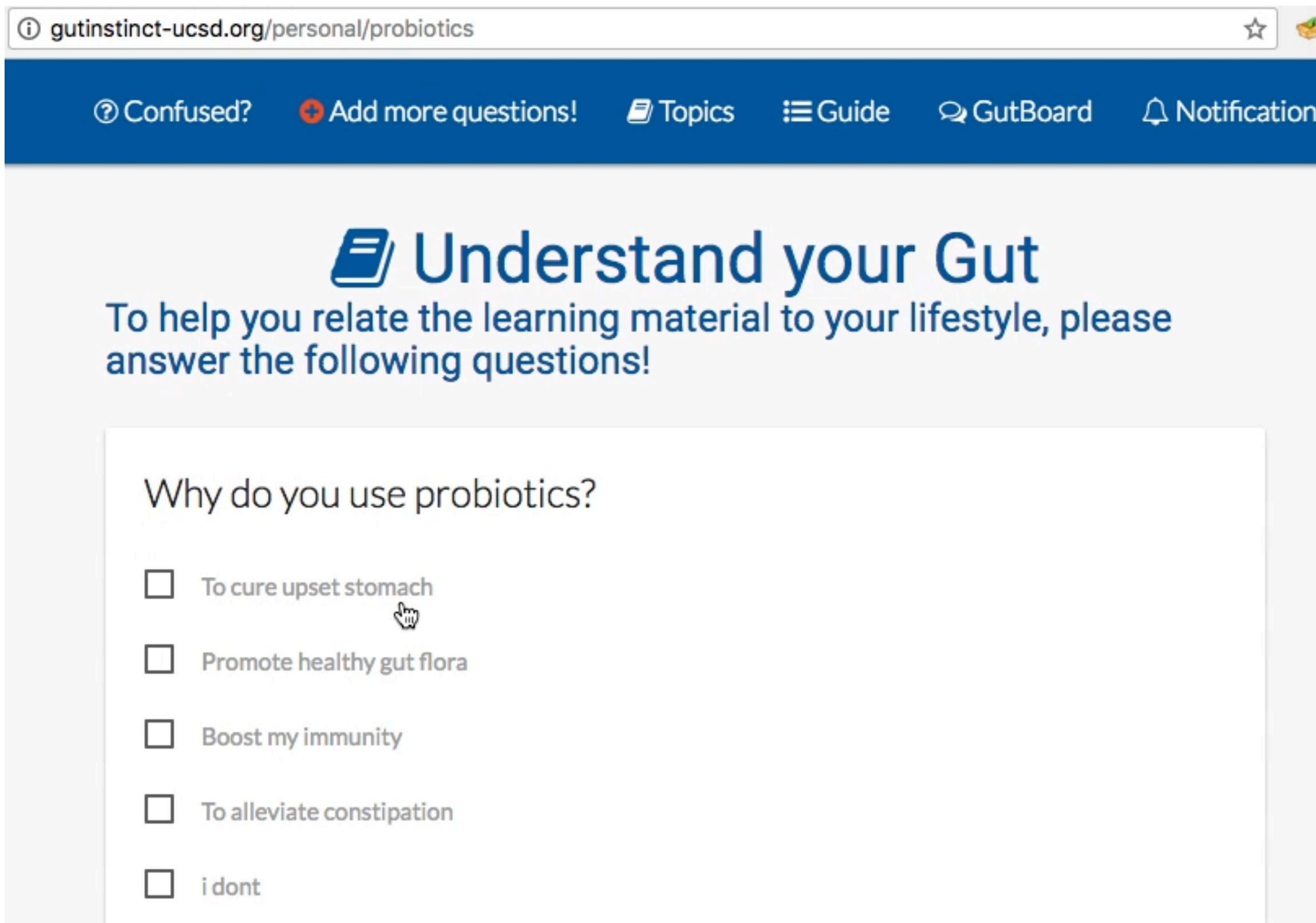
Skip



# Insight: Scaffold hypothesis-generation using procedural training

- 1) Teach people about the success criteria of sharing questions, and
- 2) Support this in the interface

# Learn about a lifestyle topic + the microbiome



The screenshot shows a web page from [gutinstinct-ucsd.org/personal/probiotics](http://gutinstinct-ucsd.org/personal/probiotics). The top navigation bar includes links for 'Confused?', 'Add more questions!', 'Topics', 'Guide', 'GutBoard', and 'Notifications'. The main content area features a blue header with the text 'Understand your Gut' and a sub-instruction: 'To help you relate the learning material to your lifestyle, please answer the following questions!'. Below this, a question 'Why do you use probiotics?' is followed by a list of options with checkboxes:

- To cure upset stomach (cursor hovering over)
- Promote healthy gut flora
- Boost my immunity
- To alleviate constipation
- i dont
- Add your own option

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

Which probiotics do you use?

# Learn about probiotics + the microbiome

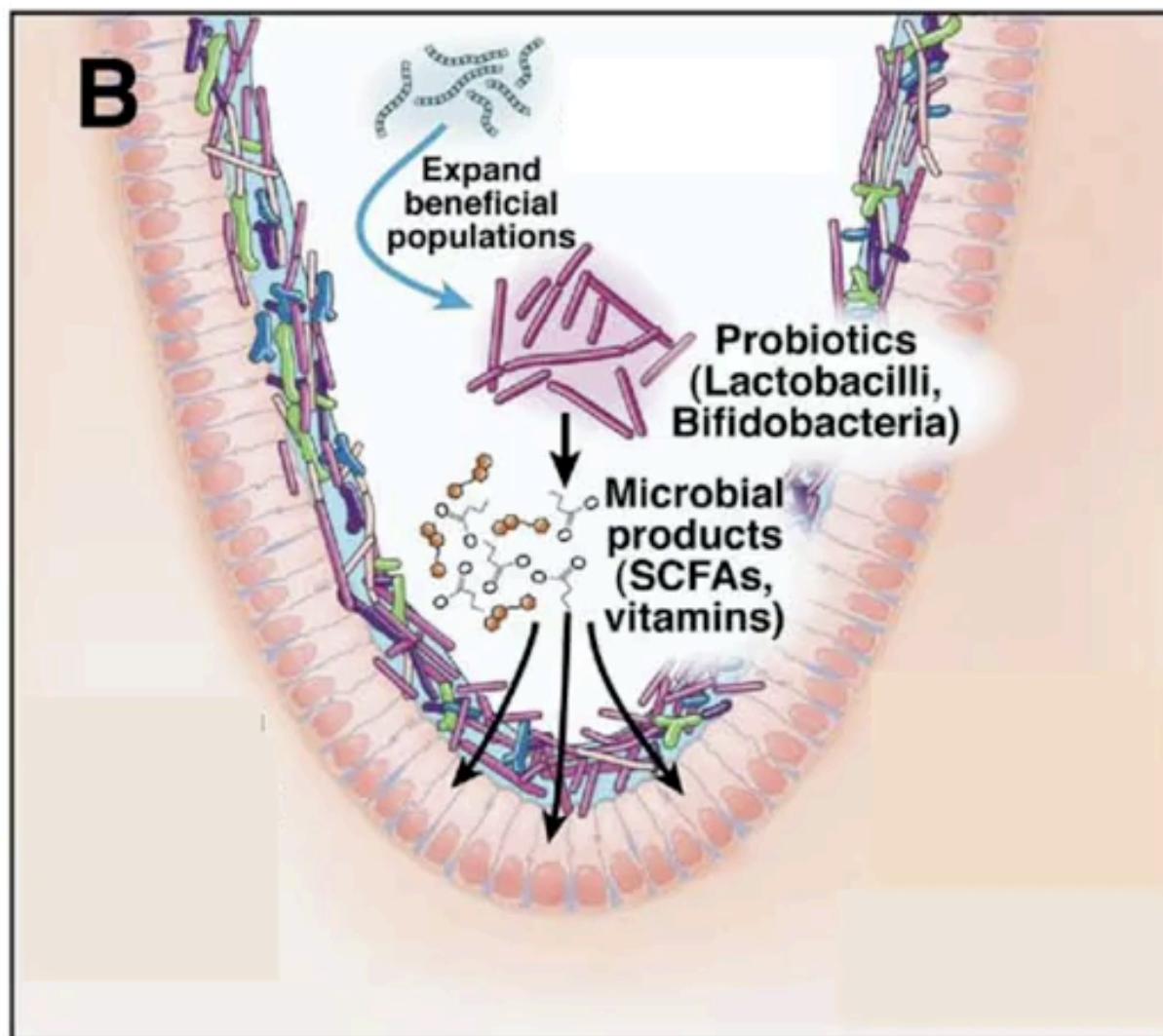
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Confused? Add more questions! Topics Guide GutBoard Notifications

Back to Topics

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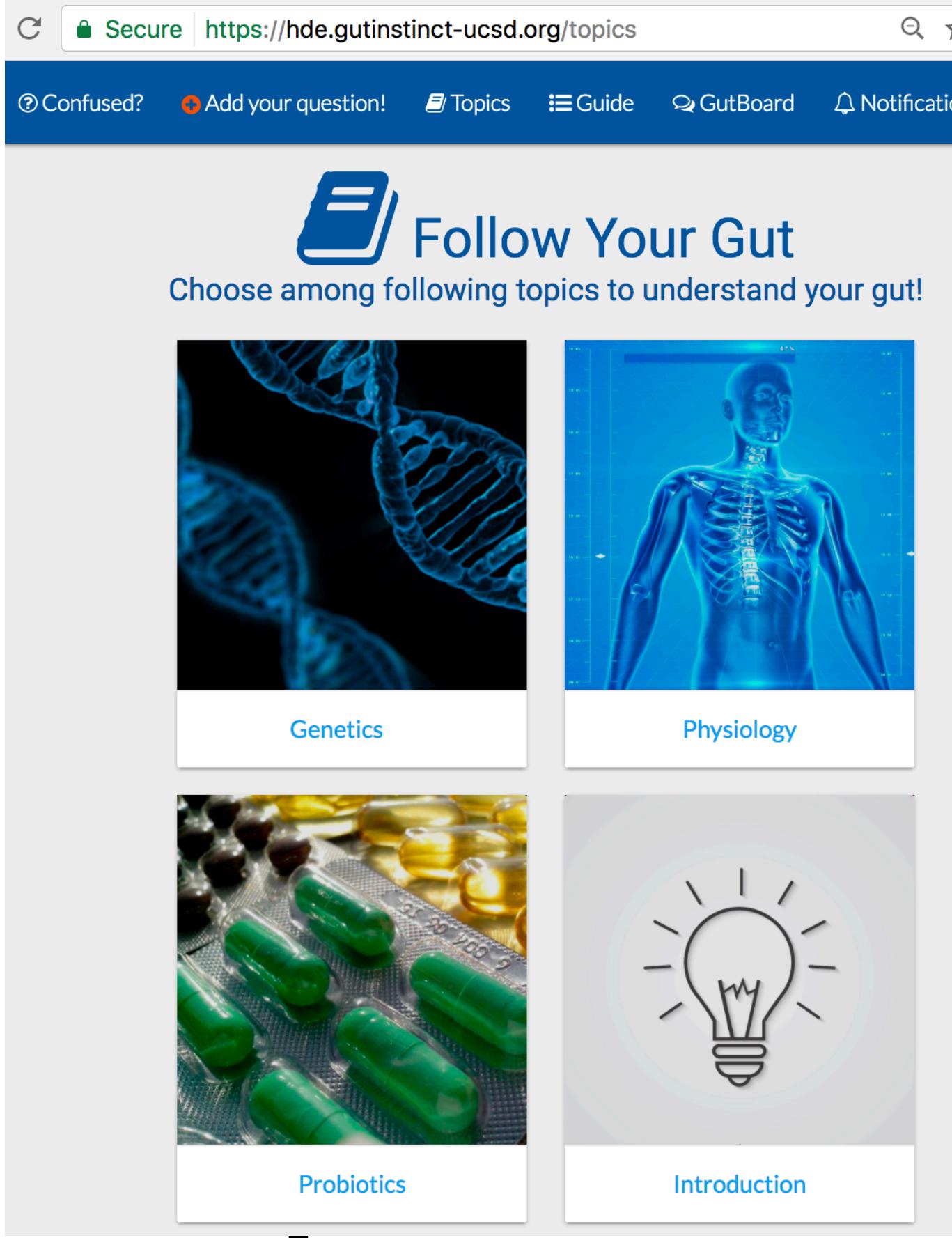
Video  
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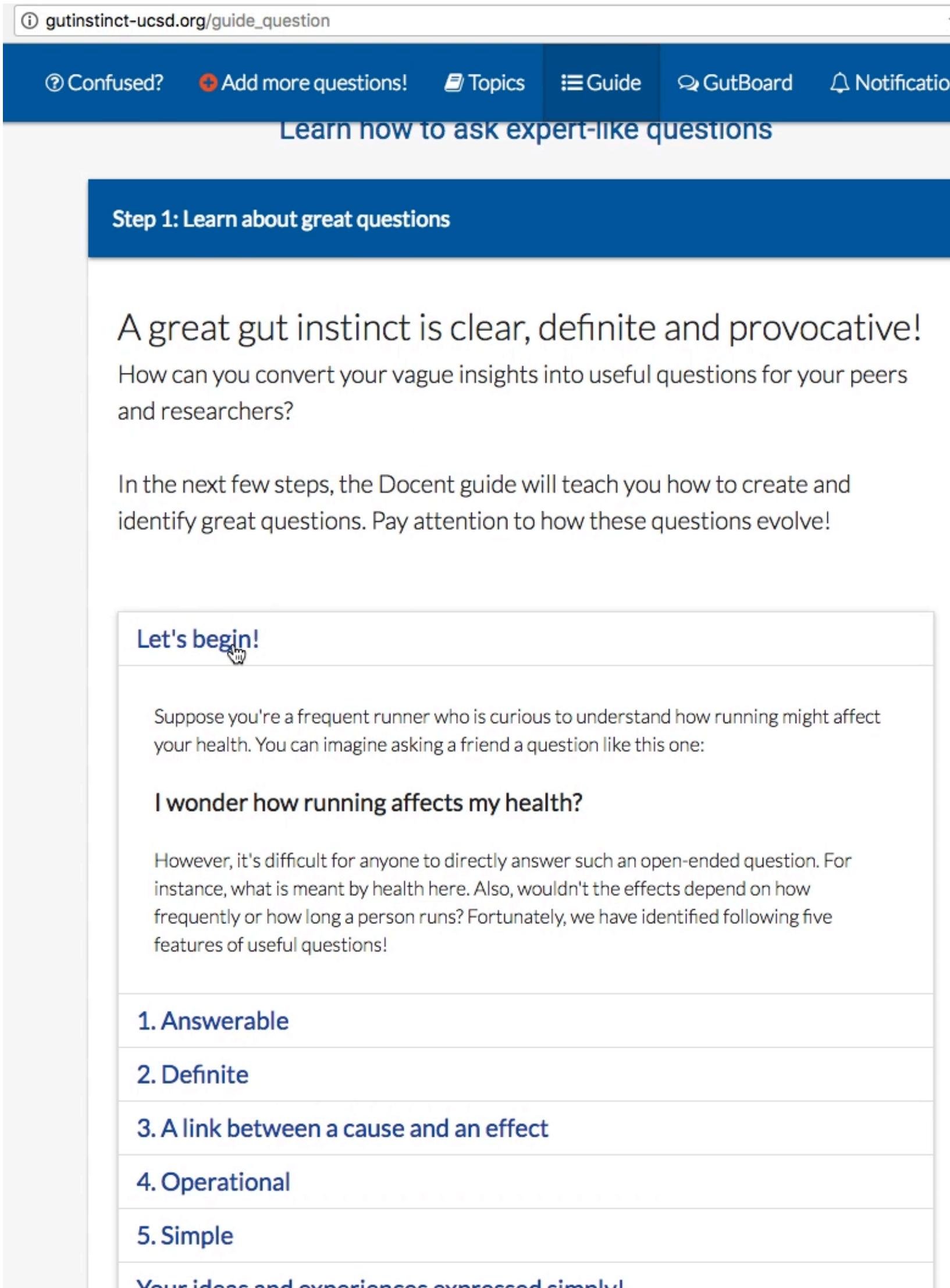
Preidis and Versalovic 2009, Gastroenterology

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

# Train to frame useful questions



The screenshot shows the homepage of the 'Follow Your Gut' website. At the top, there's a navigation bar with links for 'Secure', 'https://hde.gutinstinct-ucsd.org/topics', a search icon, and a star icon. Below this is another navigation bar with links for 'Confused?', 'Add your question!', 'Topics', 'Guide', 'GutBoard', and 'Notifications'. The main content area features a blue header 'Follow Your Gut' with a stylized 'F' logo. Below it, a sub-header says 'Choose among following topics to understand your gut!'. There are four topic cards: 'Genetics' (with a DNA helix image), 'Physiology' (with a human torso image), 'Probiotics' (with a blister pack of capsules image), and 'Introduction' (with a lightbulb icon). A large 'Learn' button is at the bottom.



The screenshot shows a guide page titled 'Step 1: Learn about great questions'. The URL in the browser bar is 'gutinstinct-ucsd.org/guide\_question'. The page has a blue header with the title. Below it is a section with text: 'A great gut instinct is clear, definite and provocative! How can you convert your vague insights into useful questions for your peers and researchers?'. It also includes a note: 'In the next few steps, the Docent guide will teach you how to create and identify great questions. Pay attention to how these questions evolve!'. A 'Let's begin!' button is present. The page lists five features of useful questions: 1. Answerable, 2. Definite, 3. A link between a cause and an effect, 4. Operational, 5. Simple. A footer at the bottom says 'Your ideas and experiences expressed simply!'. The page has a dark blue header and a white body with some blue highlights.

## Understand what makes a question useful

# Ask questions of people

The screenshot shows the homepage of the 'Follow Your Gut' website. At the top, there's a navigation bar with links for 'Secure', 'https://hde.gutinstinct-ucsd.org/topics', a search icon, and a star icon. Below the bar, there are links for 'Confused?', 'Add your question!', 'Topics', 'Guide', 'GutBoard', and 'Notifications'. The main title 'Follow Your Gut' is displayed with a blue stylized 'F' icon. Below the title, a subtext says 'Choose among following topics to understand your gut!'. There are four topic cards: 'Genetics' (with a DNA helix image), 'Physiology' (with a human body diagram), 'Probiotics' (with a photo of capsules), and 'Introduction' (with a lightbulb icon). Each card has a blue 'Learn' button at the bottom.

The screenshot shows a 'Share your Gut Instinct!' page. The URL in the address bar is 'gutinstinct-ucsd.org/gutboard\_slider\_addq'. The page features a navigation bar with 'Confused?', 'Add more questions!', 'Topics', 'Guide', 'GutBoard', and 'Notifications'. The main content area is titled 'Share your Gut Instinct!' with a red question mark icon and a 'Show me examples' link. It lists five steps: 1. Add a top-level question for others to answer (example: 'Something that you do (a cause)'), 2. Add a follow-up question (example: 'Something that happens (an effect) due to the cause above'), 3. Add more follow-up questions: More effects, 4. Guess the mechanism for your Gut Instinct, and 5. Check the criteria.

Use the  
criteria when  
adding a  
question

# Contribution: Learn-Train-Ask workflow

The screenshot shows a web browser window with the URL <https://hde.gutinstinct-ucsd.org/topics>. The page title is "Follow Your Gut". Below the title, it says "Choose among following topics to understand your gut!". There are four topic cards: "Genetics" (image of DNA), "Physiology" (image of a human skeleton), "Probiotics" (image of green capsules), and "Introduction" (image of a lightbulb).

Learn

32

## 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

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](#)

Train

Ask

# 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=Yes			
		Train	Both		
Learn=No	Train=Yes	What type of alcoholic drinks (with sugar) affect your bowel movements?	What type of alcoholic drinks (with sugar) affect your bowel movements?		Probiotics
	Both	<input type="checkbox"/> wine	<input type="checkbox"/> wine		
Learn=Yes	Train=Yes	<input type="checkbox"/> beer	<input type="checkbox"/> beer		Probiotics
	Both	<input type="checkbox"/> liquor	<input type="checkbox"/> liquor		
Learn=Yes	Train=No	<input type="checkbox"/> sugary mixed drinks	<input type="checkbox"/> sugary mixed drinks		
	Learn	<input type="checkbox"/> wine	<input type="checkbox"/> wine		
Neither	Train=Yes	<input type="checkbox"/> beer	<input type="checkbox"/> beer		Probiotics
	Both	<input type="checkbox"/> liquor	<input type="checkbox"/> liquor		
Neither	Train=No	<input type="checkbox"/> sugary mixed drinks	<input type="checkbox"/> sugary mixed drinks		
	Learn	<input type="checkbox"/> wine	<input type="checkbox"/> wine		

## 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

### *Content*

Insightful: Does the question & discussion link to existing knowledge of the microbiome?  
Novel: Is there a chance the world will learn something?

### *Structure*

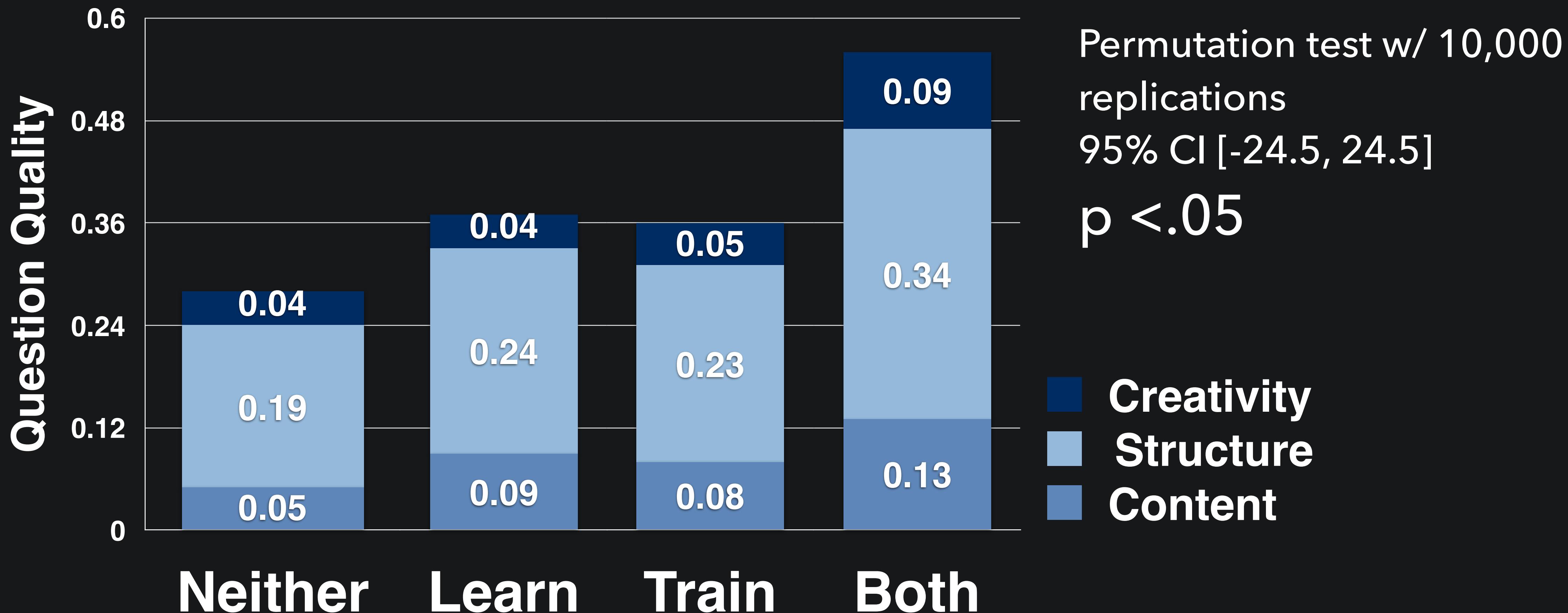
Answerable: Is it a question about the participant?  
Specific: Does it ask about only one topic?

### *Creativity*

Is it reasonably interesting/ creative?

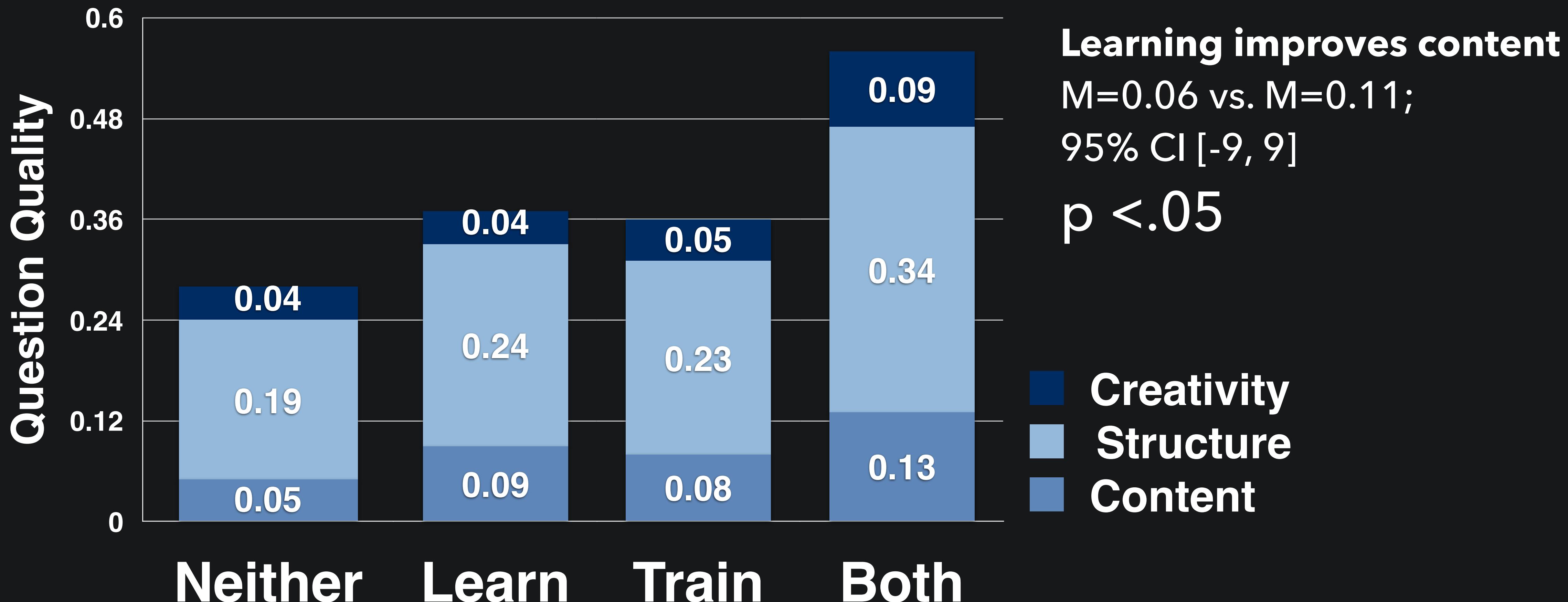
# Results

Learn-Train yields better questions ( $N=344$ )



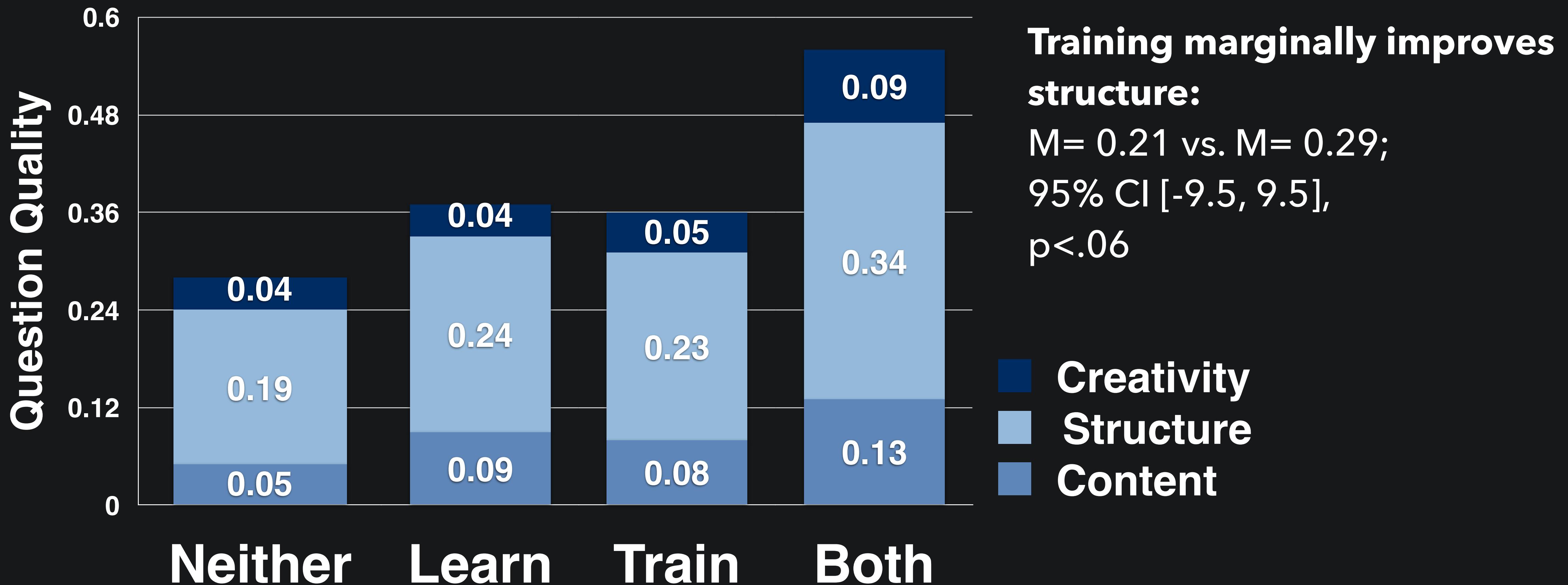
# Results

Learn-Train yields better questions ( $N=344$ )



# Results

Learn-Train yields better questions ( $N=344$ )



# Why did Learning and Training help?

- Content learning engaged people
  - greater time on task → more questions
  - exposure to 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 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*

**Does eating more plants change my bowel movements?**

**Do antibiotics lead to GI issues?**

*Common themes*



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
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[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](http://gutinstinct.ucsd.edu/topics) Please keep sharing your gut instincts, these are helpful!

## Add follow-on questions<sup>40</sup>

## Discuss questions and responses

## Share scientific feedback

People contributed in different ways

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

## *Role and Actions*

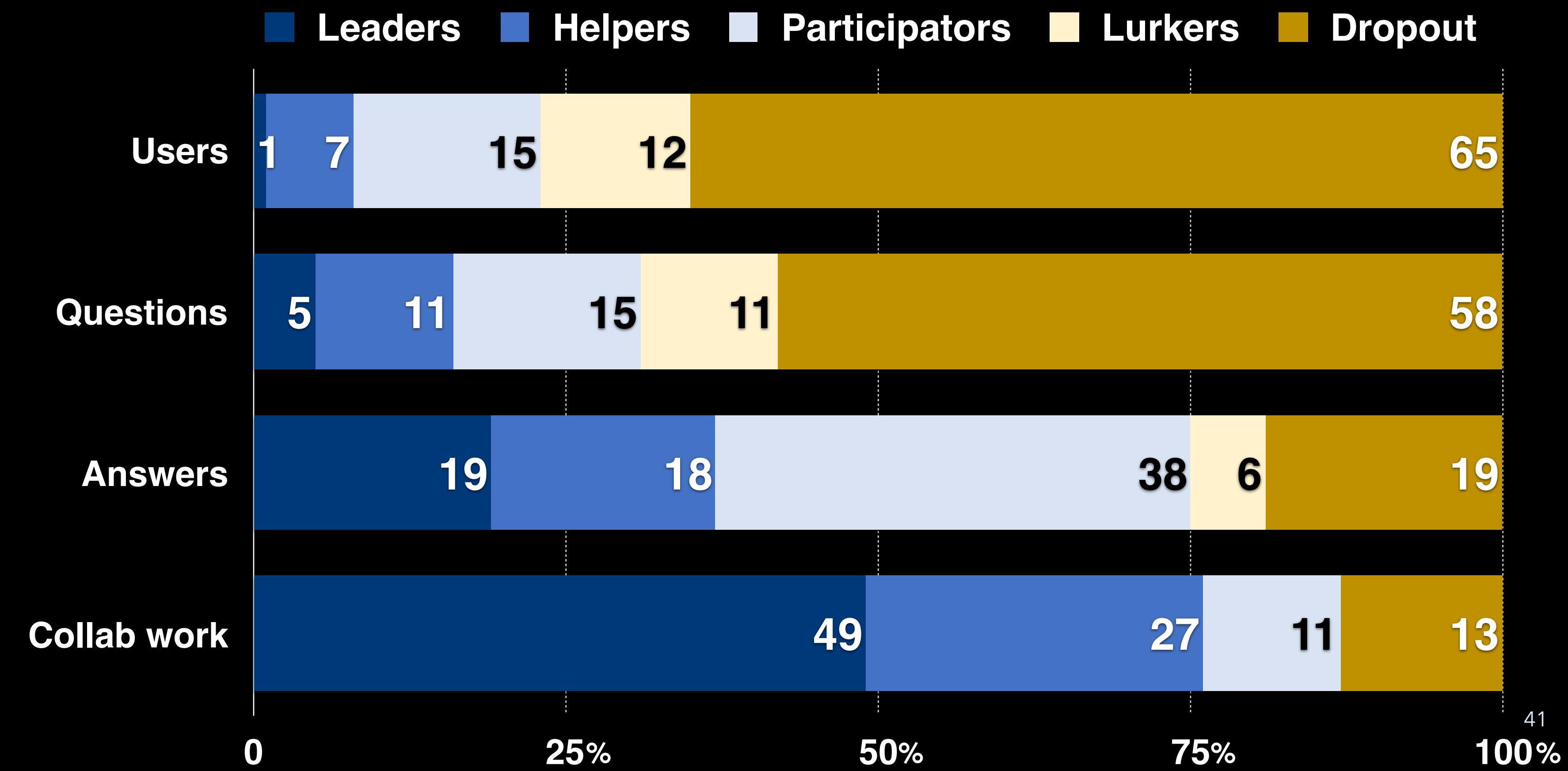
**Leader:** Add questions, answer & edit others' questions, add follow-ups, discuss

**Helper:** Add & answer questions, add follow-ups

**Participant:** Answer questions

**Lurker:** Add questions but no collaborative work

**Dropout:** Add a question; never returned



Two lessons from collaborative hypotheses-generation:  
Procedural training helps and people take roles

# How might citizens design and run experiments?



**Kombucha bacteria: a gut probiotic?**



**Adriana: Kombucha producer from Rio**

# Experimentation requires making many choices

“Kombucha helps the gut” - what does this mean?

Do people just drink kombucha and report its effects?

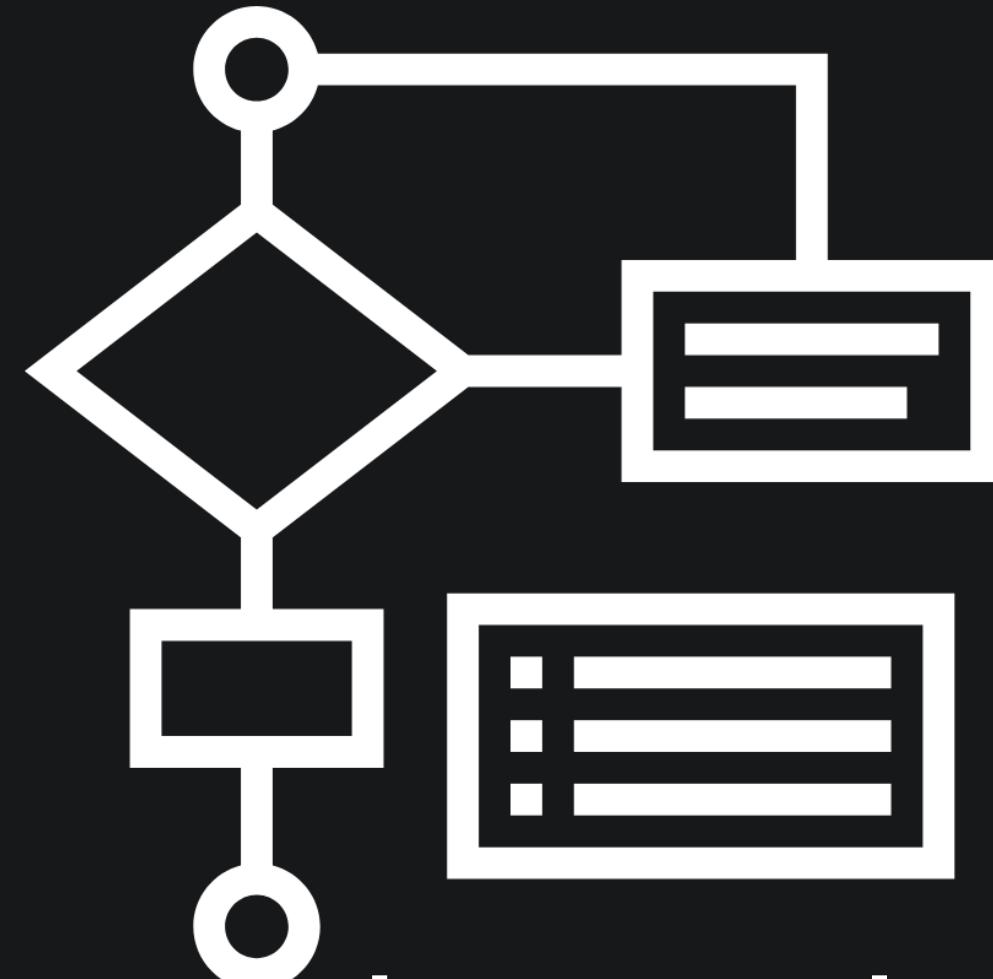
How might participants provide their data?

Which is the right set of participants?

Where do I find them?

Can I place my friend in experimental condition?

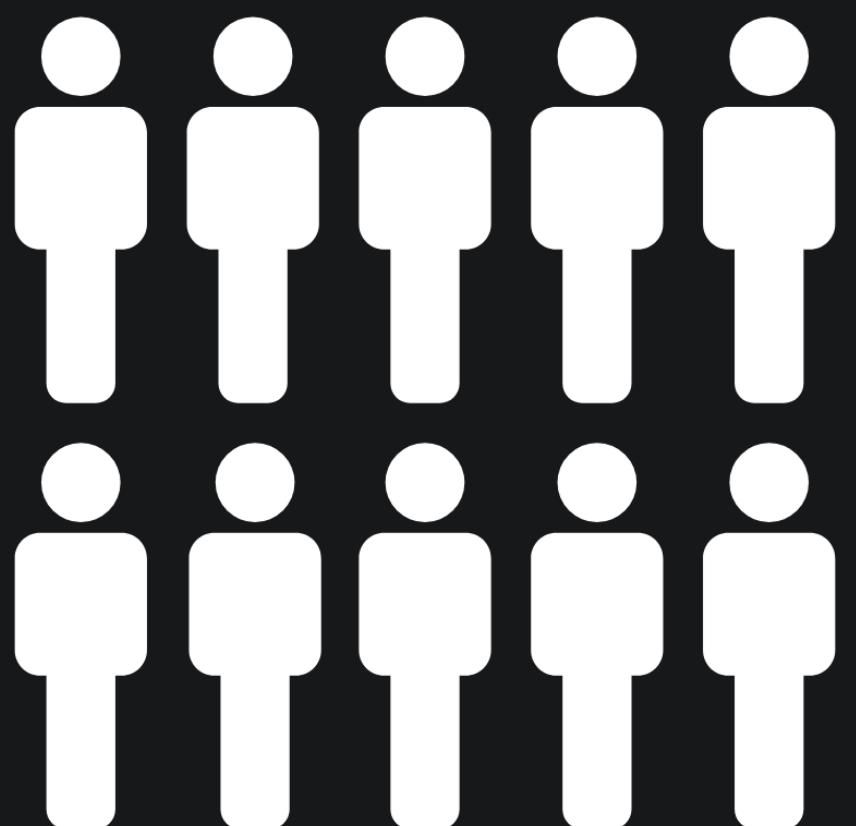
# Experimentation is hard



Know what makes  
for an experiment  
+ get the individual  
elements right

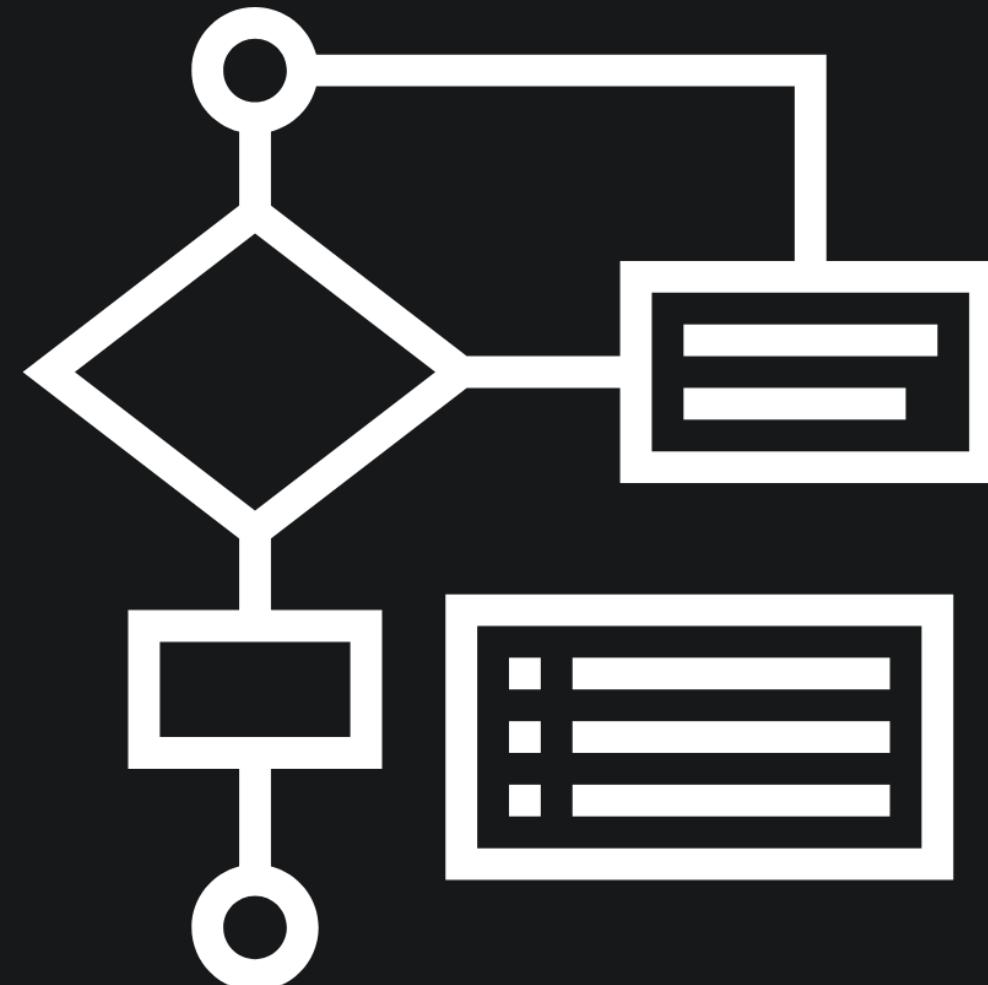


Iterate to improve  
the design

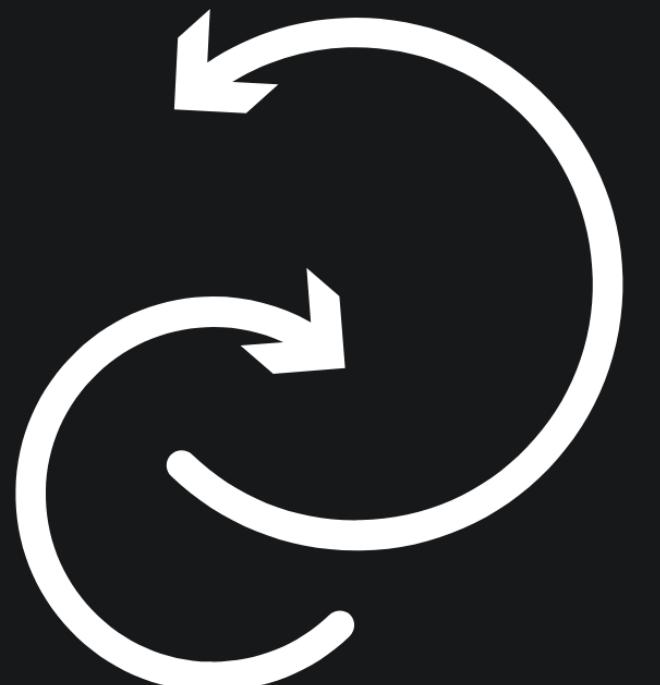


Run it correctly  
(without adding  
biases)

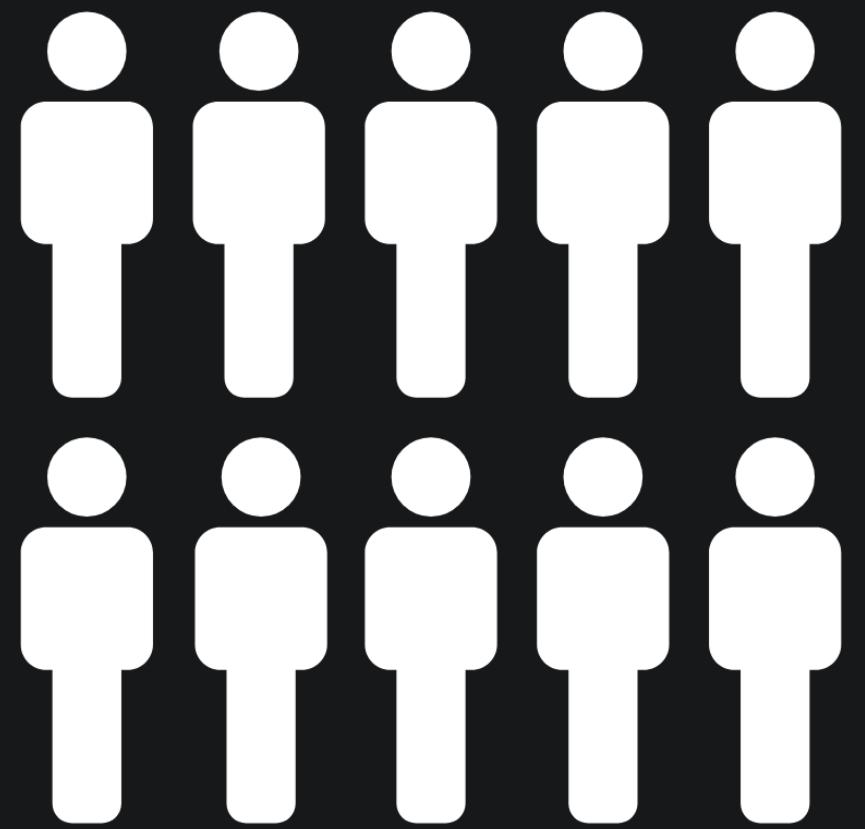
# Experimentation is hard because it requires multiple kinds of knowledge and skills



Conceptual +  
Procedural training

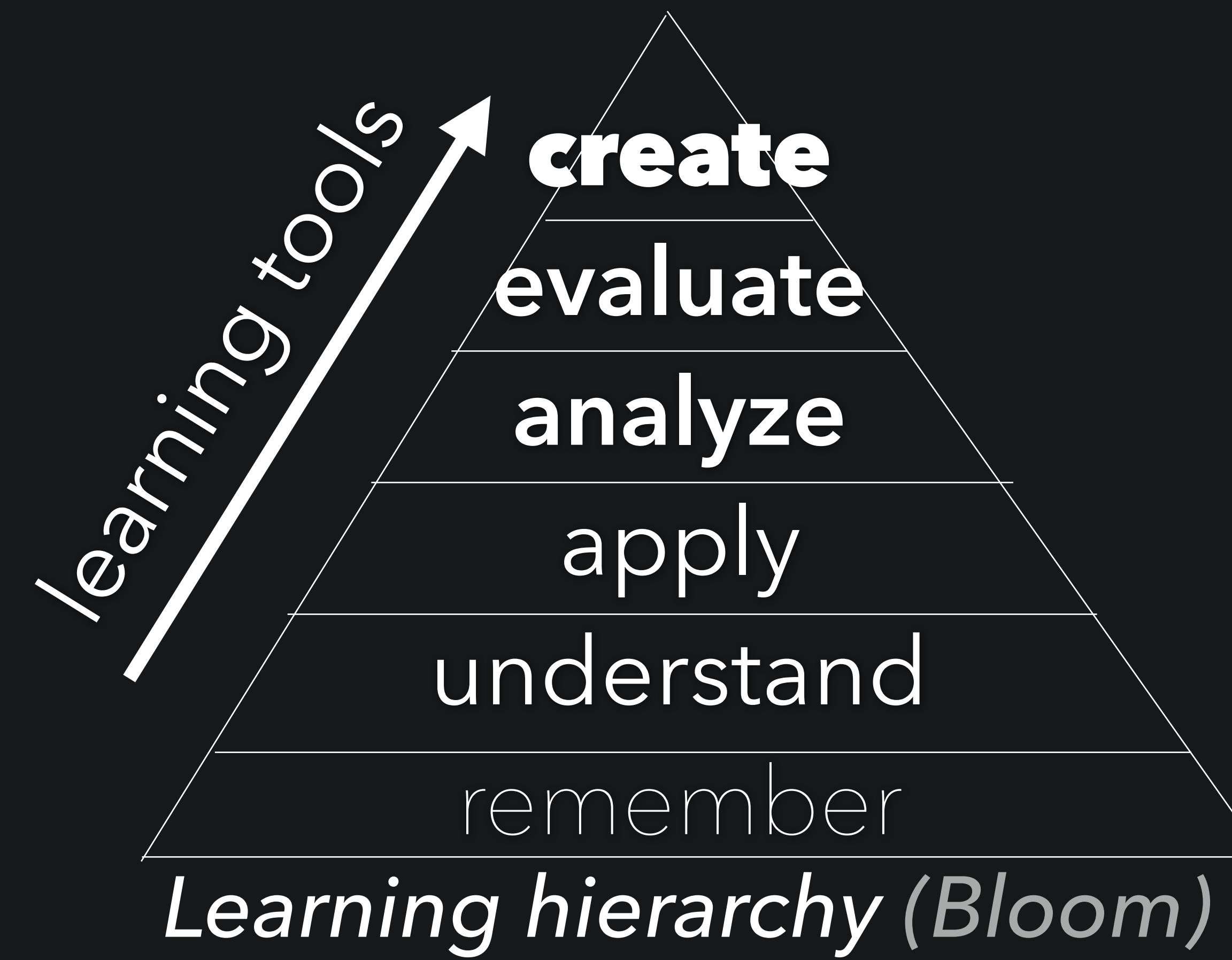


Structured  
collaboration

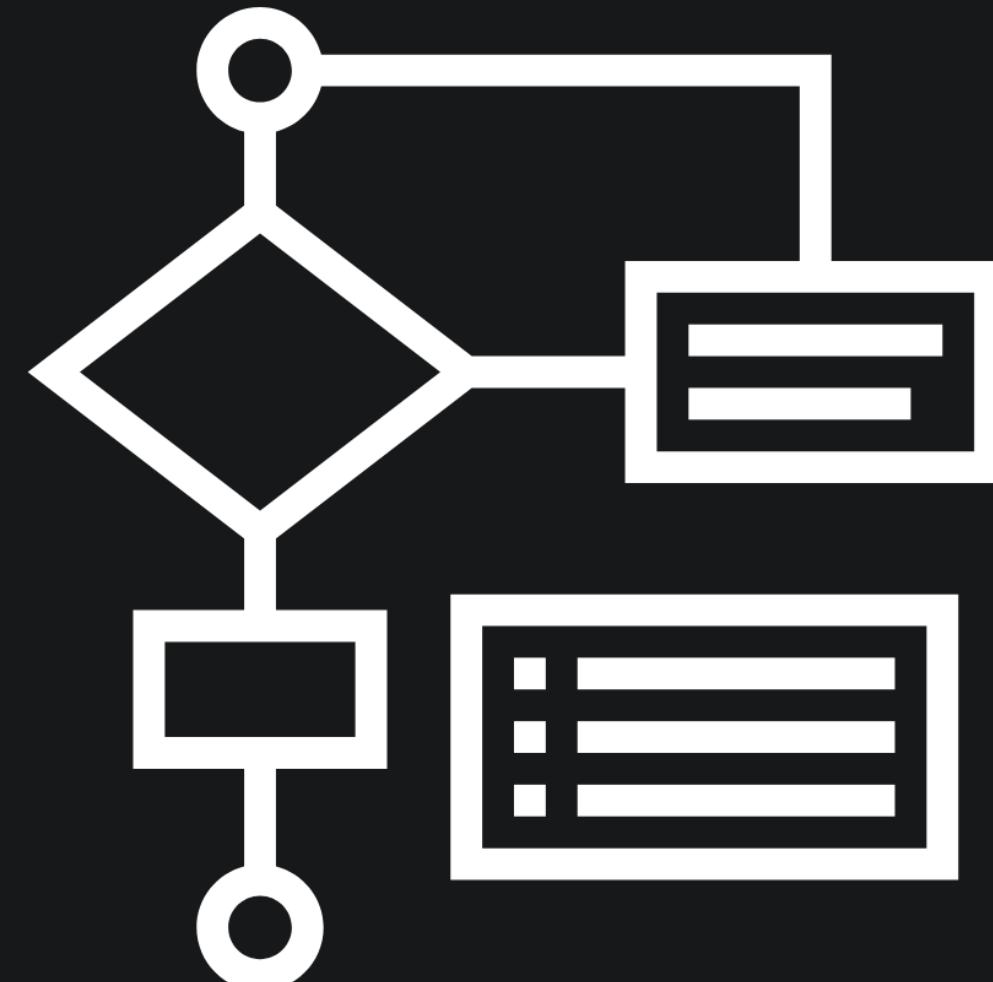


Consistent  
implementation

# Complex work: learning & collaboration



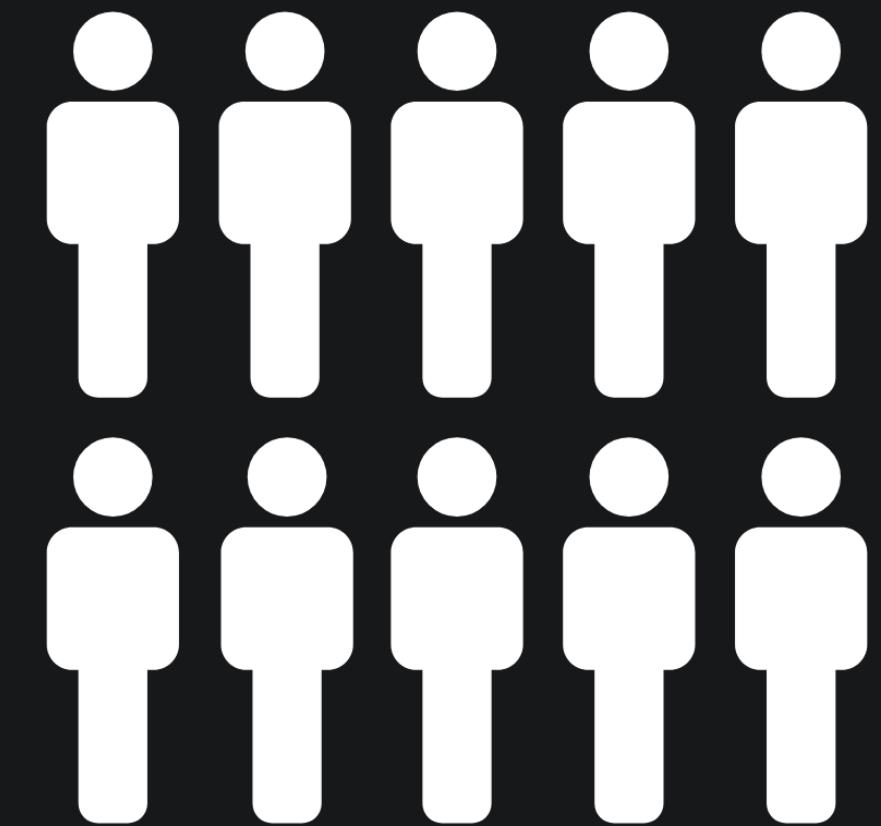
# Support for learning: just-in-time procedural help



Reify experimentation  
genre + Integrate  
procedural learning



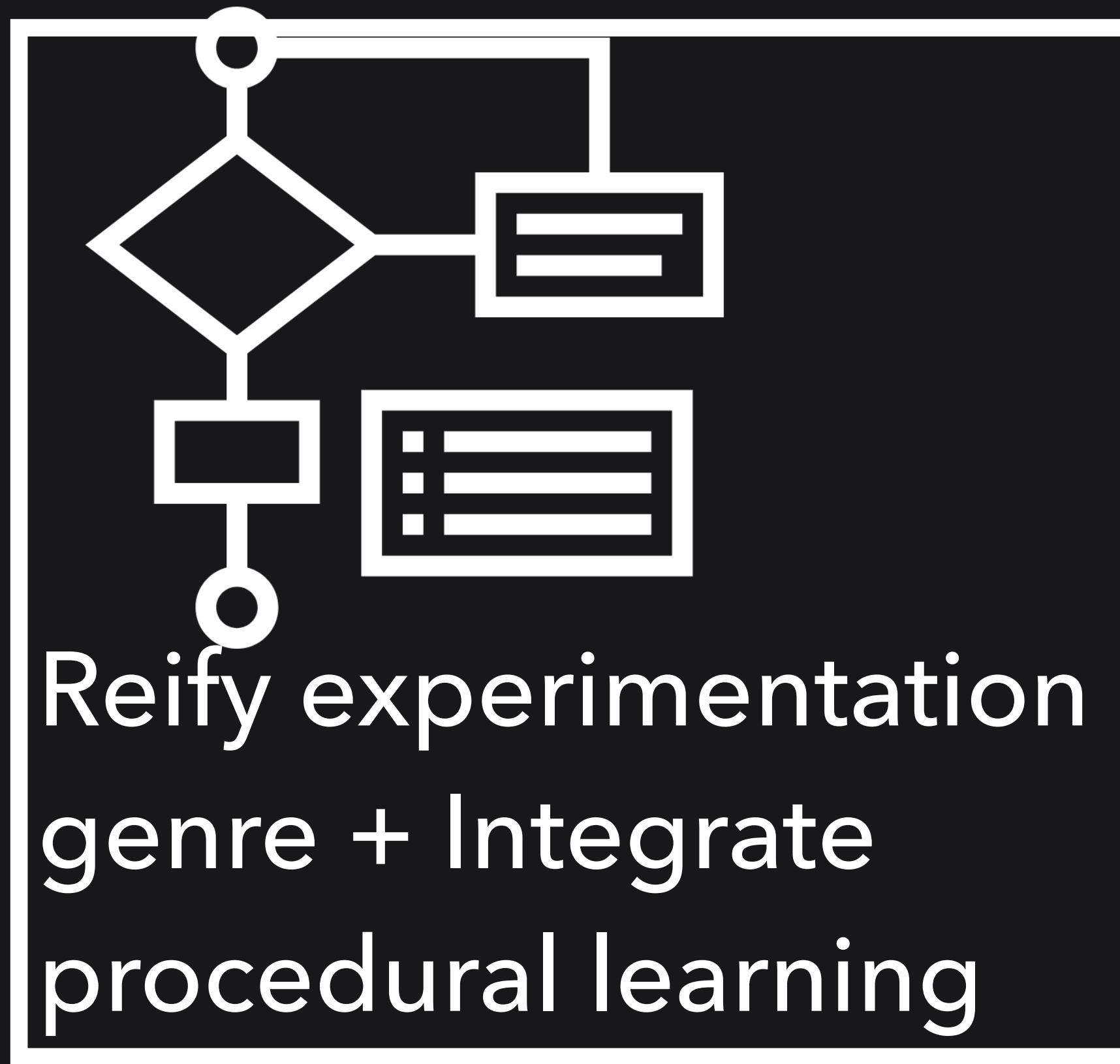
Scaffolded  
Community  
Review



Automate this

# Support for collaboration: Provide concrete roles

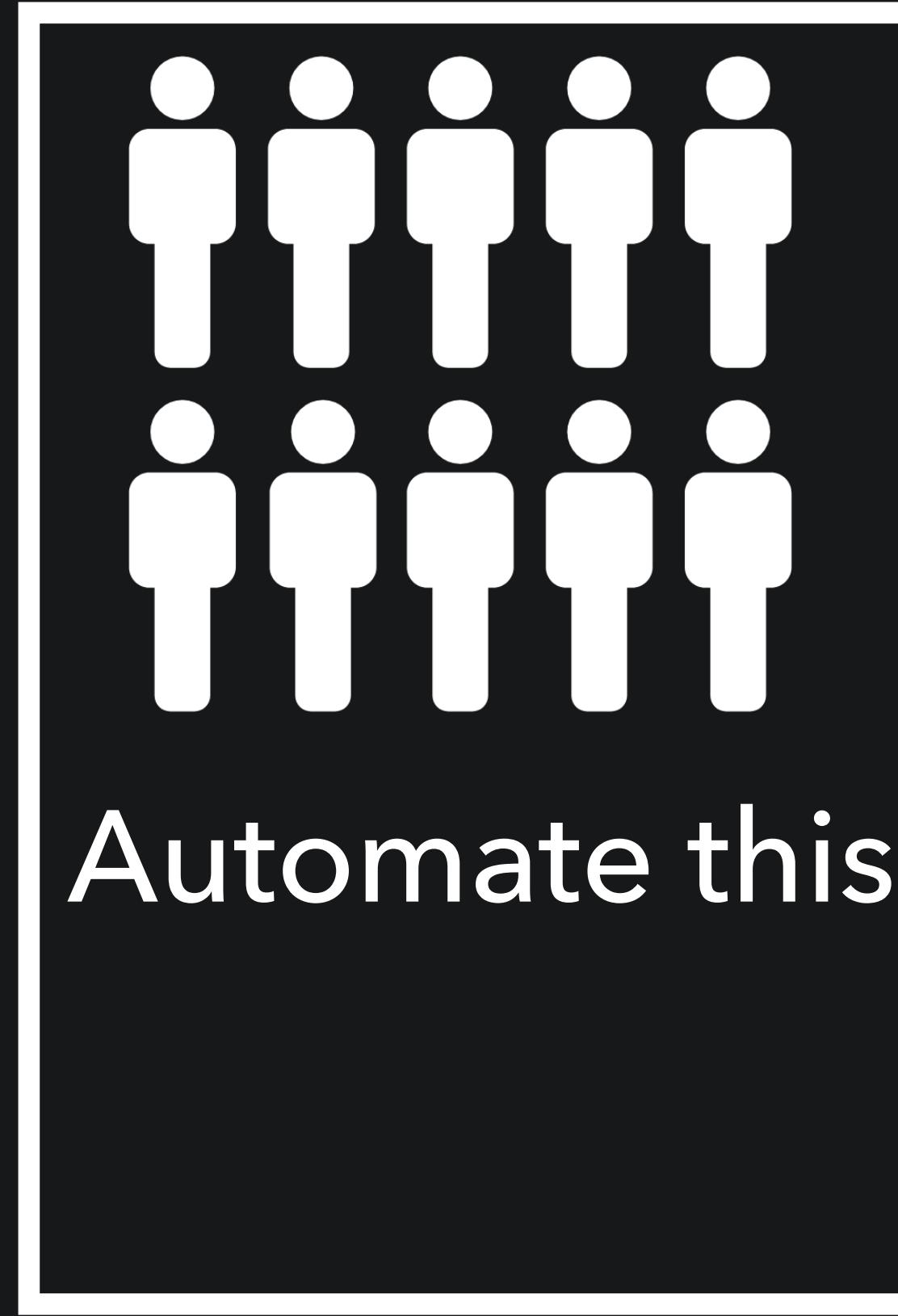
## Design



## Review



## Run



# Design using procedural training cues baked into the interface

## 1 Start with an intuition

Drinking kombucha makes me less bloated

These examples might help:

Cause	Relation	Effect
Drinking coffee	increases	alertness
Eating raisins every day	decreases	number of bowel movements
Not brushing teeth	results in	bad breath

**Cause**      **Relation**    **Effect**

Drinking kombucha      improves      stool consistency

## 2 Measure the cause

**Drinking kombucha** improves stool consistency

To conduct an experiment, you need to

1. change the cause (called manipulation) and then
2. record the effect.

How will you manipulate **Drinking kombucha** in your experiment?

(To keep your experiment simple, choose **one** option)

**Absence or Presence**

E.g. Milk in your diet could be present or absent

E.g. Exercise in your day could be present or absent



EXAMPLES



number of bowel movements  
bad breath

stool consistency

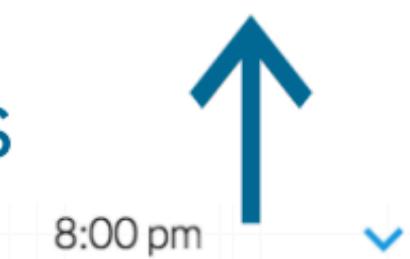


TEMPLATE

## 3 Set up data collection messages

Send all participants a reminder to provide **Bristol Scale Value** of **stool consistency** at

**edit** the content for the reminder text message to track **stool consistency** at **8:00 pm**



8:00 pm

Hello from Galileo! This is your 8:00 pm reminder to measure "stool consistency" today.

How would you classify stool consistency on the Bristol Stool Chart? Please refer to the chart ([https://en.wikipedia.org/wiki/Bristol\\_stool\\_scale](https://en.wikipedia.org/wiki/Bristol_stool_scale)) and reply with a value between 1 to 7.

## 4 Set up exp/control conditions

Your **Hypothesis**: **Drinking kombucha improves stool consistency**

Your **Experimental Group**:

Drinks Kombucha

Your **Control Group**:

Does not drink Kombucha

## Experiment Details

## Review

**Hypothesis:** Drinking Kombucha improve stool consistency

## Cause

Drinking Kombucha

## Relation

improve

## Effect

stool consistency

## Mechanism:

kombucha has beneficial probiotics to help keeping a normal stool consistency

## Related Work:

There are papers about Kombucha benefits but they do not look specifically at stool consistency. Dufresne and Farnworth (Tea, Kombucha, and health: a review) gives an overview of kombucha benefits (mostly from drinker's testimony) and indicates the need to investigate it with a more scientific approach. This is an old paper, though (from 2000). We have more recent papers, but I could not find one specifically related to stool consistency. There are some related to diabetes, for example.

## How is Drinking Kombucha manipulated?

- Participants measure Absence/Presence of Drinking Kombucha
- Reminder sent every day at 6 pm with the following message:

"Hello from Austin! This is your 6:00 pm reminder to measure "Drinking Kombucha" 🍃 today. Was Drinking Kombucha absent or present in your day today? Reply Yes for present, No for absent."

## How is stool consistency measured?

- Participants measure Bristol Scale value of stool consistency

## The Bristol Stool Chart

	Looks like	Consistency	Indicates
Type 1		Separate hard lumps	Very constipated
Type 2		Lumpy and sausage like	Slightly constipated
Type 3		Sausage shaped with cracks in the surface	Normal
Type 4		A smooth, soft sausage or snake	Normal
Type 5		Soft blobs with clear-cut edges	Lacking fibre

Feedback request from the creator of the experiment:  
none

## People's review of the hypothesis

Is the cause specific?

Yes 1 | No 0

Is the effect specific?

Yes 1 | No 0

Is the relation between cause and effect clear?

Yes 1 | No 0

Is the hypothesis concrete i.e. it either holds or it does not hold?

Yes 1 | No 0

Is this mechanism the most plausible explanation?

Yes 0 | No 0

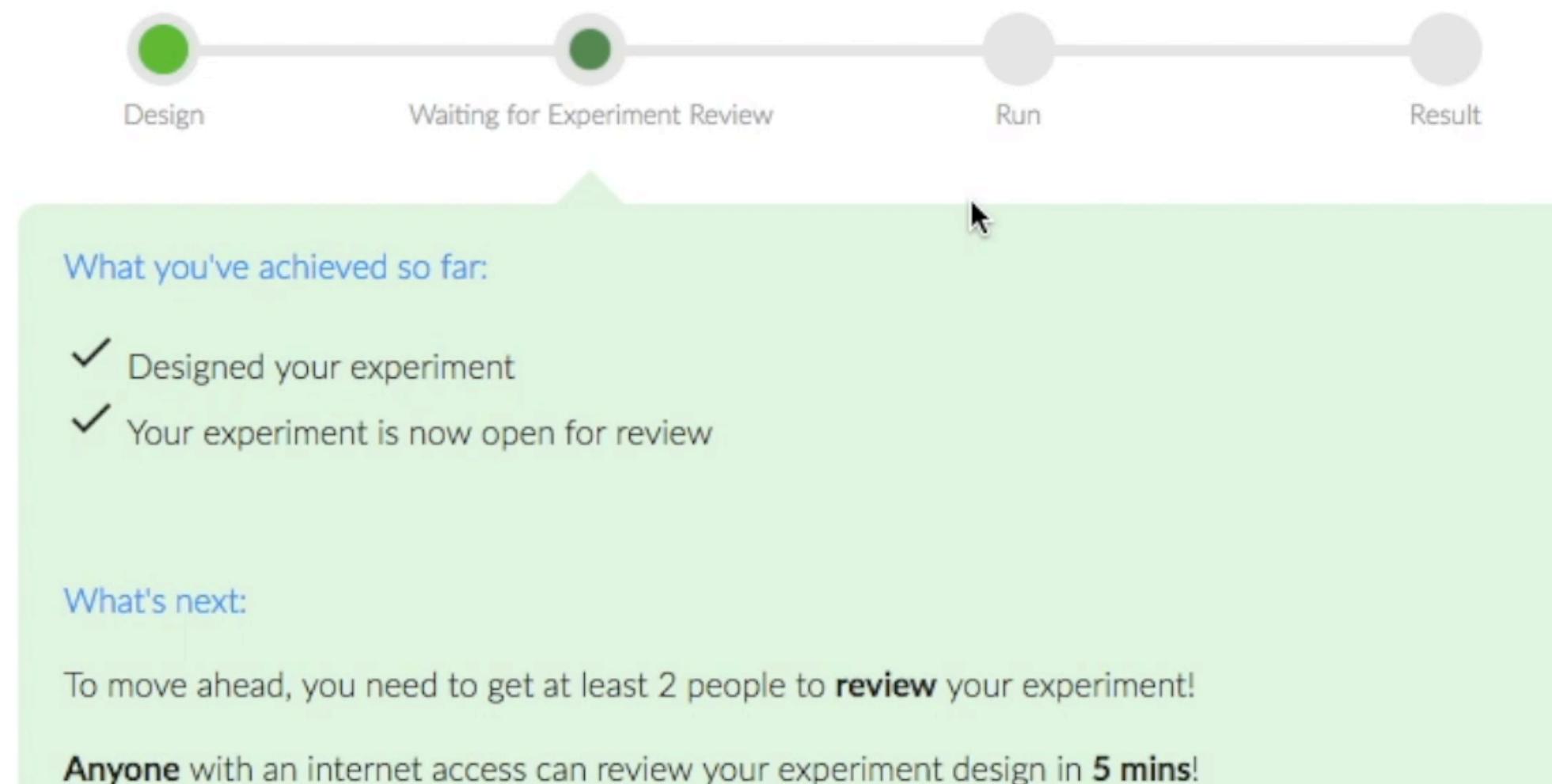
Is the related works description comprehensive?

Yes 0 | No 0

NEXT SECTION

# Improve using community reviews; Reviewers use a scaffolded interface that enables boolean and open-ended comments

## Experiment Status



Is this choice of measurement appropriate for the effect?

Yes 0 | No 1

**Structural**

user As previously stated, quality of sleep could mean different things sleep, feelings of tiredness upon waking up, etc.

Can the experiment participants correctly measure the effect?

Yes 1 | No 0

**Pragmatic**

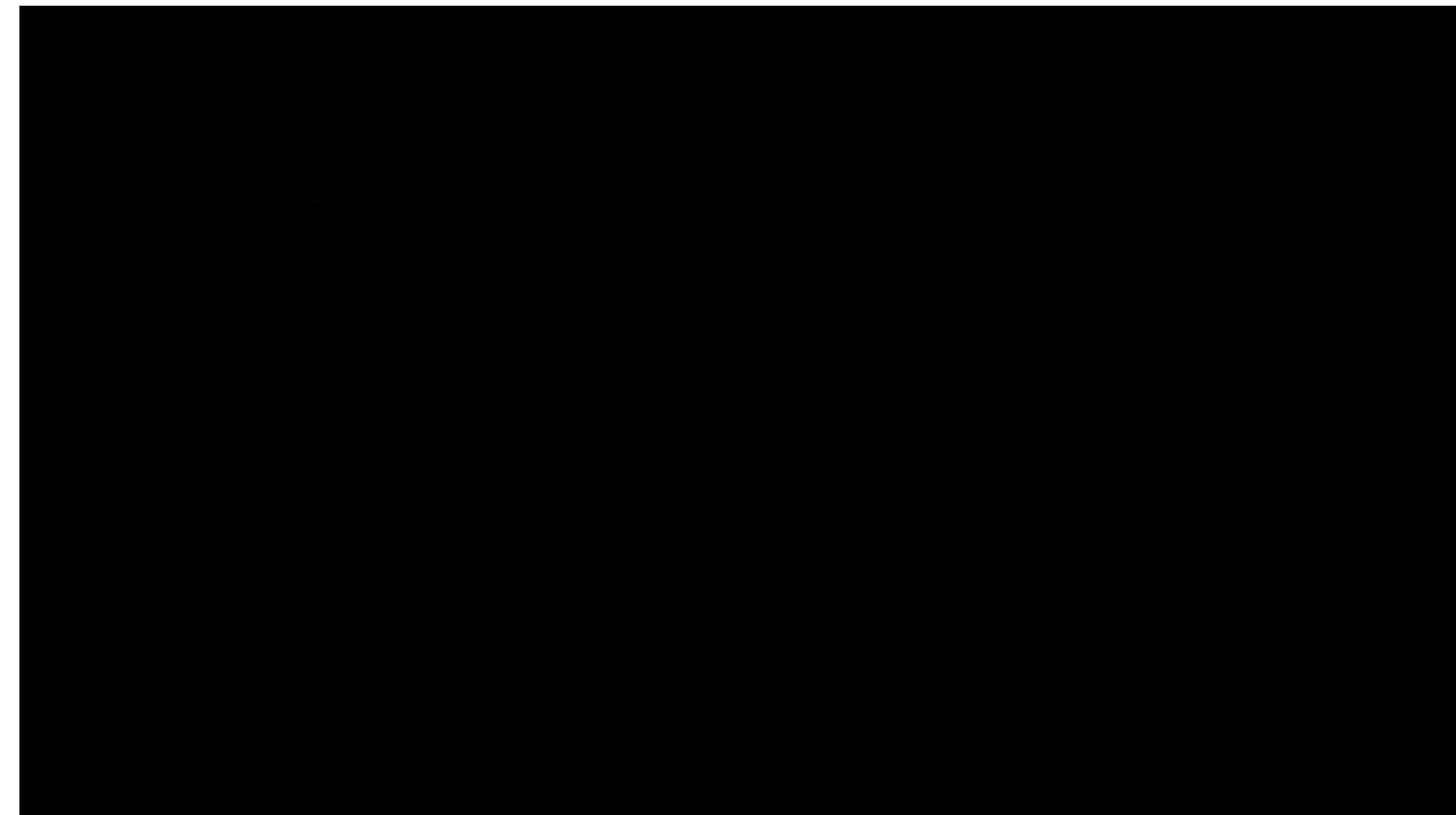
Is the time of reminder convenient for the participants?

Yes 1 | No 0

**Experience**

## Community reviews

# **Participants join online and provide data via text reminders**



People join

Select the appropriate community below to design your own experiments and to view others' experiments

### Knight Lab

Experiments: 10



If you are affiliated with the Knight Lab,  
click here to design, review, and  
participate in experiments.

### Diet (including Coffee)

Experiments: 6



If you are interested in Diet (incl Coffee),  
click here to design, review and  
participate in experiments [\(?\)](#)

### American Gut Project

Experiments: 7



Join the American Gut Project  
community to design, review, and  
participate in experiments! [\(?\)](#)

### Coursera Gut Check

Experiments: 7



Join the Coursera Gut Check  
community to design, review, and  
participate in experiments! [\(?\)](#)

### Open Humans

Experiments: 5



If you are interested in Open Humans,  
click here to design, review and  
participate in experiments [\(?\)](#)

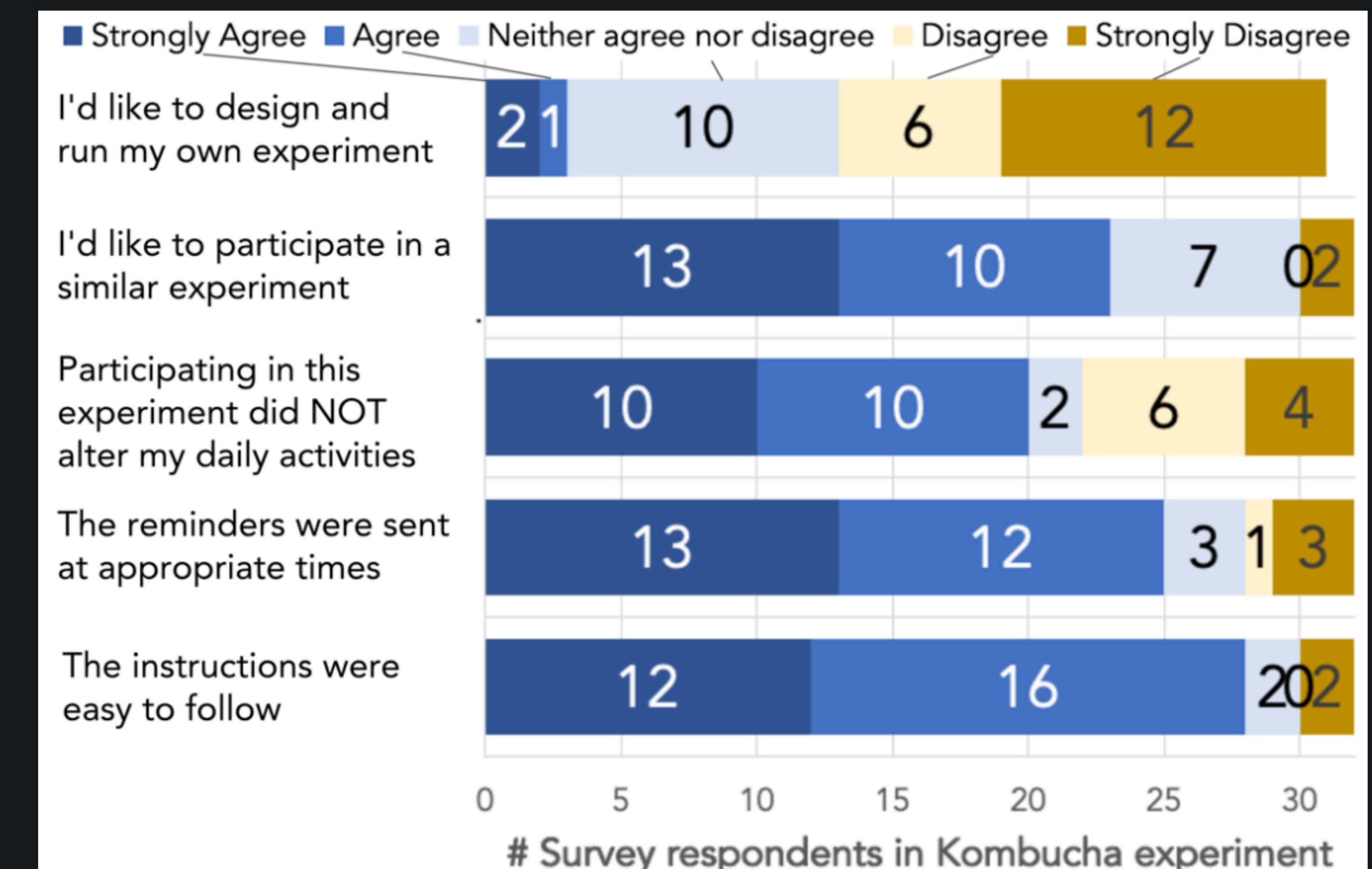
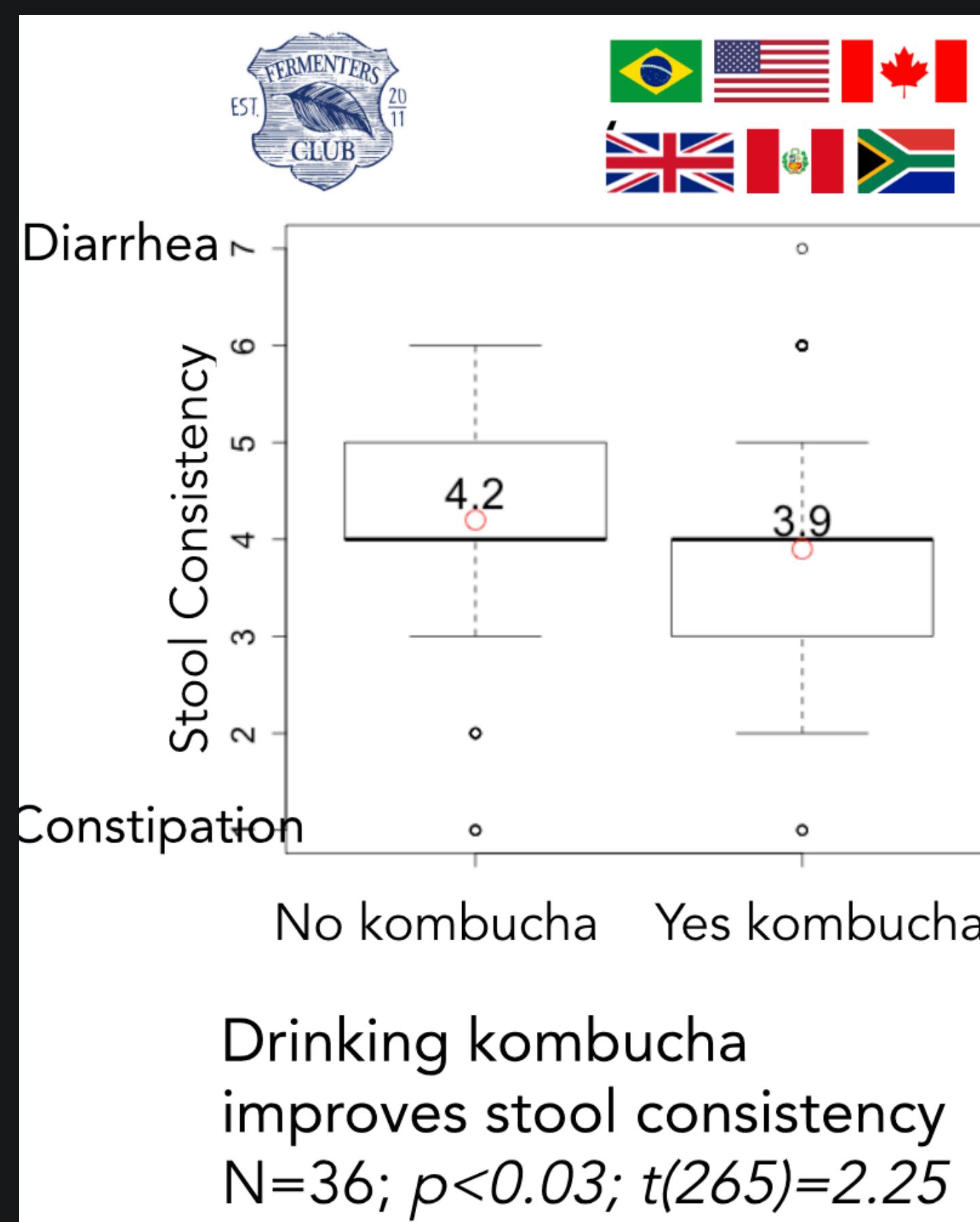
### Circadian Rhythms

Experiments: 4



Join the Circadian Rhythm community  
to design, review, and participate in  
experiments! [\(?\)](#)

# Kombucha community: Does drinking kombucha improve your stool consistency? (N=36)



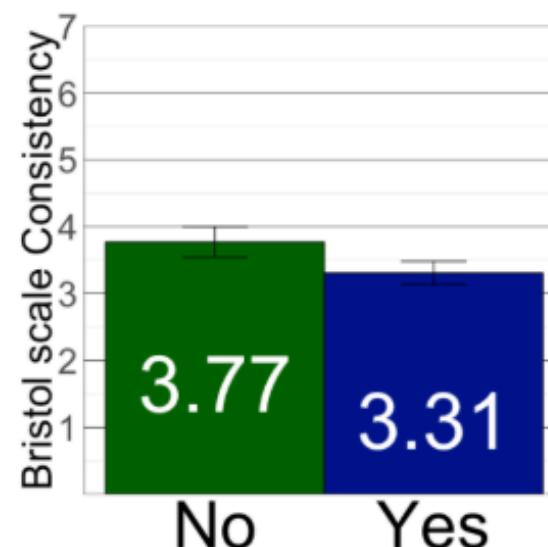
# Experimental result for user789

## Hypothesis

Drinking Kombucha improves stool consistency

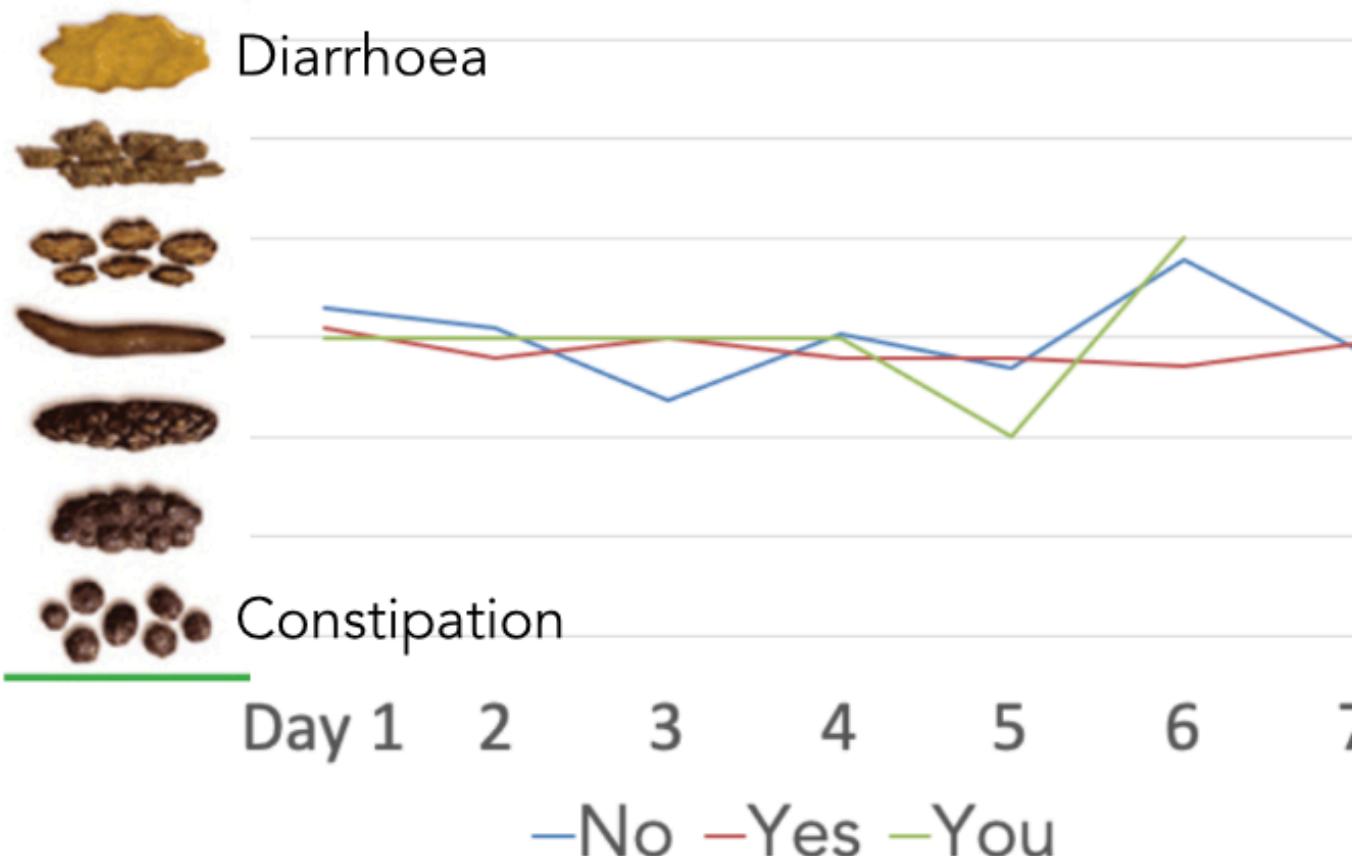
## Result

Evidence found for the hypothesis



There was a significant difference between people who drank kombucha vs. not

## How does your week compare?



## Why this experiment?

Papers about kombucha's benefits do not look specifically at stool consistency. Dufresne and Farnworth (Tea, Kombucha, and health: a review, 2000) give an overview of kombucha benefits (mostly from drinkers' testimony).

## How does the experiment work?

39 participants, for a week



## Limitations

1. Self-reported data can be biased
- 2.

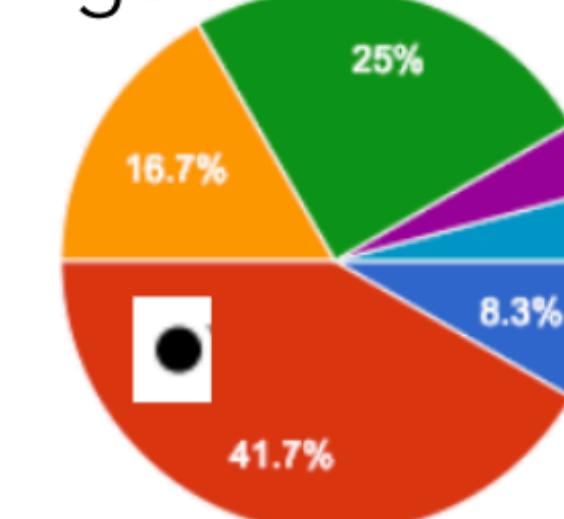
## Participant comments

"I did learn to pay more attention to how food/activities affect my digestion"

"I learned that i have healthy poops!"

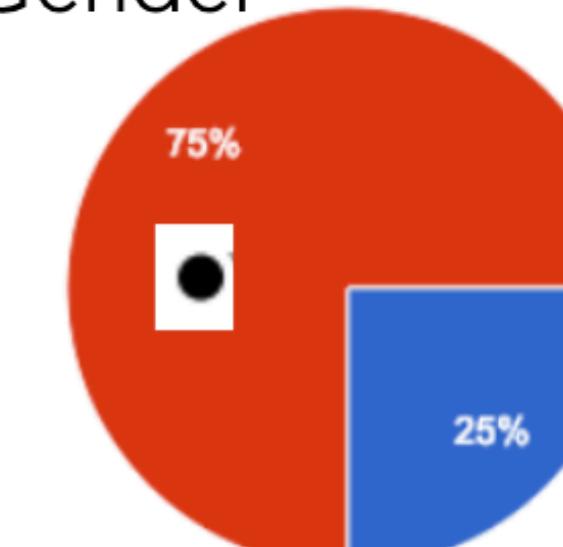
## Who participated in this experiment?

### Age



Your sample is here

### Gender

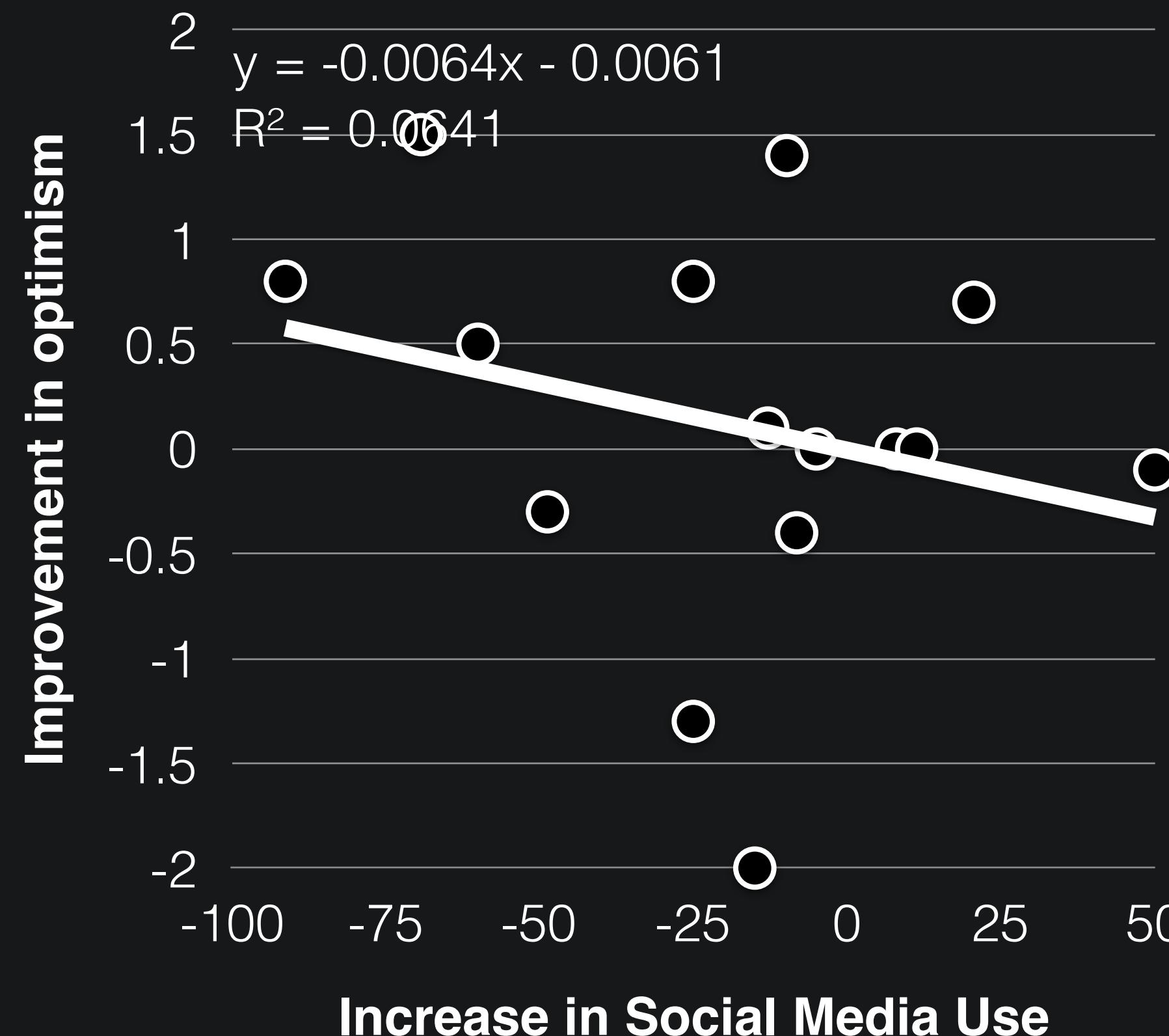


● Male  
● Female  
● Prefer not to answer

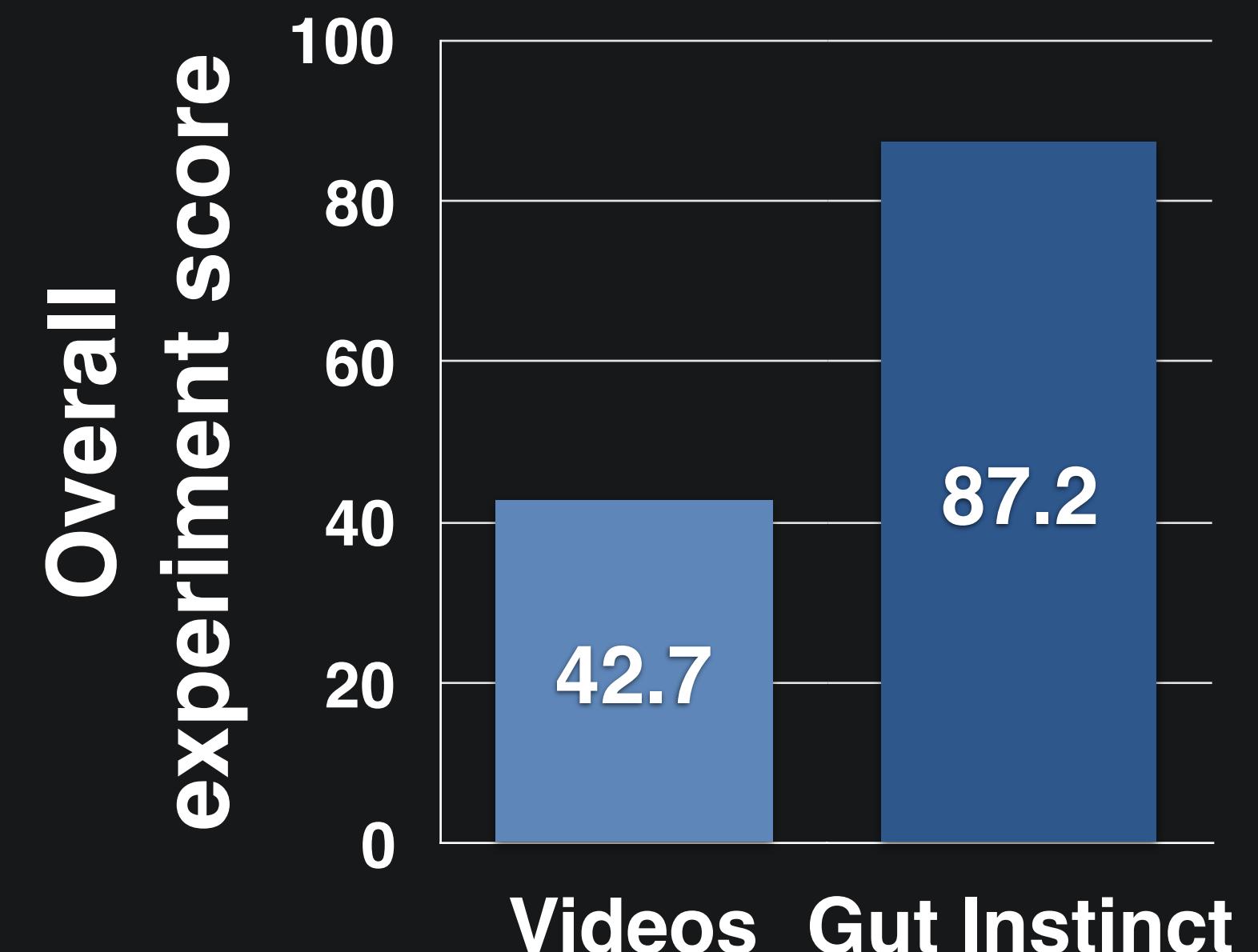
## Experimenter

Austin Durant, Fermenters Club, San Diego + Adriana Daudt Grativol, Brewer, Rio

# Communities can design and run experiments!



Open Humans community studied the effect of social media on optimism ( $N=68$ )



People design structurally-sound experiments ( $N=54$ )

People design better with procedural training ( $N=72$ )

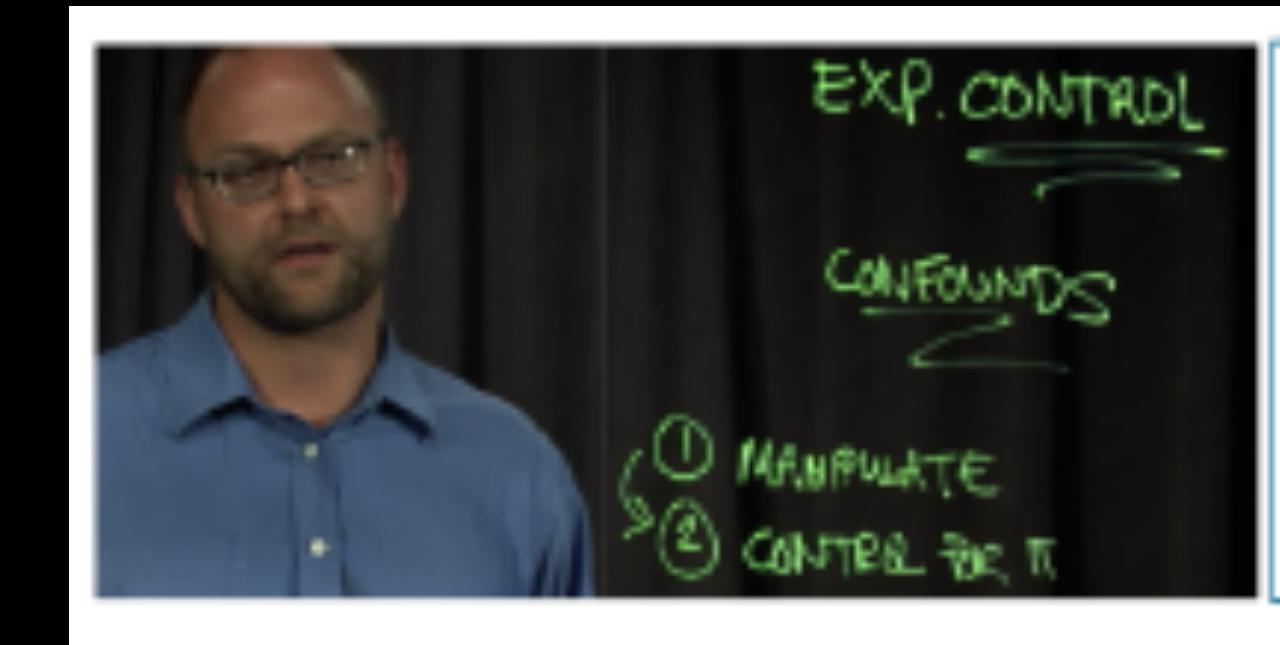
# Method

## Between-subjects experiment (N=72)

### with two conditions: Videos and Galileo

Hypothesis

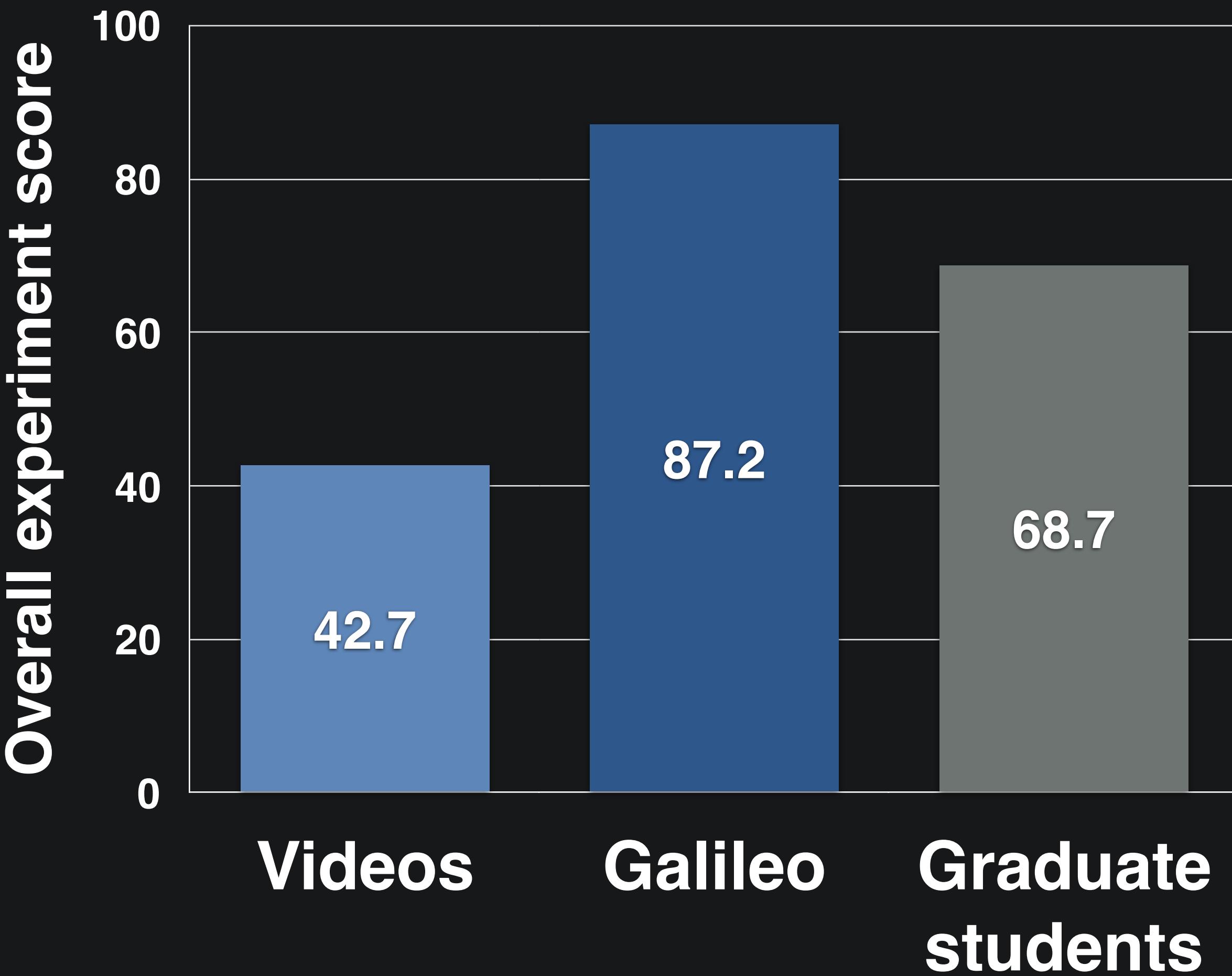
**Structured procedural training yields higher quality experimental designs than learning from lecture videos**



- Minimal pairs: The experimental steps in the two conditions should differ in only one step. Your experiment should strictly manipulate only one behavior for a [true minimal pairs experiment](#) ↗
- Minimize confounders: Participants should not perform other activities ([called confounders](#)) ↗ that might contribute to the cause and/or effect

# Results

Galileo participants created higher-quality experiments ( $N=72$ )

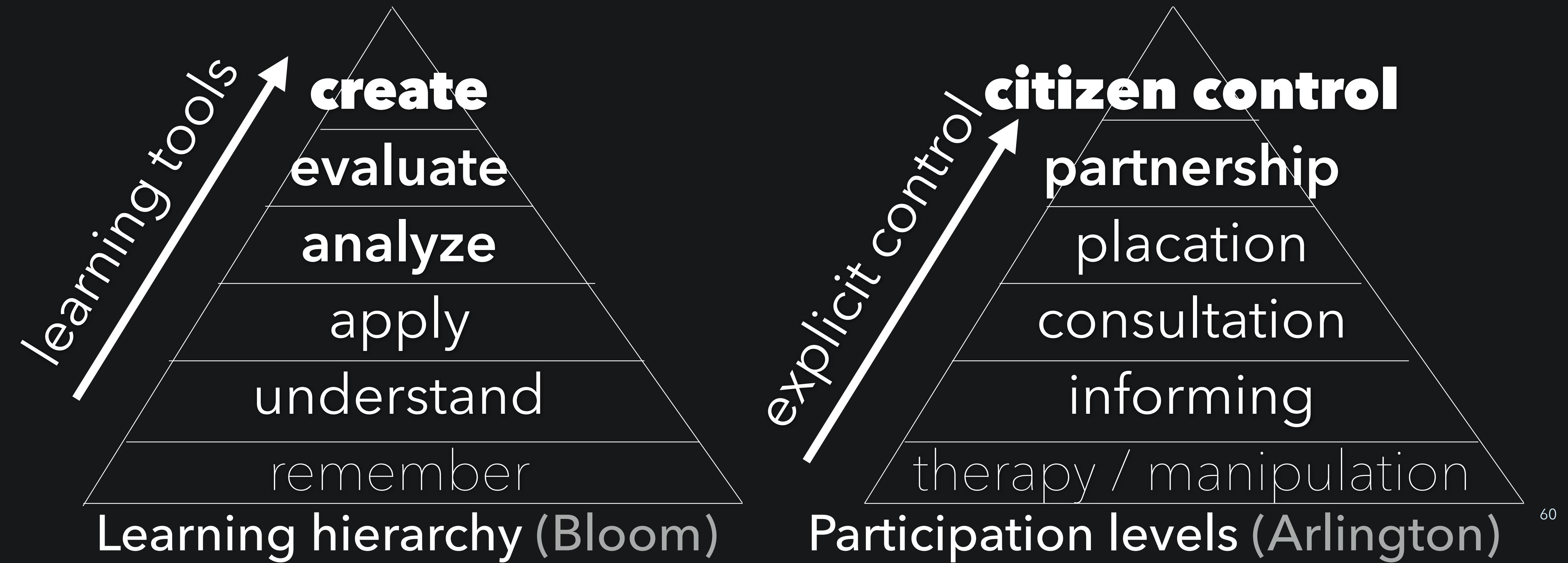


**Galileo improves experimental design.**  $M=11.3$  vs.  $M=5.6$ ;  
Mann-Whitney  $U = 108$ ,  $n_1 = n_2 = 36$ ,  $p < 0.005$

**Novices with Galileo created better experimental designs than experts without Galileo.**  $M=11.3$   $M=8.9$ ;  
Mann-Whitney  $U=104$ ,  $n_1=15$ ,  $n_2=36$ ,  
 $p<0.005$

# Learning in Social Computing:

## Doing big things, together!



# Takeaways: How to enable complex work by online communities

1. Architecture: Divide complex activities into separate roles
2. Technique: Procedural training to collaboratively generate hypotheses and run experiments
3. Results: Novel hypotheses, successful experiments

# Todos

1. Survey - <https://bit.ly/2vkwyen>
2. [gutinstinct.ucsd.edu](http://gutinstinct.ucsd.edu) – Design your own experiment!