

CAUSAL REASONING & MENTAL IMAGERY

UPDATES

- Previous CogLabs
 - Link Word
 - Monty Hall
- Coming soon...
 - Typical reasoning (11/3)
 - Risky decisions (last week of class - no report)

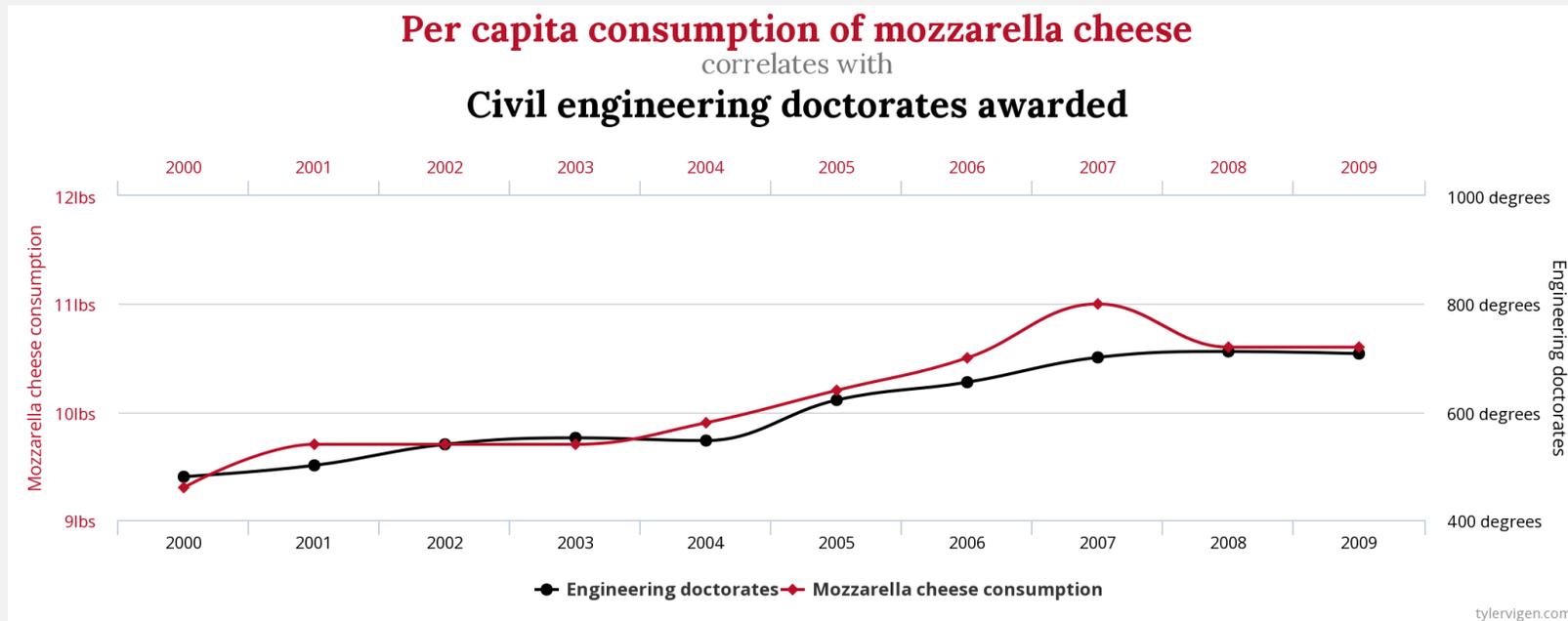
OVERVIEW

- Causation... what is it, and who cares?
- Some recent research
- Work in progress

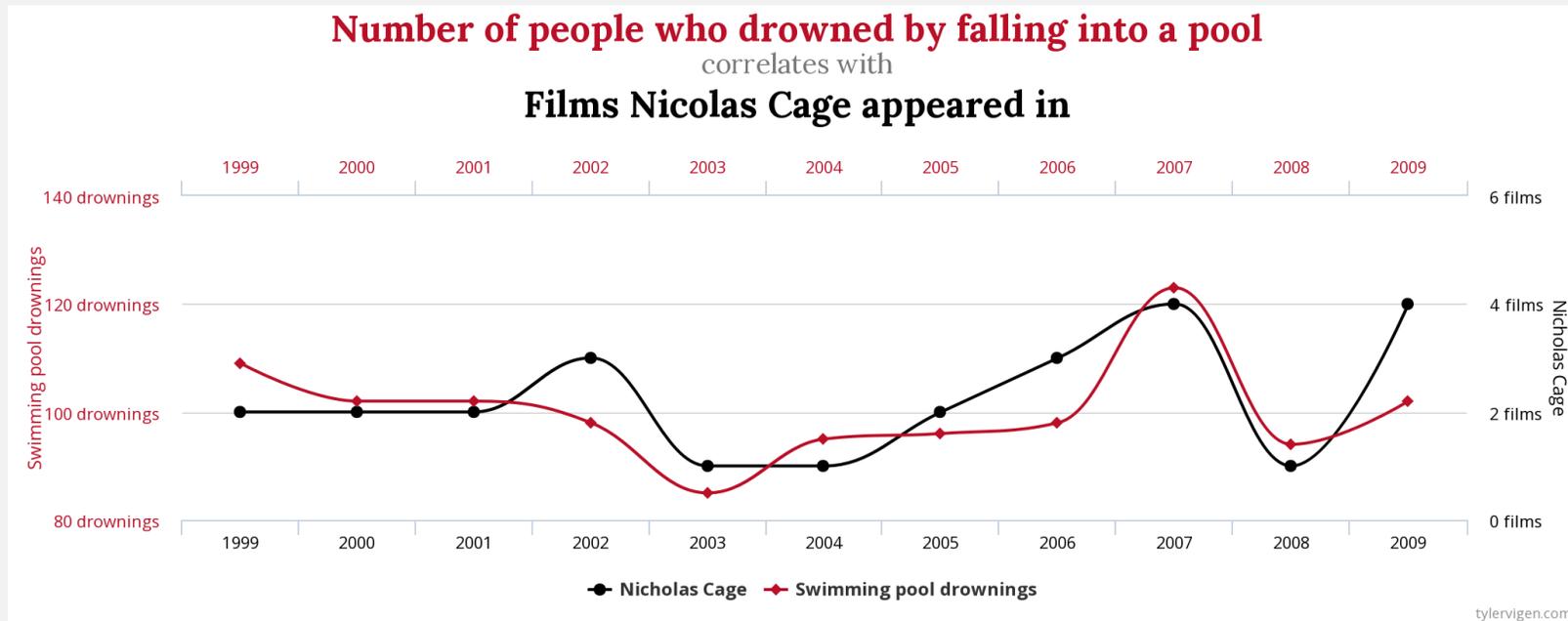
CAUSATION

How are these two things related?

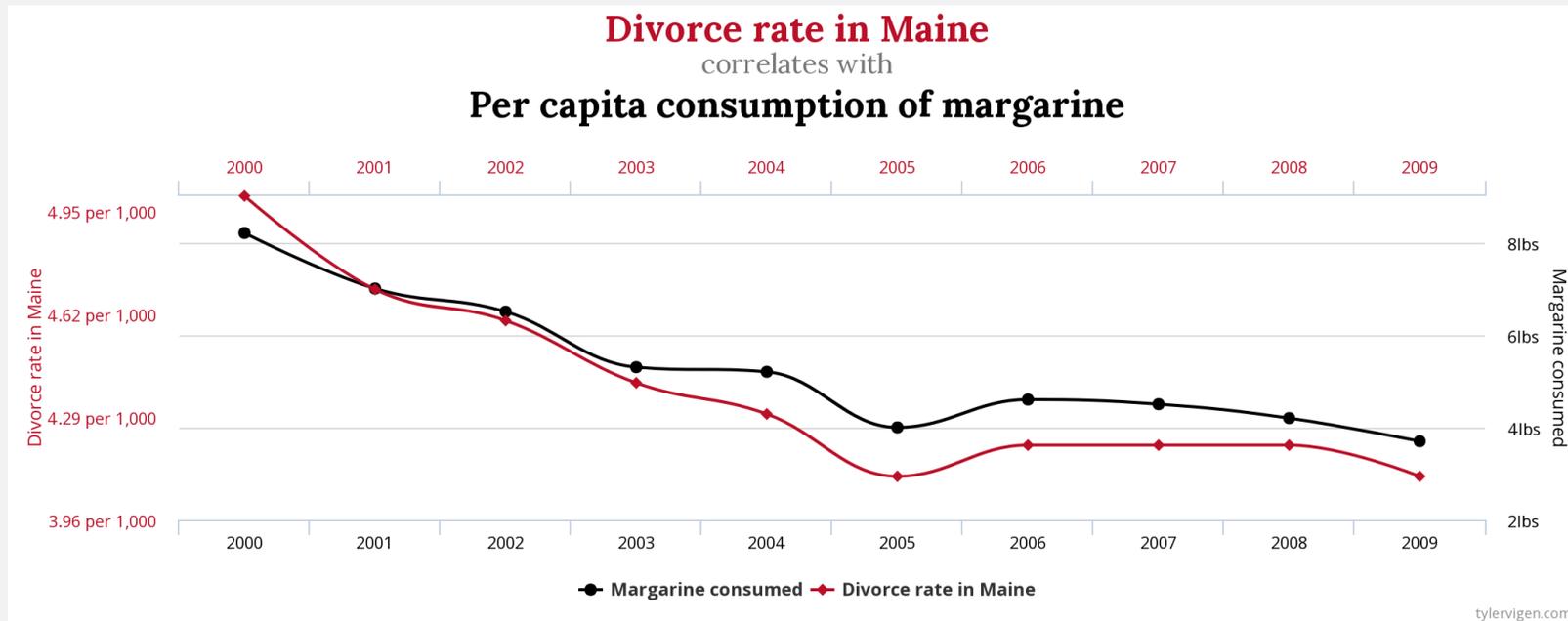
CAUSATION



CAUSATION



CAUSATION



CAUSATION

”Correlation does not imply causation”

To be able to change things, correlation isn't enough:

- Does this medicine treat these symptoms?
- Will going to college increase my future earnings?
- Can this national policy save lives?

CAUSAL REASONING

Because we're psychologists, we want to know:

why people think X caused Y

how people decide X caused Y

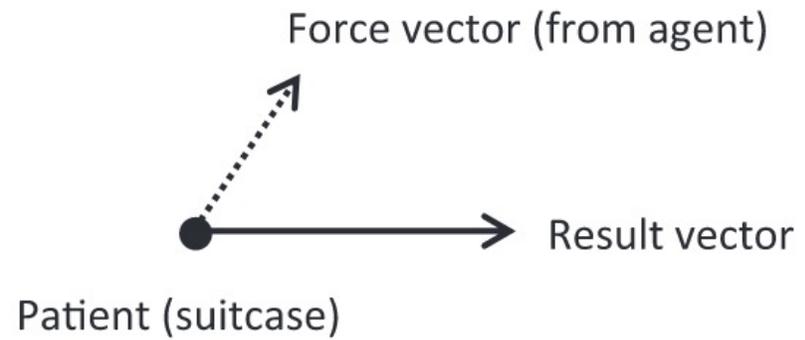
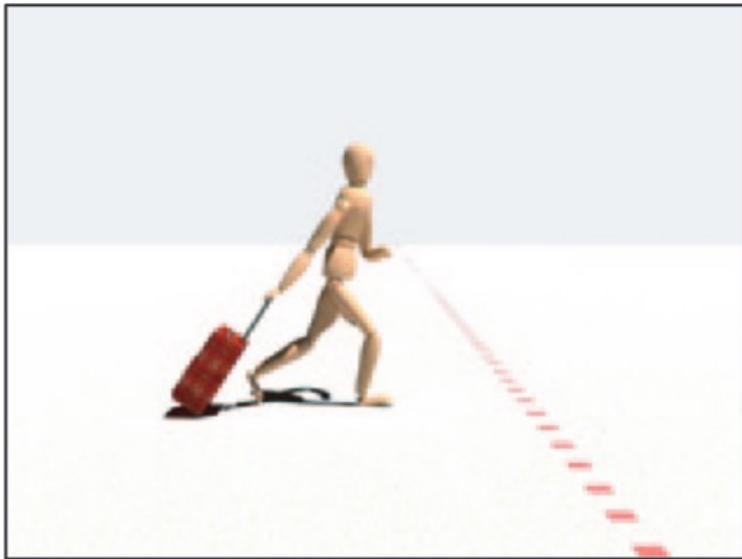
Let's look at two possible explanations...

PROCESS THEORIES

Causes transmit “stuff” to their effects

- Force
- Mass
- Energy
- ...

PROCESS THEORIES



COUNTERFACTUAL THEORIES

Causes are difference-makers

Two things to consider:

1. what actually happened
2. what **would have** happened under different circumstances

COUNTERFACTUAL THEORIES

You drive through a green light, and someone else drives through their red light at the same intersection, resulting in a car accident.

Did they cause the accident by running the red light?

Well, if they didn't, maybe the accident wouldn't have happened!

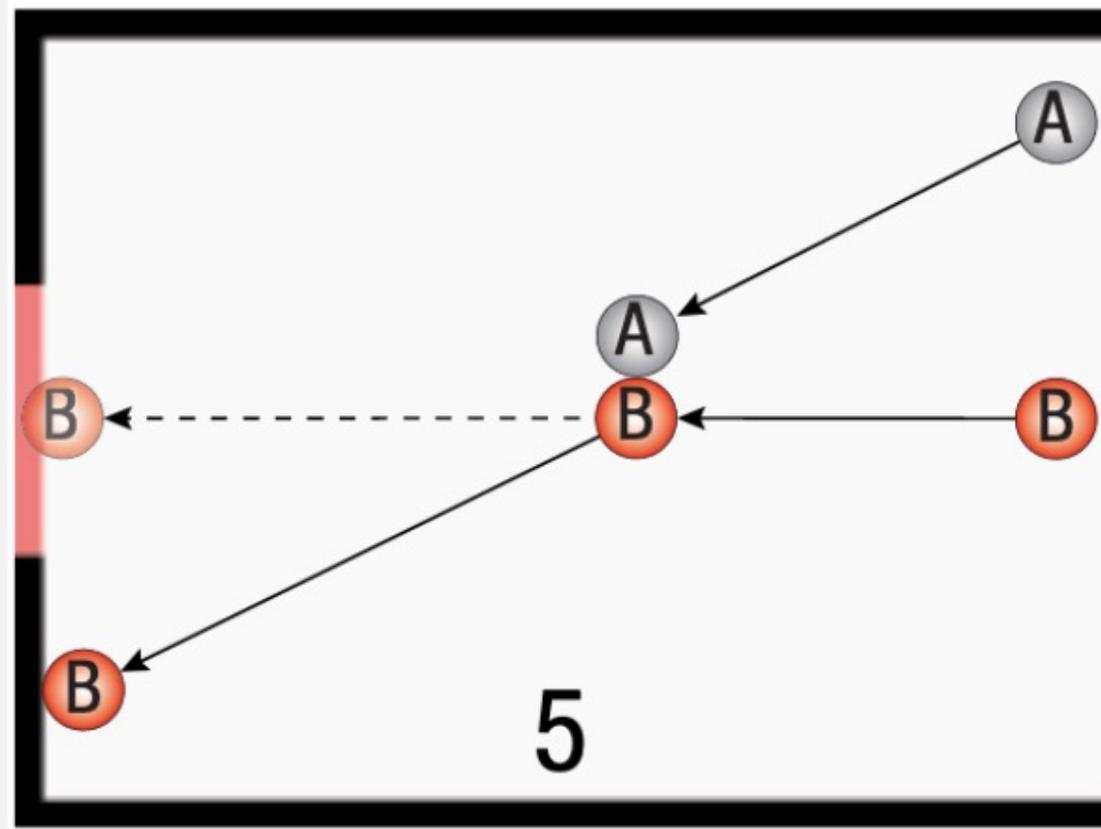
QUESTIONS SO FAR?

HOW WOULD YOU TEST THESE TWO
THEORIES?

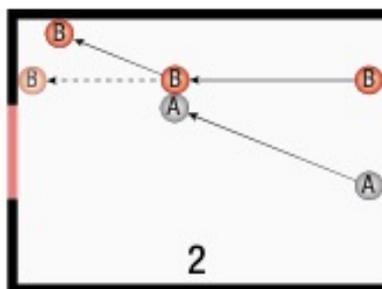
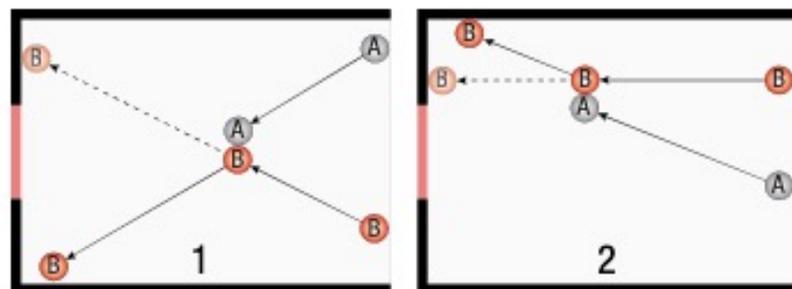
A RECENT STUDY

“Eye-tracking causality,” Gerstenberg et al (2017)

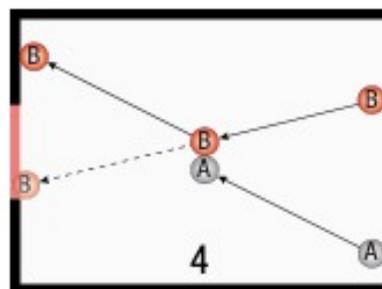
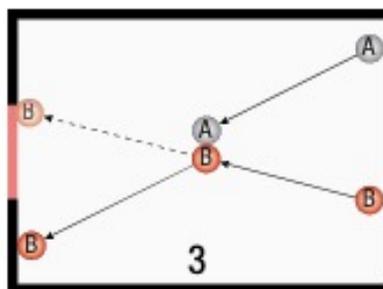
STIMULI



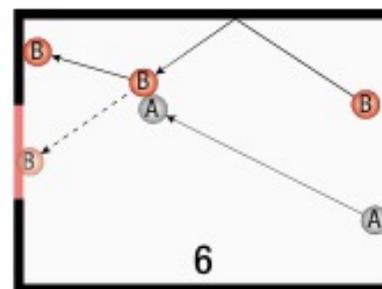
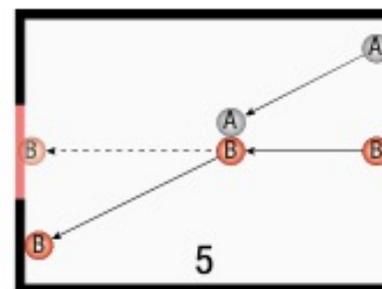
Counterfactual Miss



Counterfactual Close Call



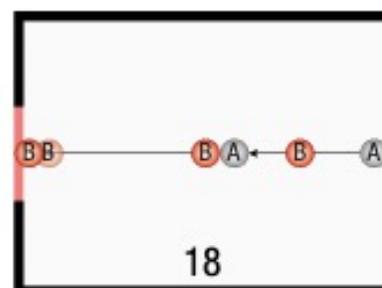
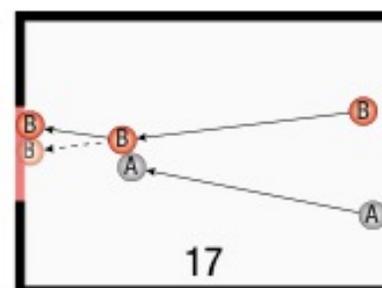
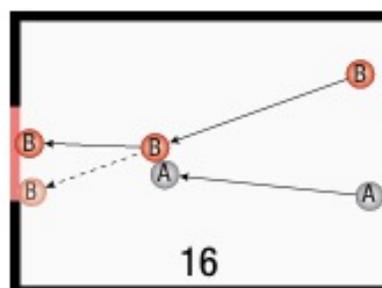
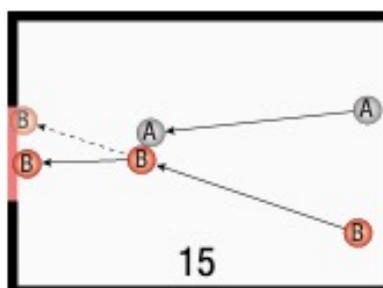
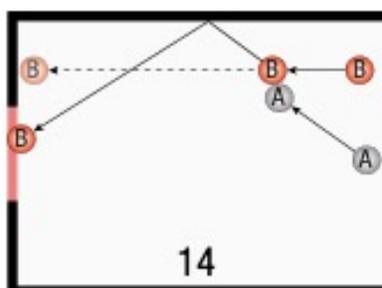
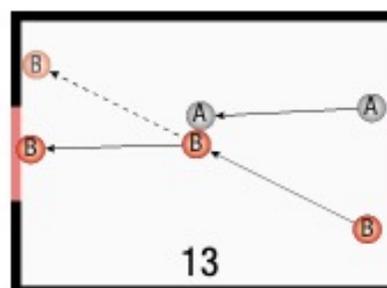
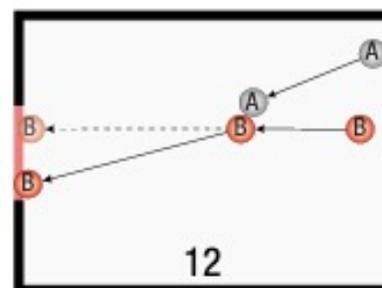
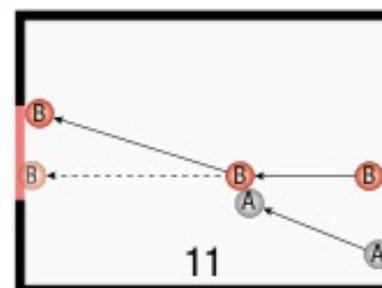
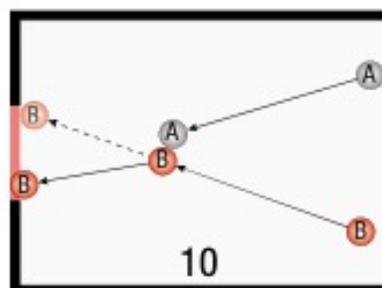
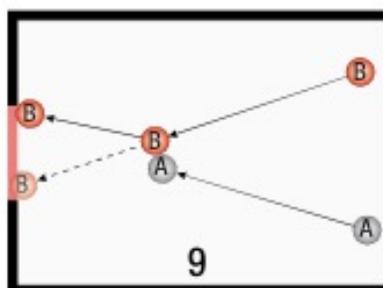
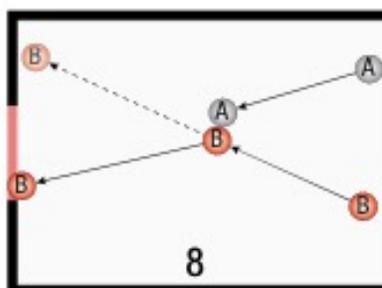
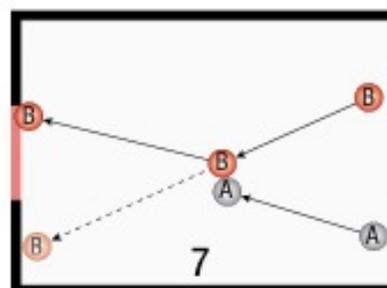
Counterfactual Hit



Actual Miss

Actual Close Call

Actual Hit



DESIGN

- Participants watched all 18 videos
- One of three tasks:
 - **Outcome-** Did ball B enter the goal?
 - **CF-** Would ball B have entered the goal if ball A didn't collide with it?
 - **Causal-** Did ball A cause ball B to (not) enter the goal?

DESIGN

INDEPENDENT VARIABLE

- Task (Outcome, CF, Causal)
- Actual outcome (B entered/missed)
- CF outcome (B would have entered/missed)

DEPENDENT VARIABLE

- Ratings from 3 tasks
- Eye movements

RESULTS

Sanity check I:

People can accurately say whether ball B went in the goal or not

	Outcome Condition			
	Counterfactual Miss	Counterfactual Close Call	Counterfactual Hit	
Agreement With Outcome Statement				Actual Miss Actual Close Call Actual Hit

Clip

RESULTS

Sanity check 2:

People can accurately say whether ball B would have went in the goal without ball A

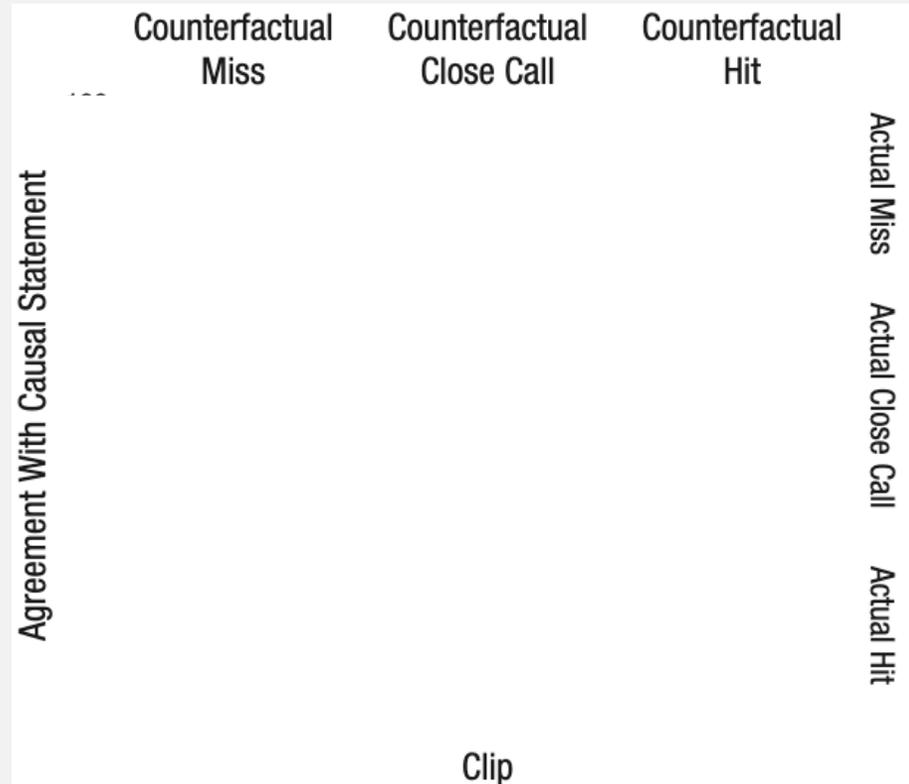
	Counterfactual Condition			Actual Miss	Actual Close Call	Actual Hit
	Counterfactual Miss	Counterfactual Close Call	Counterfactual Hit			
Agreement With Counterfactual Statement						

Clip

RESULTS

Cool finding:

People say that ball A caused ball B to enter/miss the gate when the actual and CF outcomes are different



RESULTS

	Counterfactual Condition	Causal Condition	Outcome Condition
Ball B Goes Through the Gate			
Ball B Misses the Gate			

INTERPRETATION

People consider counterfactual alternatives to make causal judgments

=>

We don't just care about what happened

We also care about what could've happened

SOME WORK IN PROGRESS

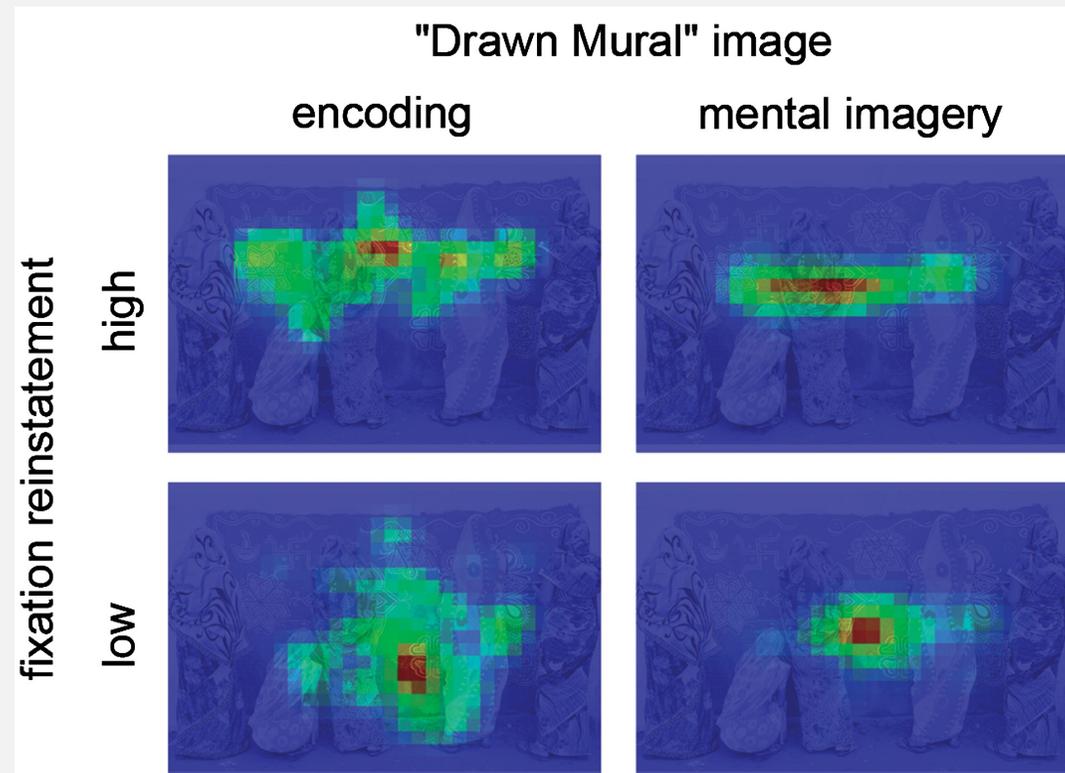
(with the help of Drs. Kristina Krasich & Felipe De Brigard)

QUESTION

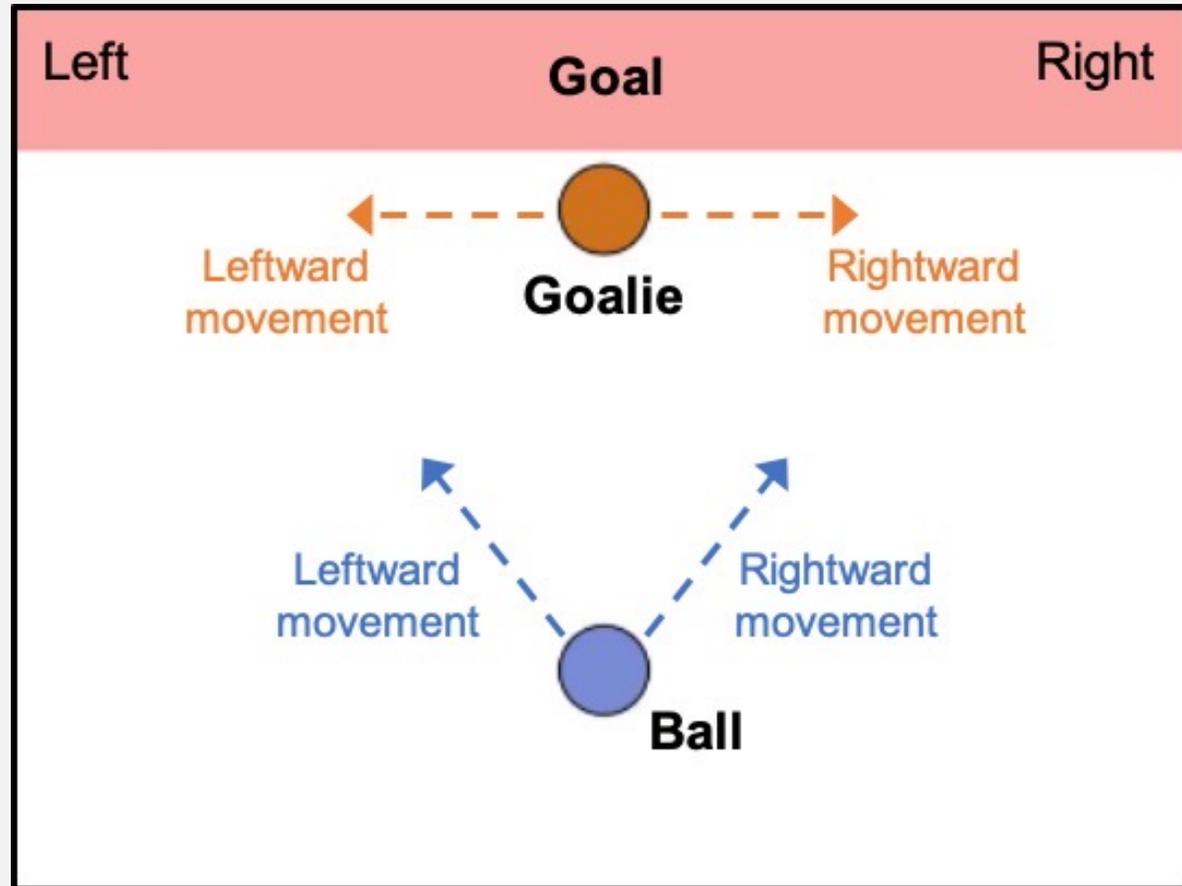
Do people use mental imagery to make causal judgments?

How could we detect this?

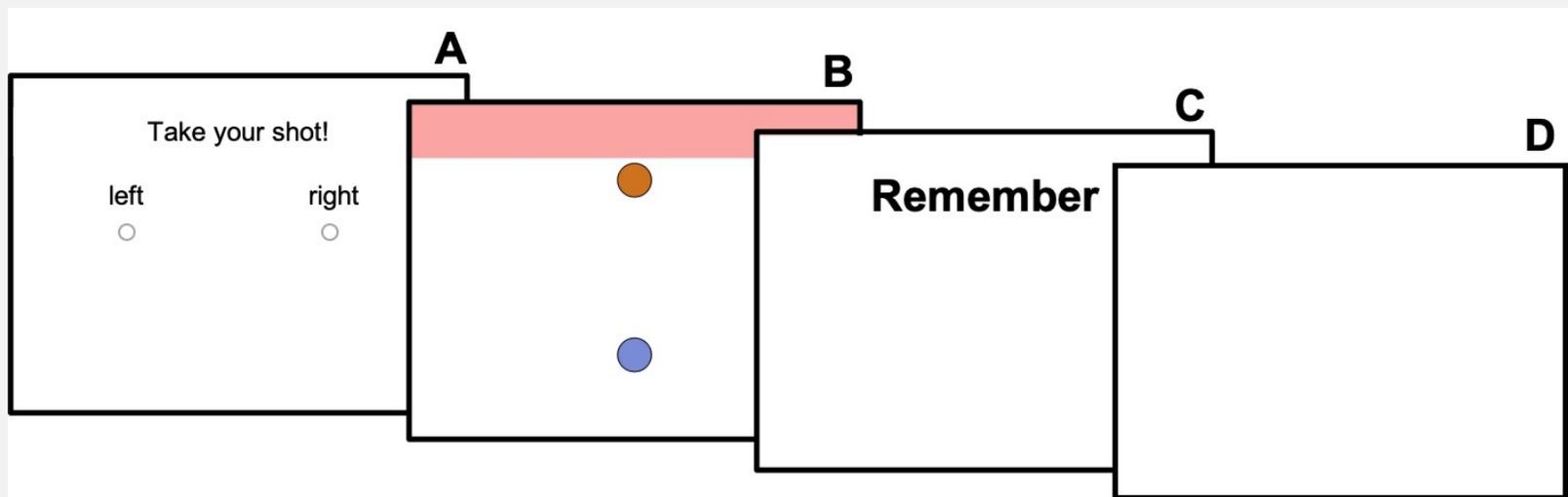
BACKGROUND



STIMULI



DESIGN



DESIGN

Three Cues:

Remember

Think about/visualize what just happened

What If?

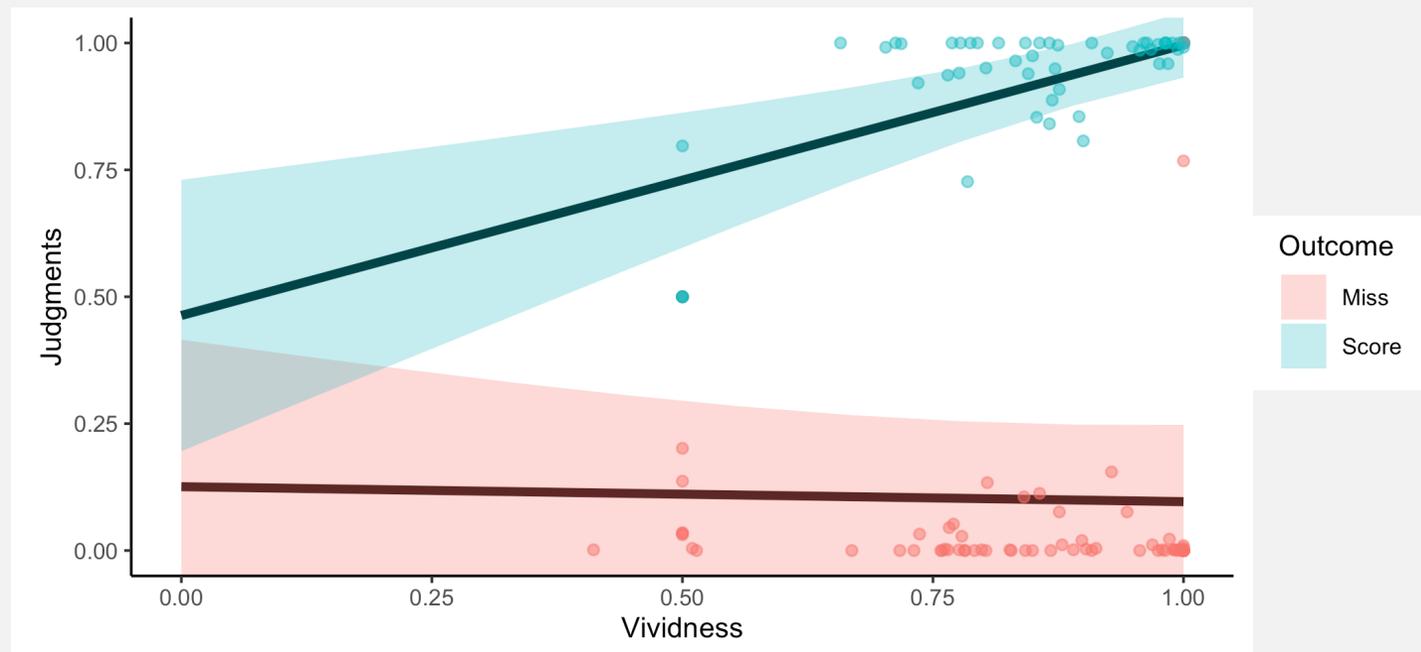
Think about/visualize what *would have* happened if you went in the other direction

Cause

Think about whether going left/right caused you to score/miss

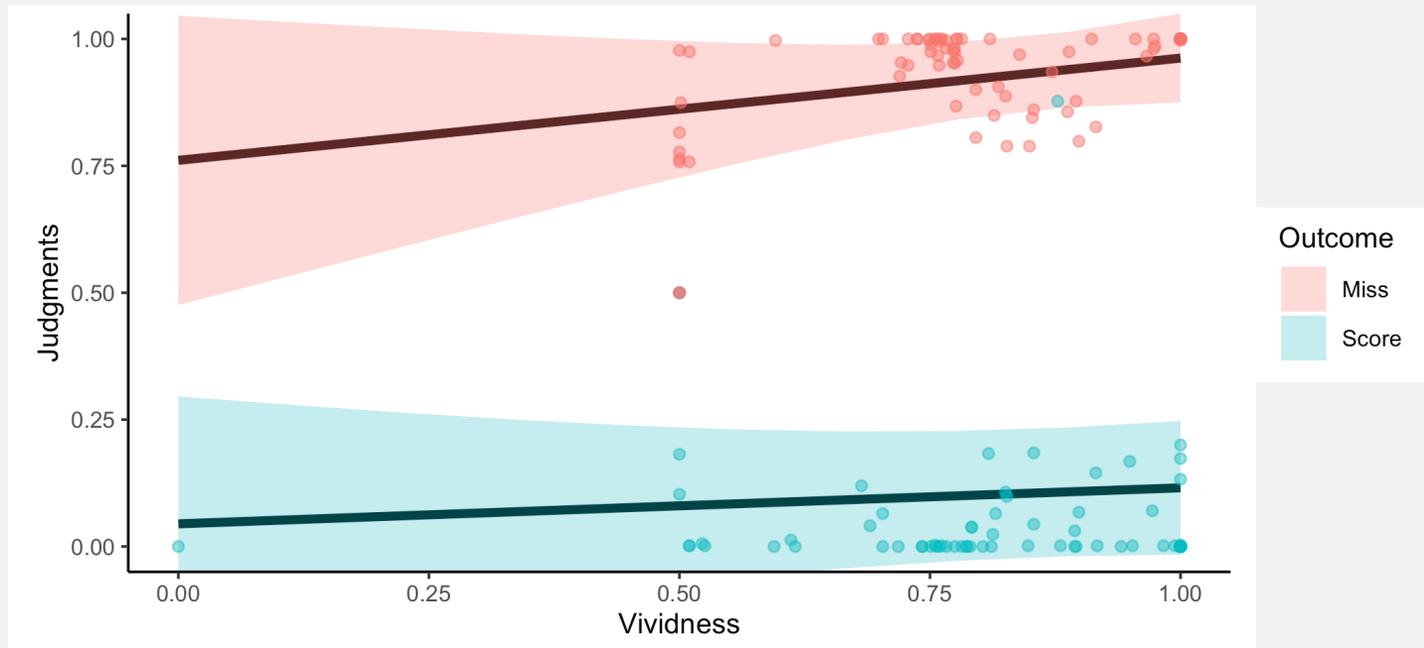
RESULTS SO FAR

To what extent did the ball score?



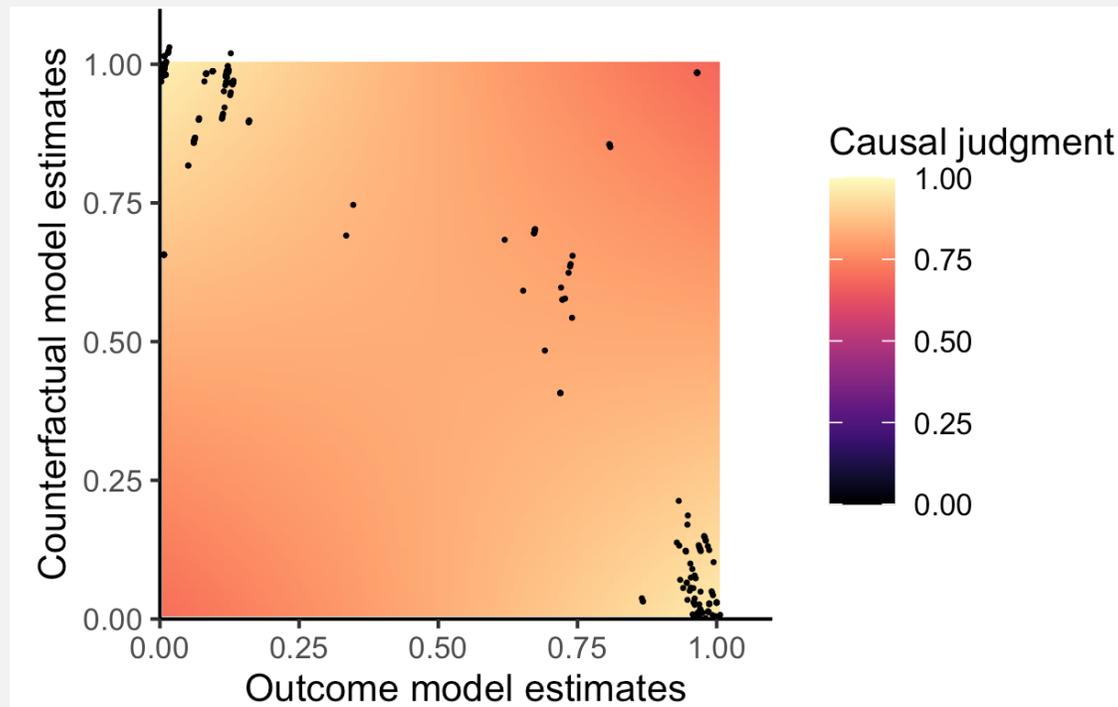
RESULTS SO FAR

To what extent would the ball have scored if it went in the other direction?



RESULTS SO FAR

To what extent did choosing left/right cause the ball to score/miss?



INTERPRETATION

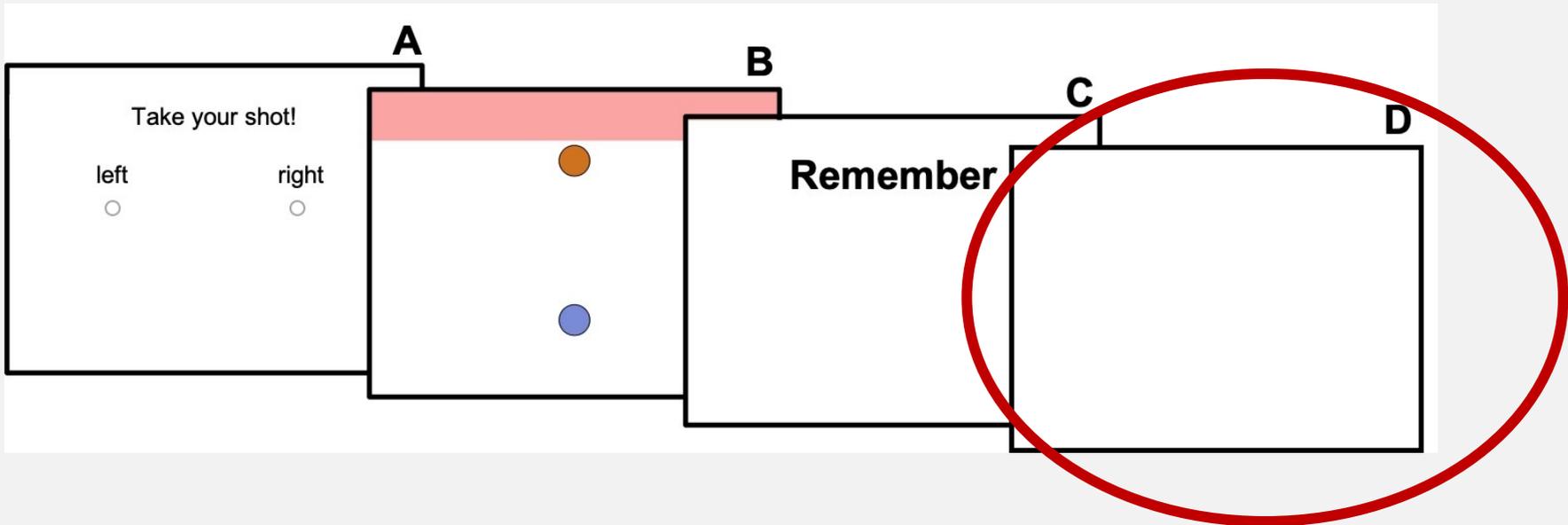
As we saw before, people consider two things to identify a cause:

what actually happened

what would have happened

RESULTS TO COME

Are people engaging in mental imagery during causal reasoning?



ONGOING WORK

Eye-tracking data

do people move their eyes towards counterfactual trajectories?

Neural Data (fMRI/EEG)

is there visual activity in the brain indicative of mental imagery?

LET'S WRAP THIS UP

- Causation matters
- Two explanations (process and counterfactual theories)
- Counterfactual theories seem to hold weight
- Mental imagery might underly this process

QUESTIONS?

REMINDERS

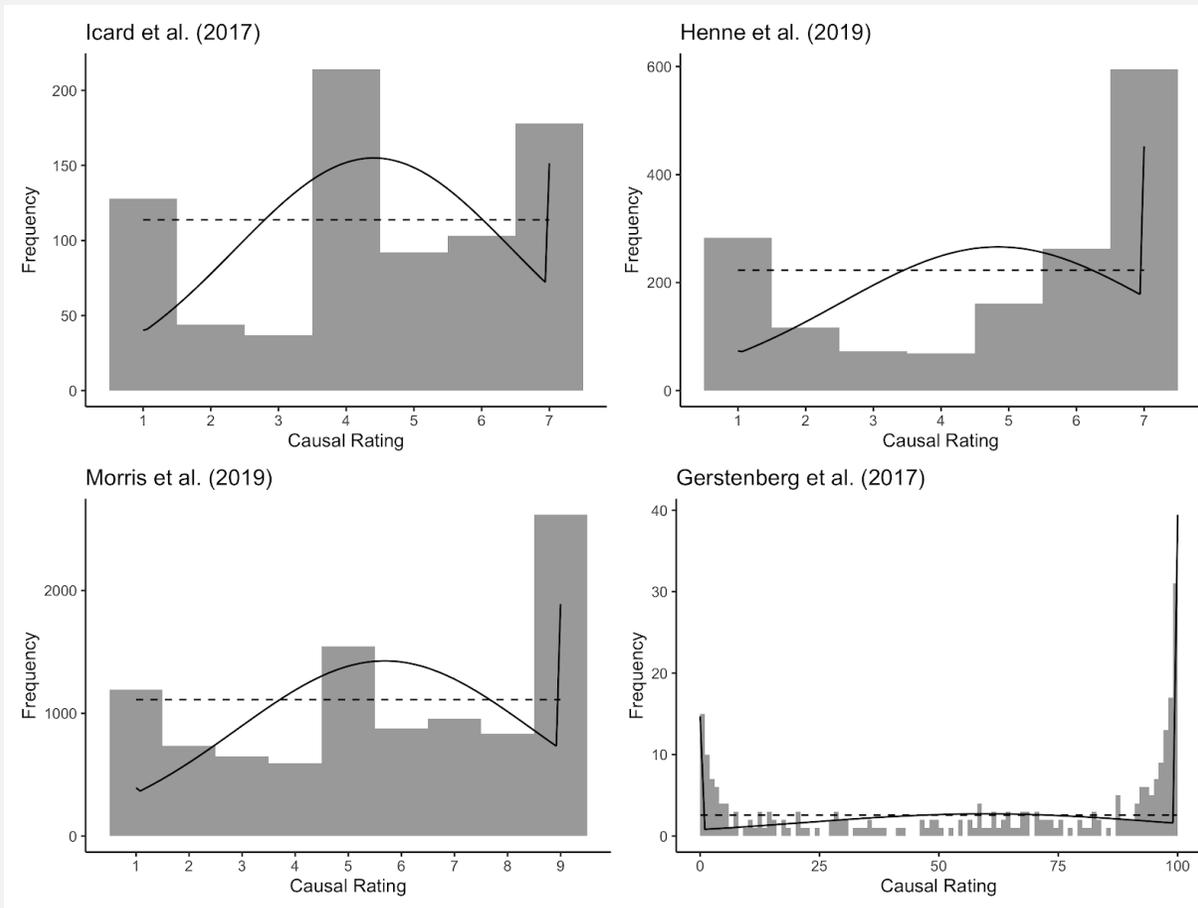
- Typical reasoning (11/13)
- Risky decisions (last week of class - no report)

BONUS – GRADED CAUSATION

Is causation an all-or-none phenomenon, or does it come in degrees?

Can something be “more of a cause” than something else?

LET'S LOOK AT SOME OPEN DATA



TWO HYPOTHESES

OK, so it looks like there are a few ratings in the middle there.

Maybe these ratings reflect how strong a cause is.

Or, maybe people are just confused, and they reflect how confident a rating is.

How do we test this? measure confidence!

DESIGN

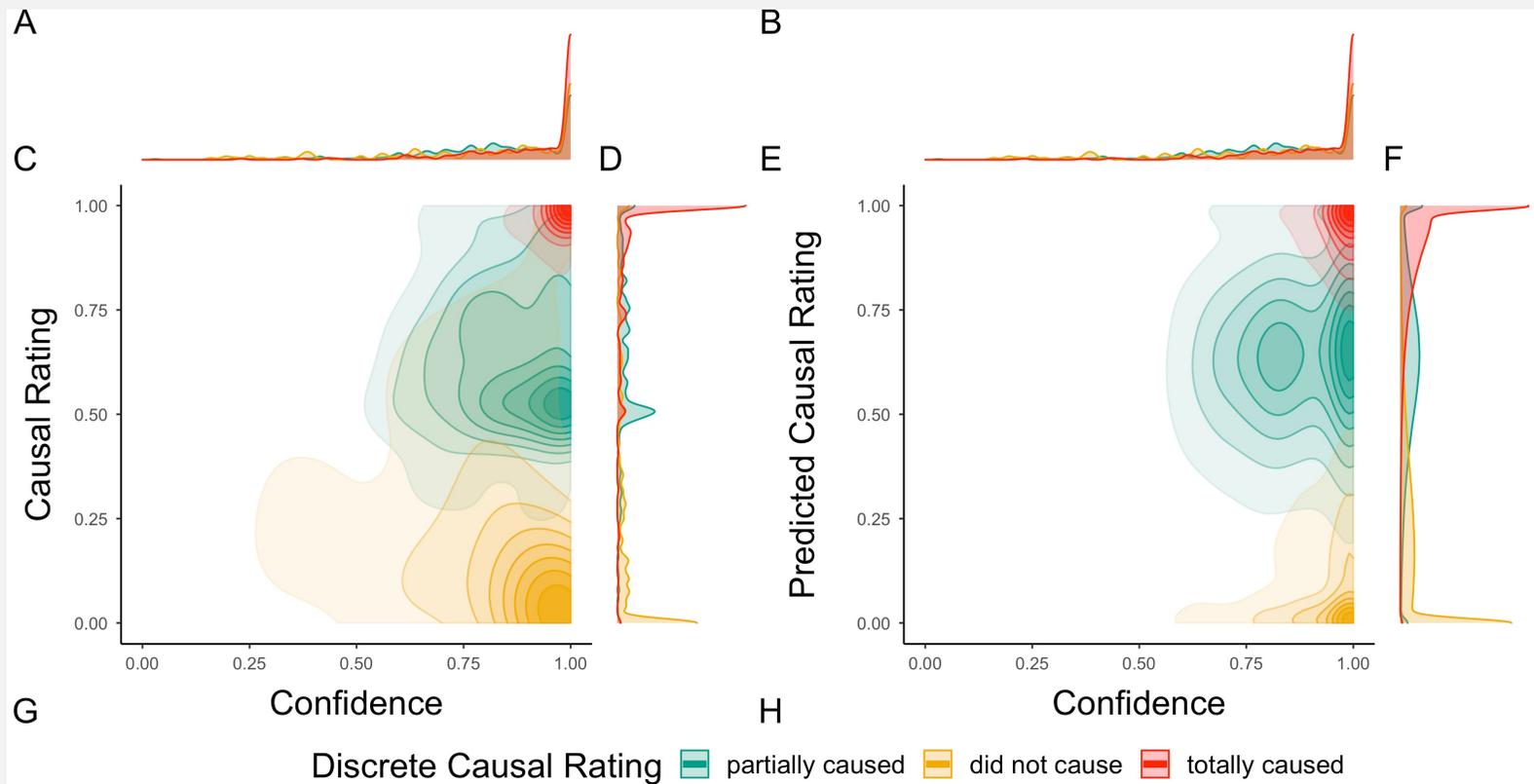
Read stories about (un)expected events happening

Rate causes two separate times:

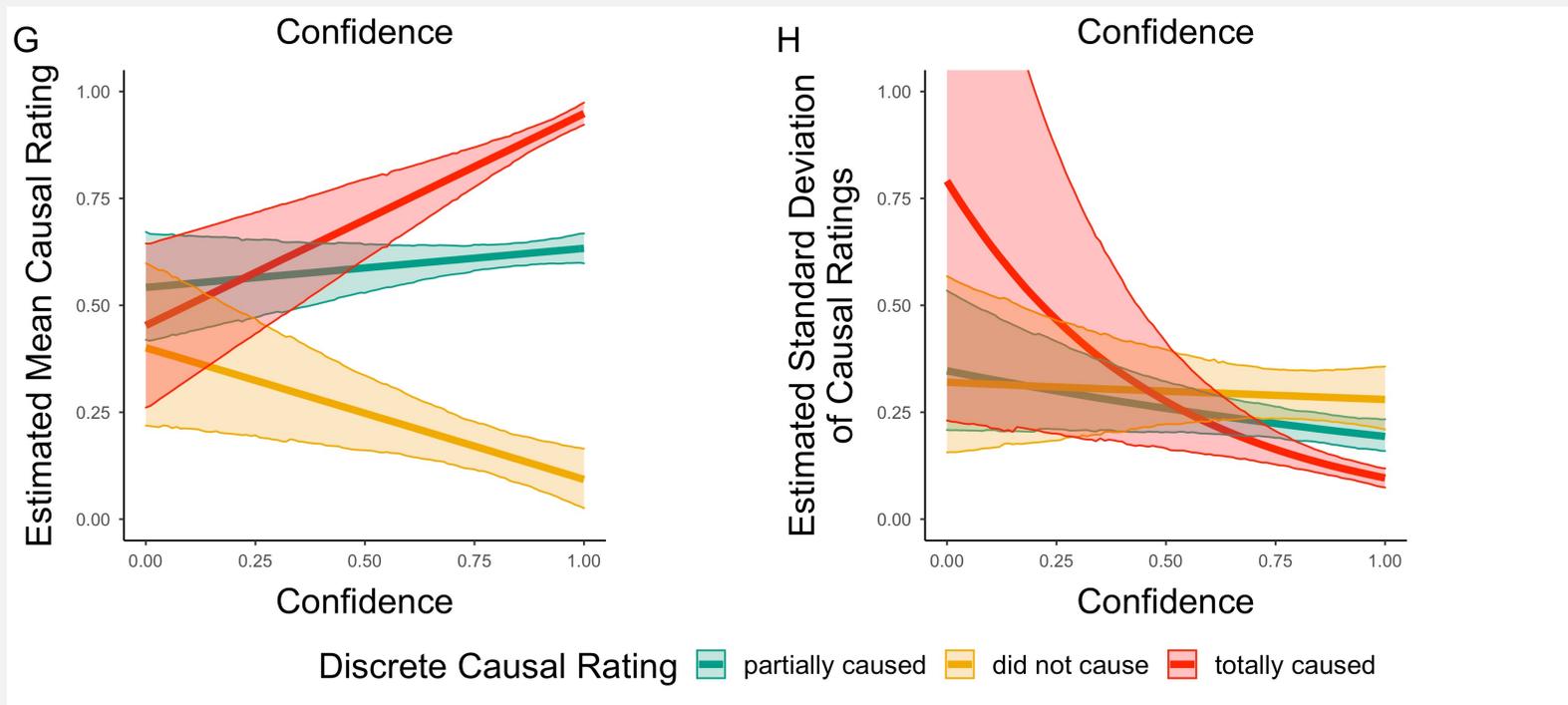
- once on a slider scale (not at all caused – totally caused)
- once on a discrete scale (did not cause, partially caused, totally caused)

For each rating, also indicate how confident you are (not at all – totally)

WHAT DO WE SEE?



WHAT DO WE SEE?



CONCLUSION

Causal ratings aren't always all-or-none

Causal ratings are influenced by confidence!

But, they also reflect our own perception of “causal strength”