

Symposia: Elucidating the Causality in Coronal Brain Circuits

Manjari Narayen Intro:

Causality: What do we mean?	<ul style="list-style-type: none"> ■ MANIPULATIONIST Changing X makes Y happen ■ COUNTERFACTUAL Had X been otherwise would Y still have happened? ■ COMPONENT CAUSES Neither necessary nor sufficient 	Causal questions about brain circuits	Region X causes Region Y: Can we identify causation within circuits?	Circuit X has many functions Y: What are the functions?
			Circuit X has function Y: Probing measurements of Y	Circuit X is a biomarker for Y: Does X need to be causal?

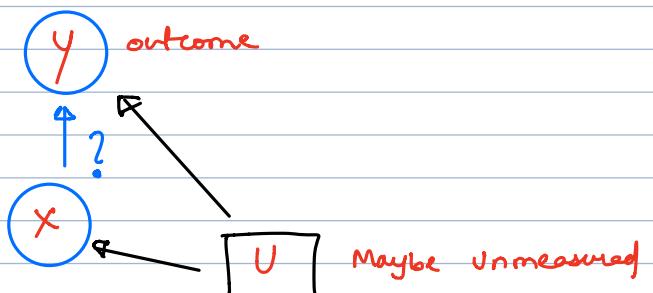
1) Konrad Kording → Do functional / effective connectivity count as causal
↳ Nice lab

↳ Nice lab

Definition of causality

- Let a and b be events
 - Causation exists if:
 - if we had changed a to a^* , the probability for b would have been different

Confounding :



- No confounders : chess, go
 - Countless - u - : Medicine
 - 10^{11} - u - : Brain

- For small systems \rightarrow "correct" is nearly identical to causation [in general]
 - For large " " \rightarrow - n - - n - not - n - " " " " in general

2) Paul Cisek: Carving up Brain Functions from an evolutionary perspective

Functional decomp of Behavior

→ Typical Approach
but it isn't good
way to cure
problem of behaviour

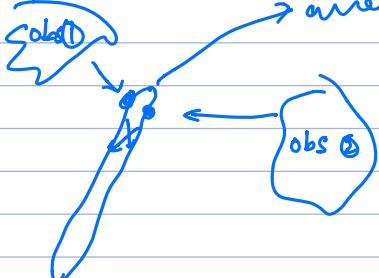
Alternative approach \rightarrow "Phylogenetic refinement"
 \Rightarrow Use evolution!

In snakes →

Avoid : 1)

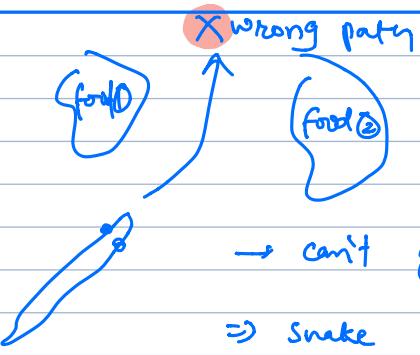


2)



average ✓

Approach :



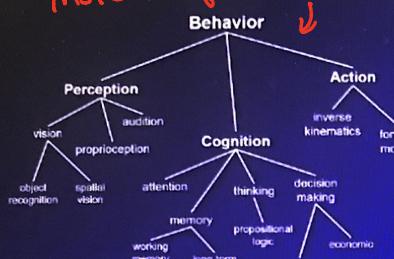
→ can't go for average

⇒ snake needs to select anyone
(call it Attention, intention,
cognit., it doesn't matter, it is
just a approach behaviour)

Similarly we can define other behaviour using evolution

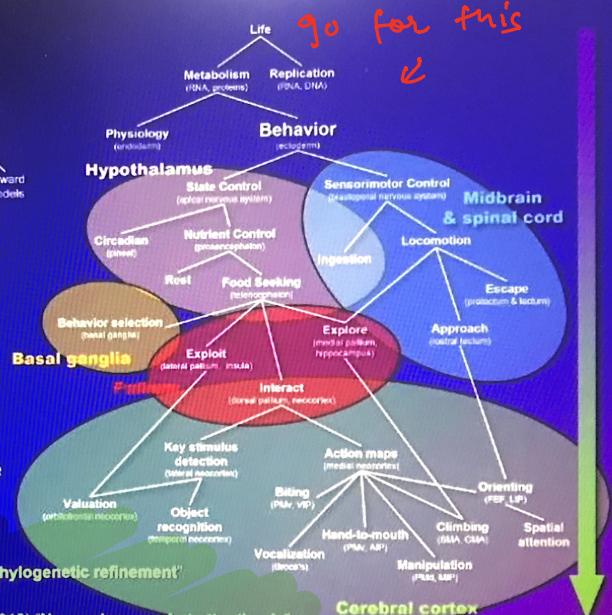
Take-home: A different taxonomy of "functions"

instead of this



- Not perception, cognition, etc.
- Differentiation / elaboration of feedback control systems
- Claim: These concepts provide a better mapping to the brain

go for this



Cisek (2019) 'Resynthesizing behavior through phylogenetic refinement'
Attention, Perception & Psychophysics

Hommel, Chapman, Cisek, Neyedli, Song, Welsh (2019) "No one knows what attention is"
Attention, Perception & Psychophysics

3) Jackie Sullivan : What kind of kinds are optimal for causal discovery in translational research?

- out of my interest

4) Manjari Nareyan - when do we need Etiological Brain Circuit Biomarkers (Stanford)

Biomarkers

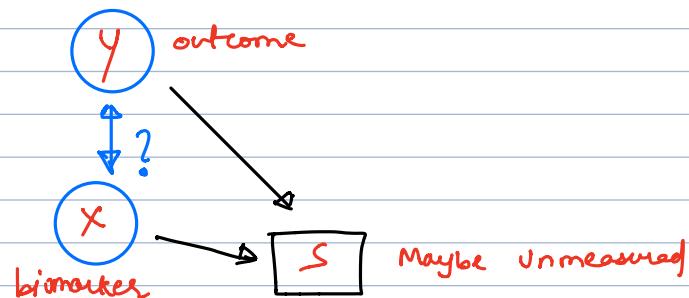
pearl's ladder of Causation

- Associational "Prediction" — $P(Y | X = x)$
- Interventional — $\perp\!\!\!\perp$ — $P(Y | \text{do}(X = x))$
- Counterfactual — $\perp\!\!\!\perp$ — $P(Y_x | X = x)$

(1) Problems with biomarkers

- i) Look at Confounding in above notes (Kording)
here X = biomarker

2) Collision



- X & Y may not be associated at all
- But we are measuring them in some specific context (S) which can create an association

So How to avoid these problems?

1) Confounding : three strategies

