

Cognitive and neurobiological processes in behavioural regulation and change

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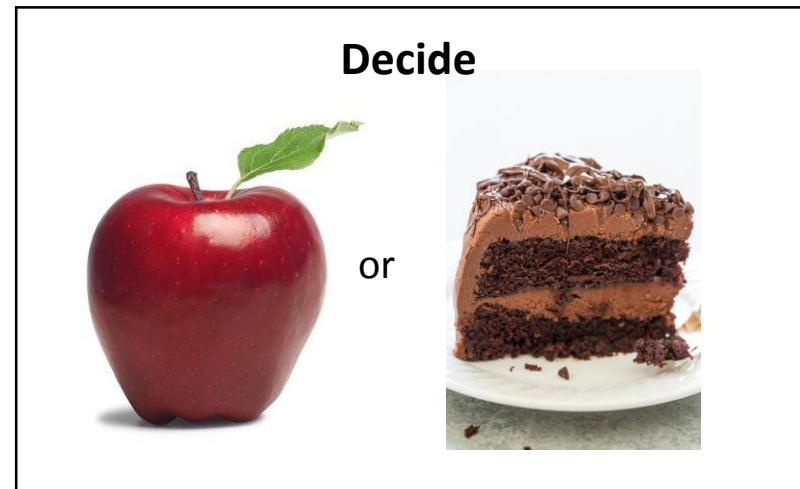
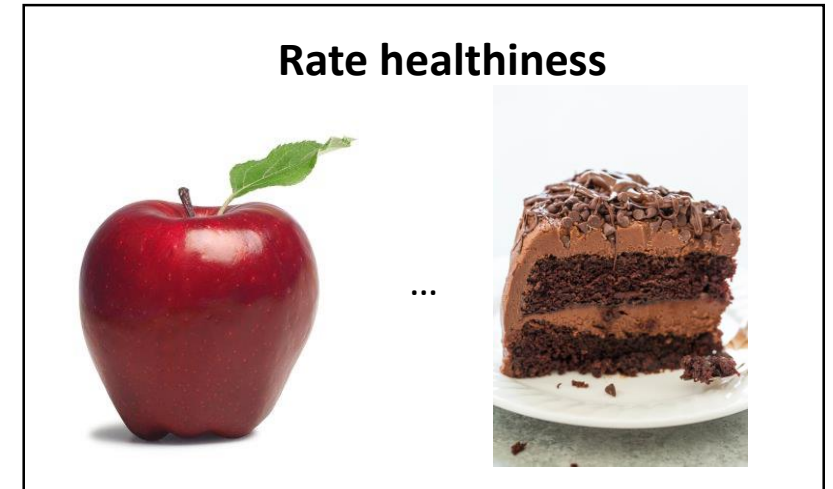
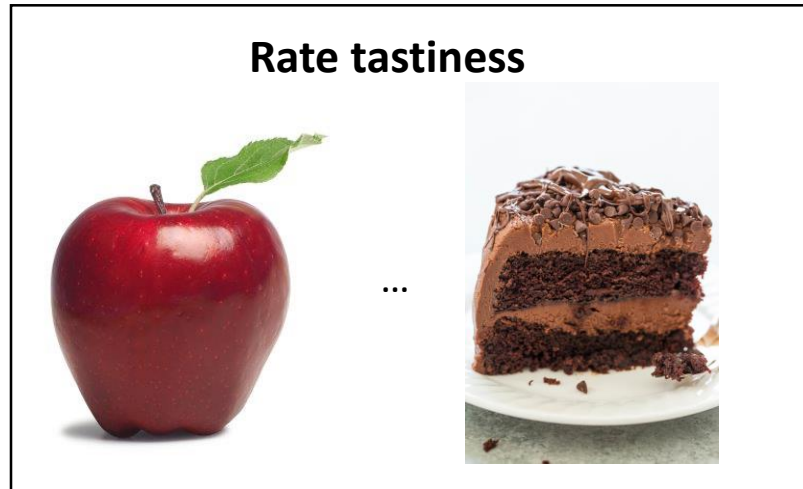
What is neuroeconomics?

- That is a good question and the answer will depend on whom you ask.
- Generally it is thought to sit at the intersection of the neuroscience, economics, psychology fields, although statistics and computer science play a large role too.
 - As such, it is inherently multi-disciplinary
- The overlapping questions across these fields deal with how we learn and make decisions.




How can neuroeconomics help us understand the neurobiology of behaviour, and what drives individual choices?

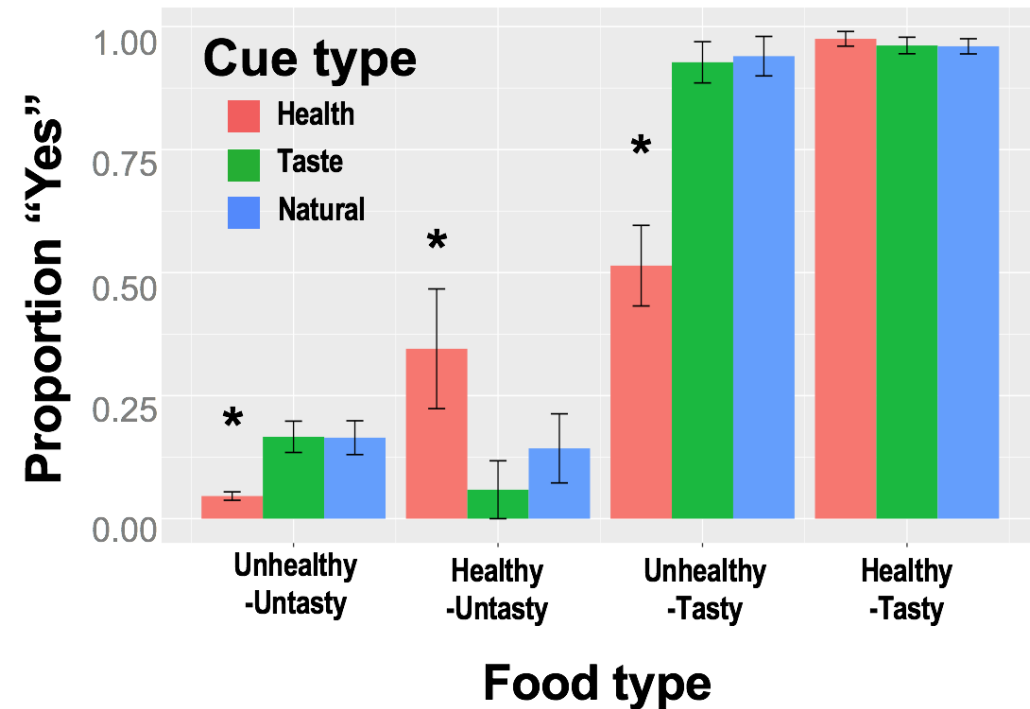
1. Neuroeconomics is focused on incentive compatible choices
2. It draws on insights from several disciplines to try and link behavior and neurobiology
3. It strives to incorporate computational modeling to better understand neural and behavioral patterns

Food choice as a relevant example

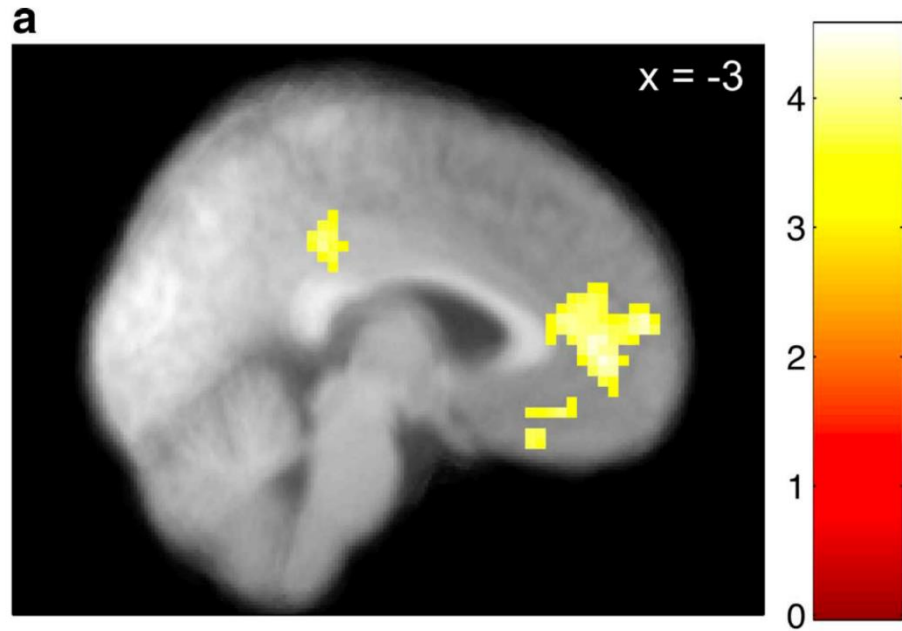


Directing attention to one specific attribute

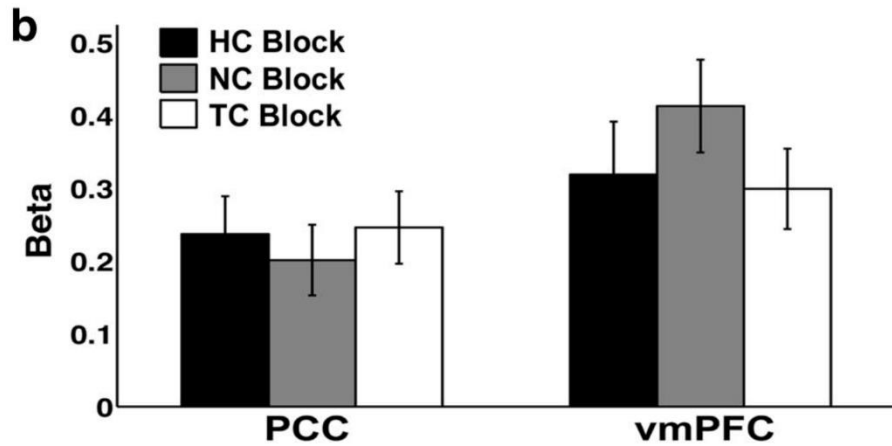
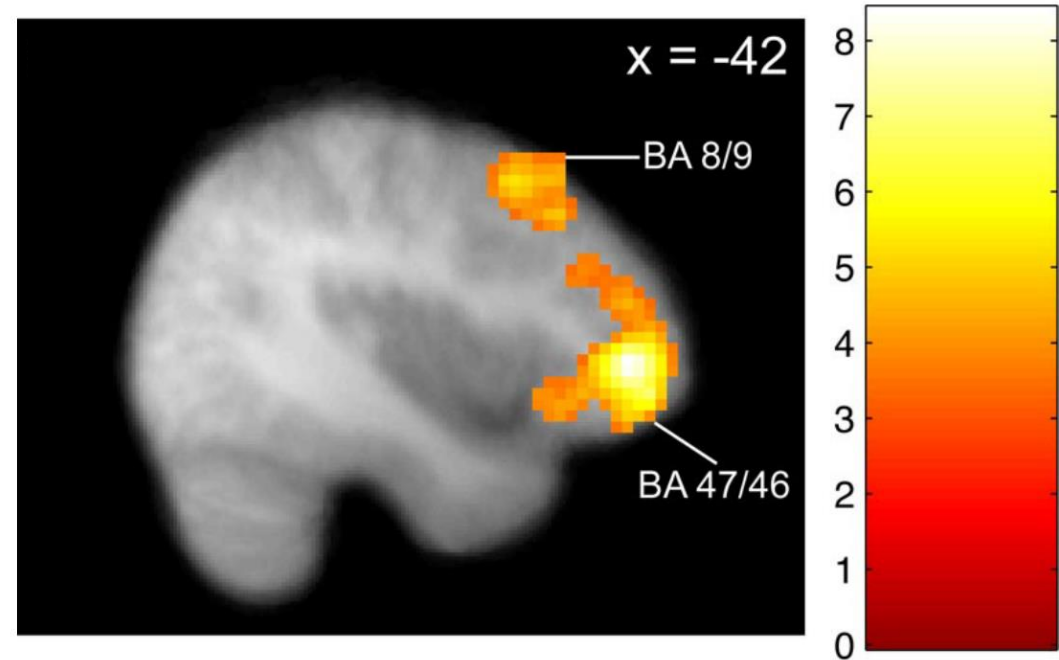
	Block Cue	Food	Feedback
Health Block	Consider the healthiness	 Decision scale	Strong Yes
Taste Block	Consider the tastiness	 Decision scale	Yes
Natural Block	Make decisions naturally	 Decision scale	Strong No



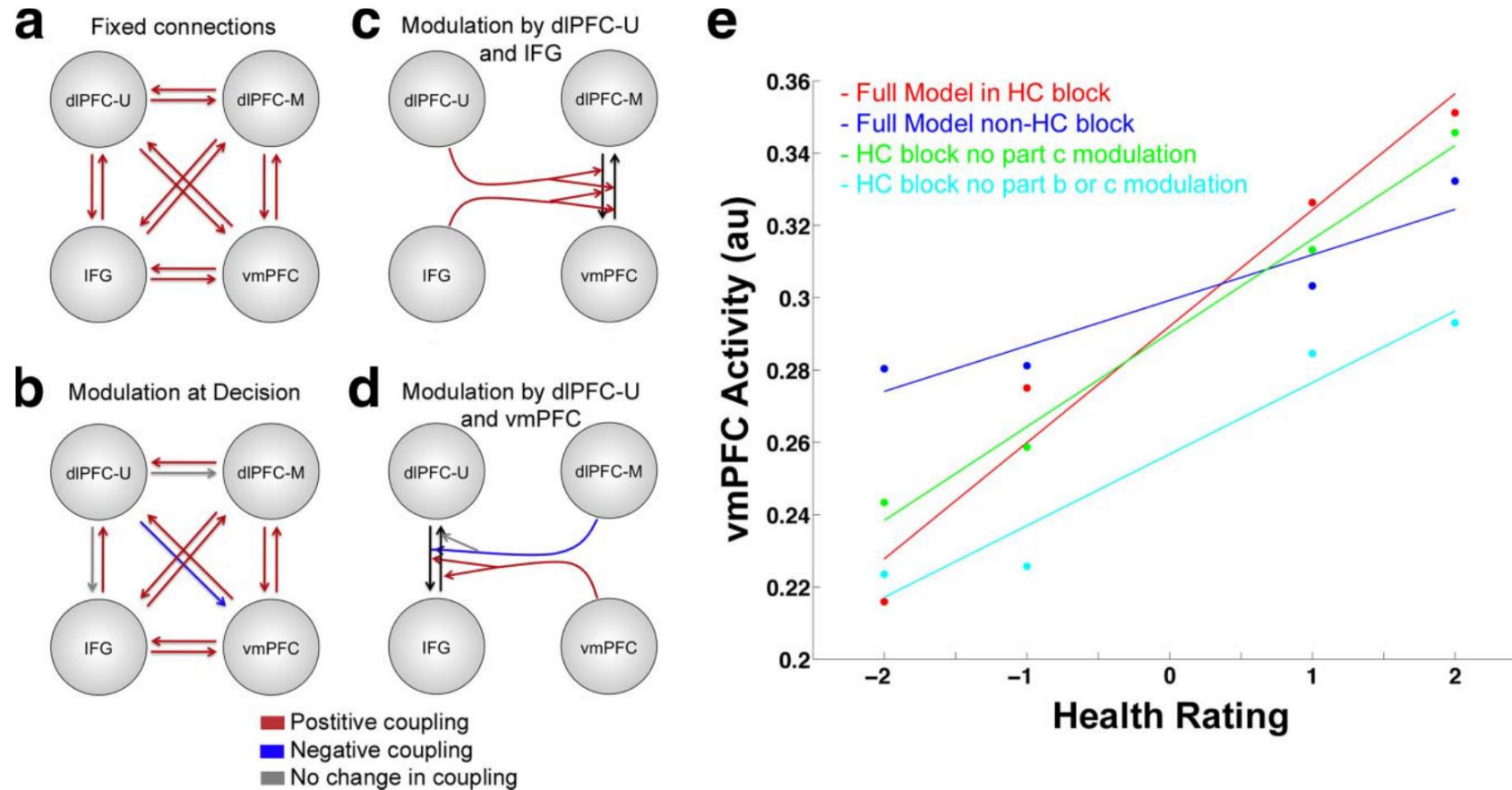
Subjective value



Sustained activity for health cues

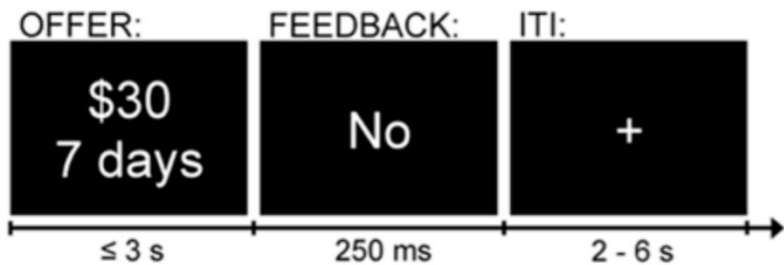


Interactions between several regions are important for dietary self-control



Similar regions and interactions are associated with temporal discounting

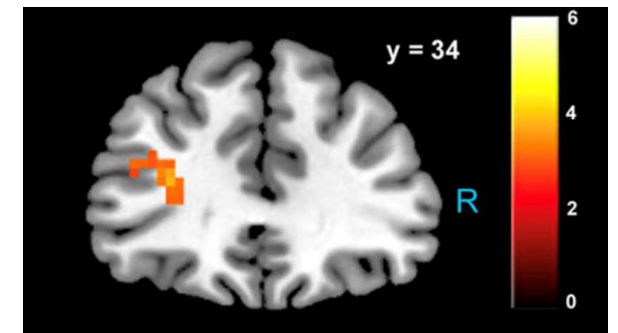
\$25 today or:



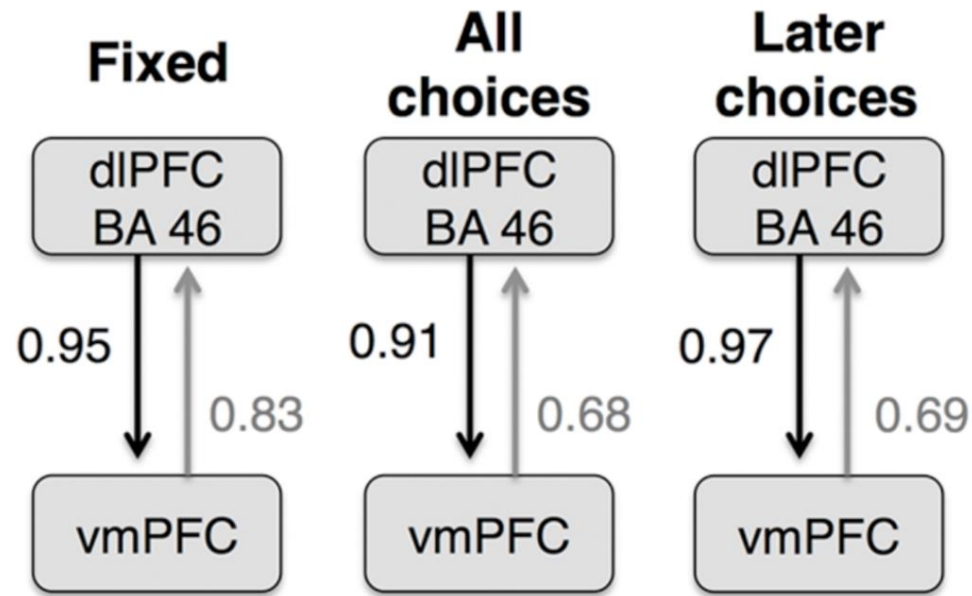
Subjective Value



Delayed Choices

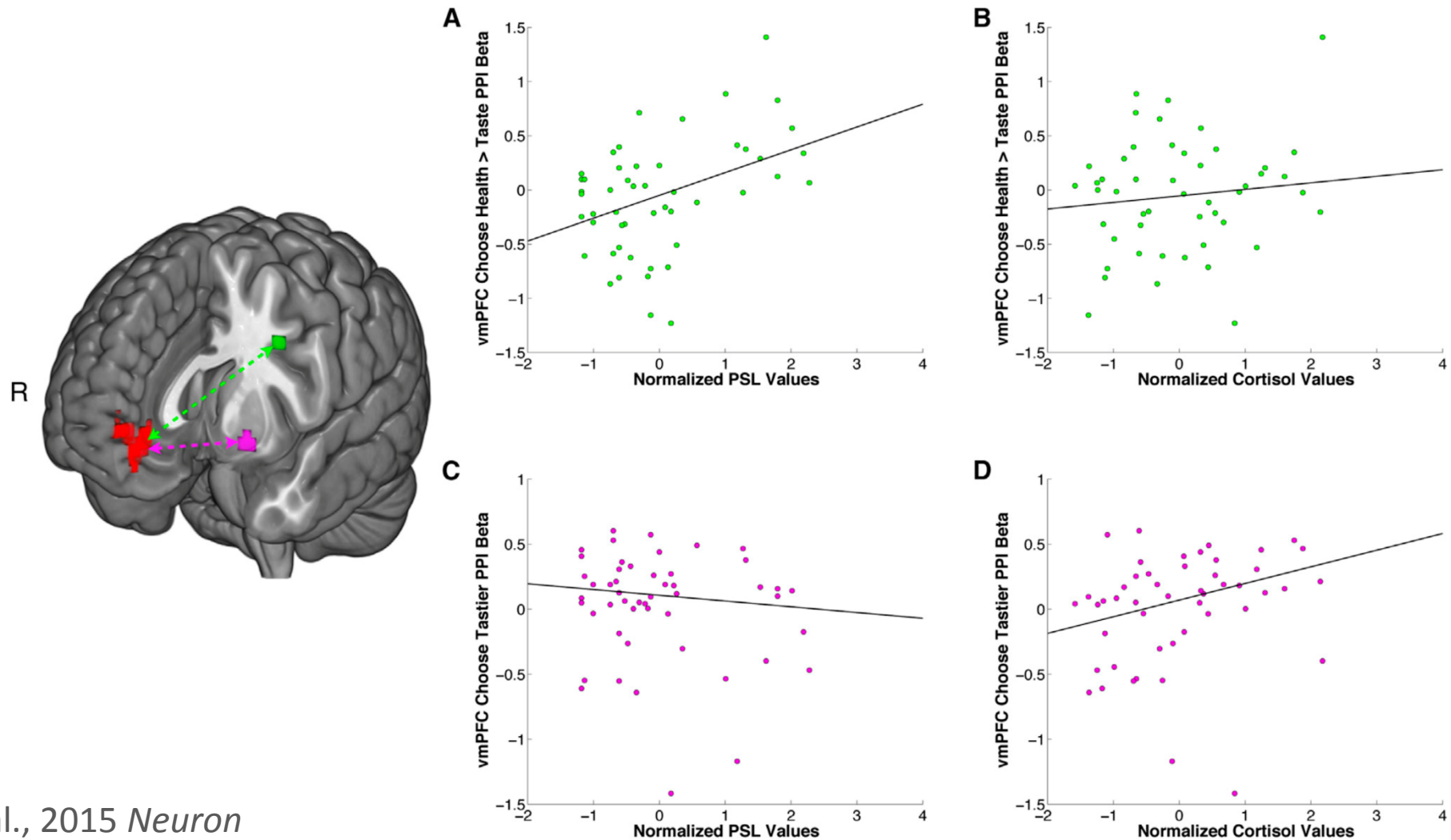


Similar regions and interactions are associated with temporal discounting



- Using a parameters estimated from this network model we can predict temporal discounting rates with 71% accuracy.
- However, we can make accurate predictions if we include model parameters quantifying both local activity and inter-regional interactions.

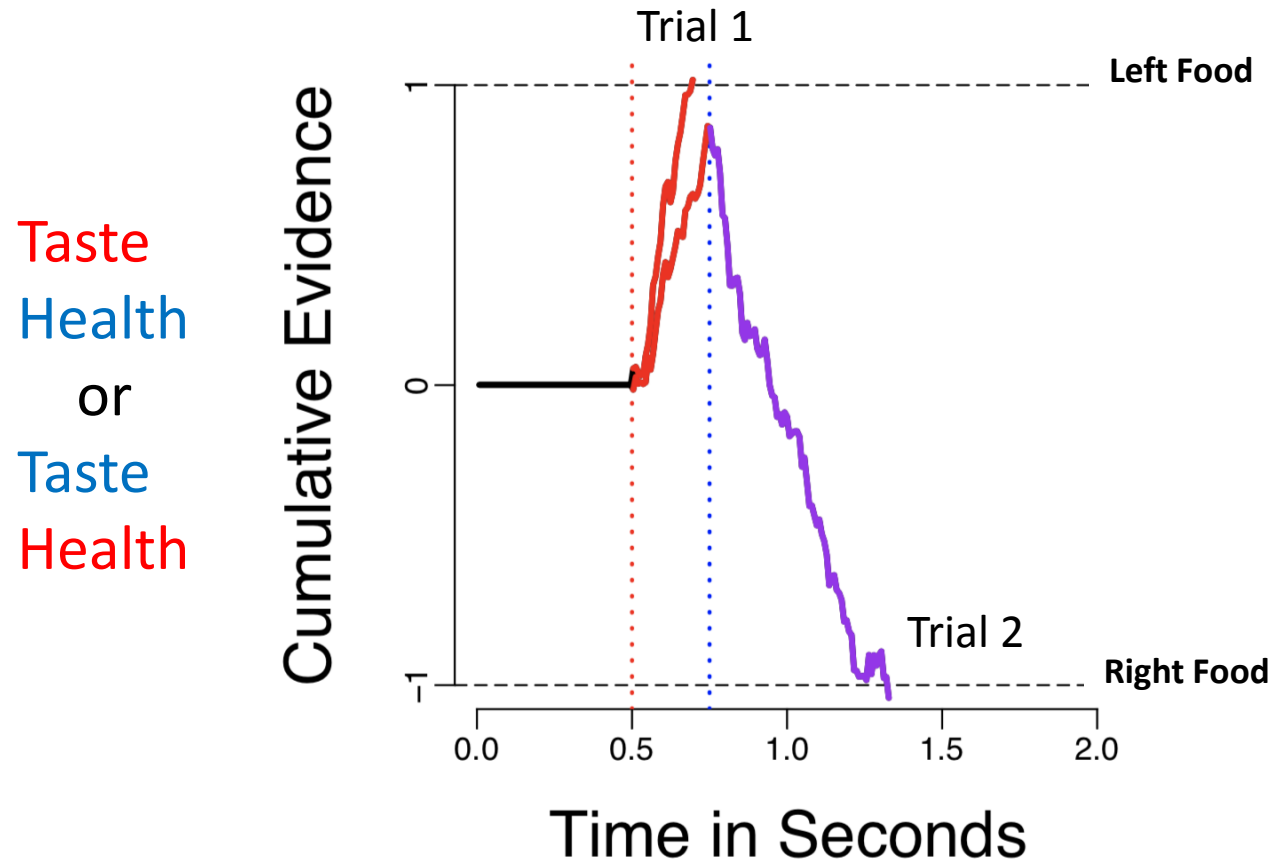
Acute stress causes disruptions in inter-regional coupling during food choices



Uncovering individual differences using computational modeling of behavior

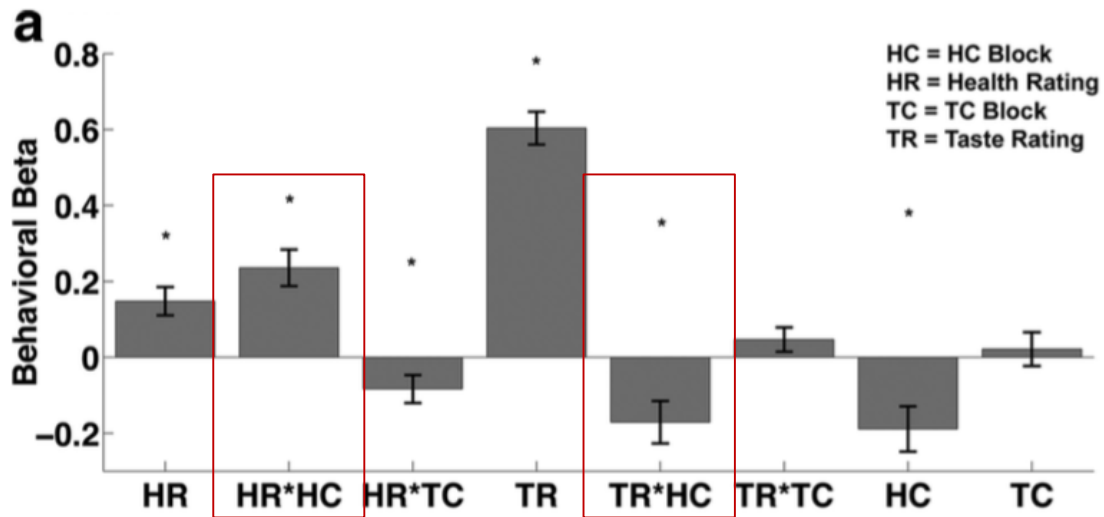
- Recent work using evidence accumulation models to better understand decision mechanisms has shown that there are dissociable processes governing,
 1. How much importance is given to healthiness or taste in determining the outcome.
 2. How soon each attribute begins to influence the evidence accumulation process

Uncovering individual differences using computational modeling of behavior

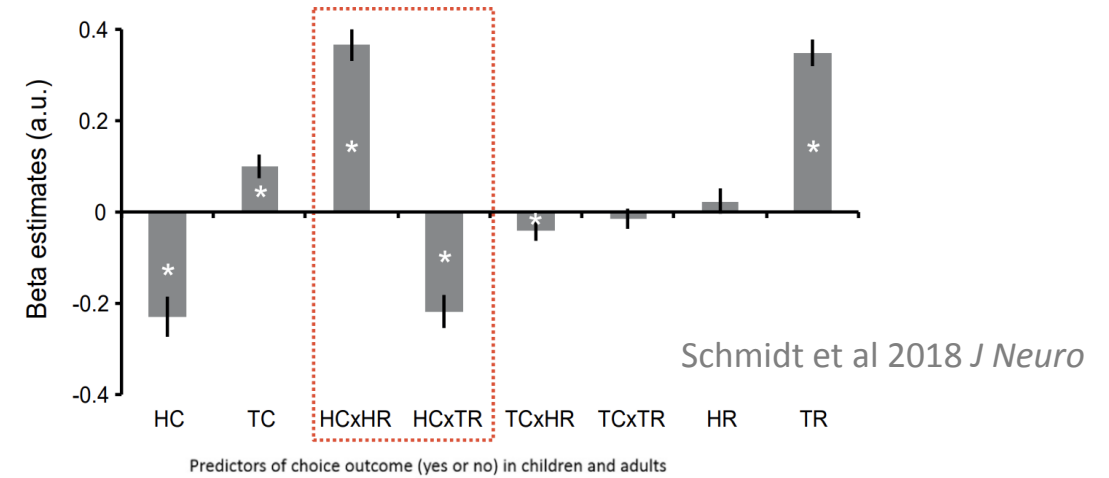


Original regression analysis

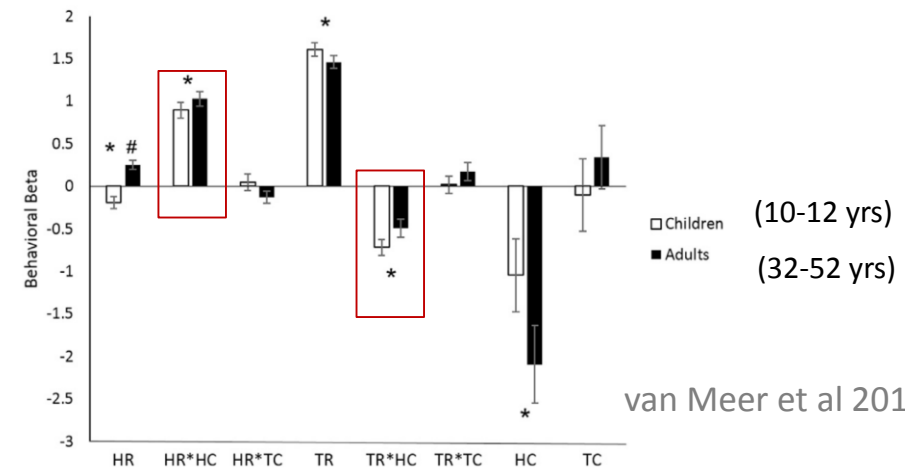
$$\text{Choice} \sim \text{blockType} * \text{HR} + \text{blockType} * \text{TR}$$



Hare et al., 2011 *J Neuro*

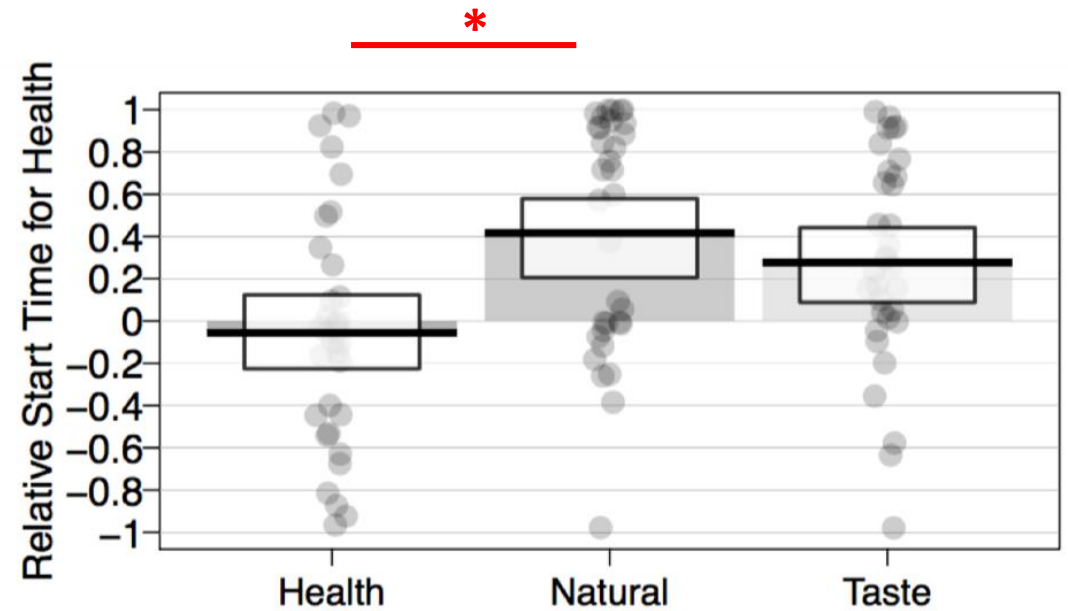
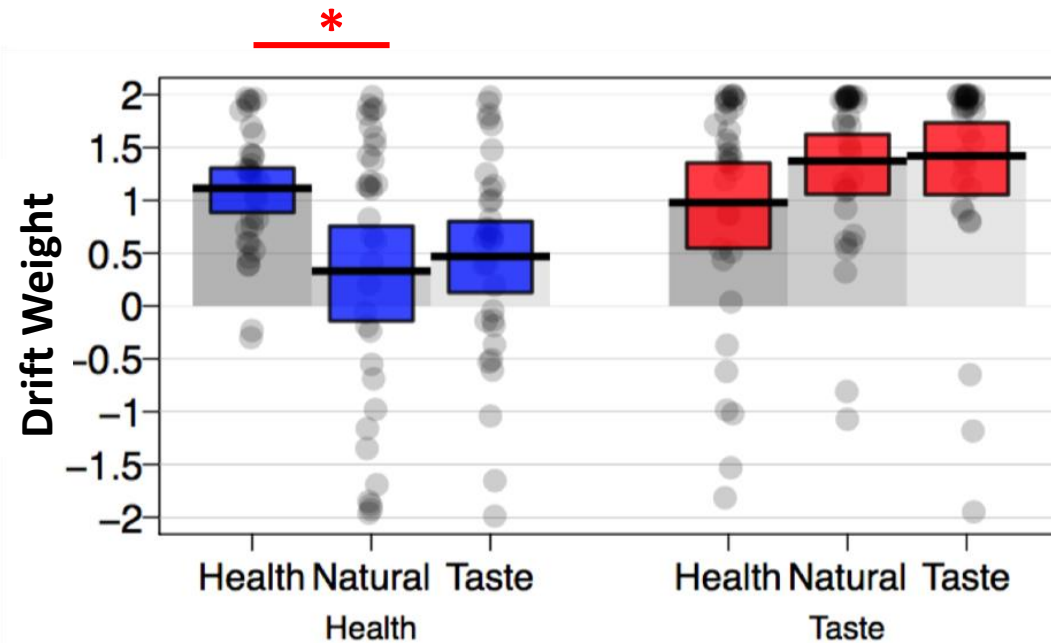


Schmidt et al 2018 *J Neuro*



van Meer et al 2017 *Neuroimage*

Computational modeling reveals changes in both the weighting and relative start times for healthiness

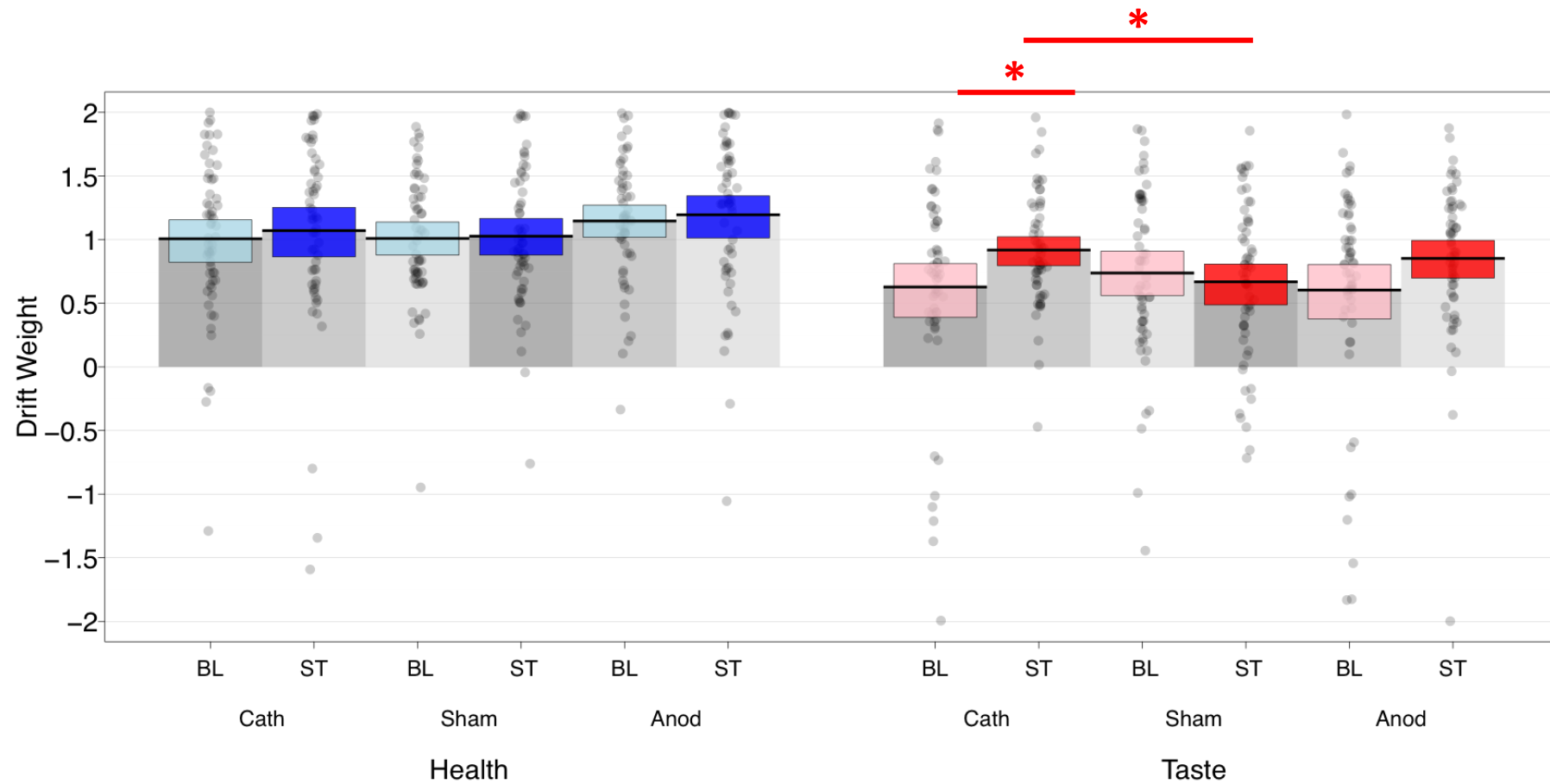


Previously undetected individual differences

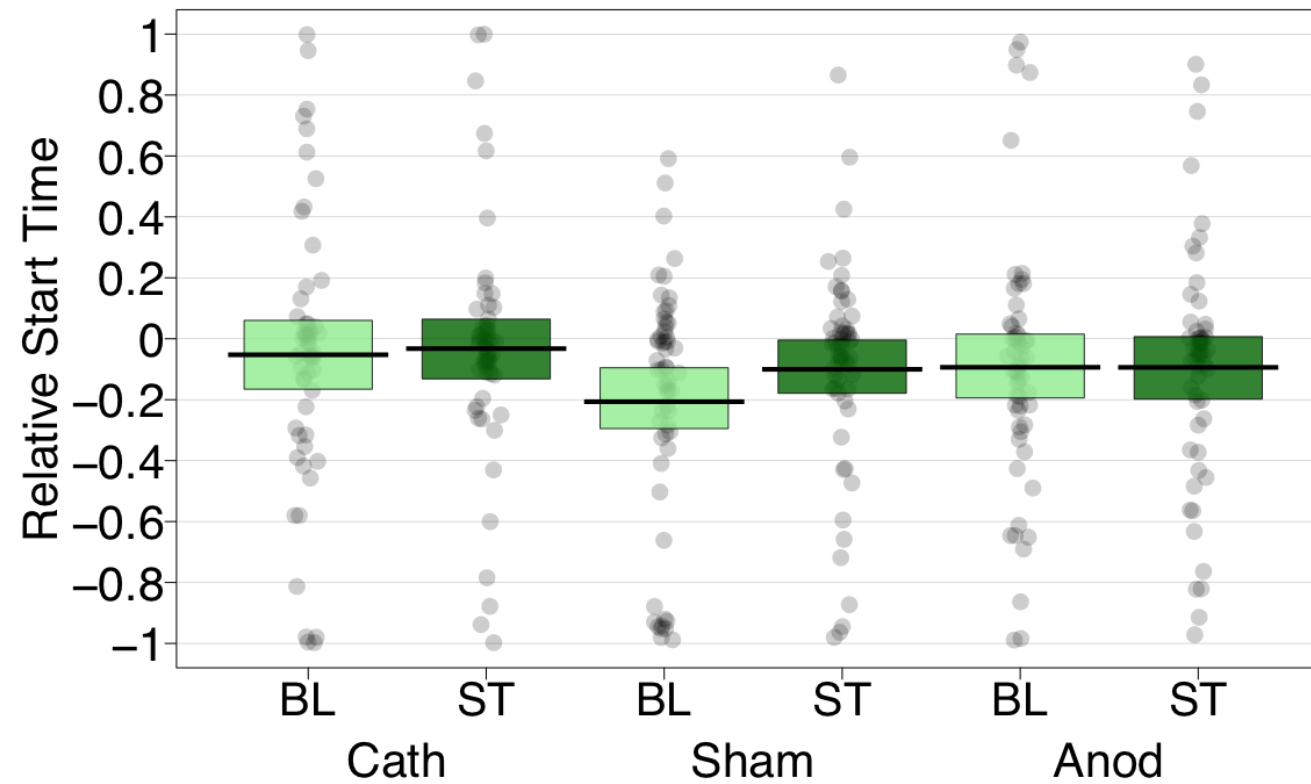
- Over **90%** of participants changed the health weight *OR* taste weight *OR* the relative-start-time in favor of healthy choices during the health-cued trials.
- **64%** changed the health weight *OR* taste attribute weight *AND* the relative-start-time.
- Only **33%** changed the health weight *AND* taste attribute weight *AND* the relative-start-time.

> Open question: What determines how an individual will respond to the attention cues?

tDCS over left dlPFC affects Taste attribute weighting



but does not change the relative-start-times



Summary

- In the context of decision making, behavioral regulation appears to rely on functional interactions between different cortical and subcortical brain regions.
 - Analyzing brain function at the network level will help us advance our understanding of decision making
 - Neuroimaging measures can reveal mechanisms and complexities that are not apparent from behavior alone.
- Structural models of behavior that seek to approximate the decision process can help to explain individual differences in neurobiology and choice behavior.

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