NOVEL APPLICATIONS OF HIGH DIMENSIONAL STATISTICS TO IDENTIFY NEURAL PROFILES

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Targeting Addiction and Compulsive Overeating
Center for Science of Information
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THE PROBLEM: NEURAL PROFILES OF RESPONSE TO FOOD CUES

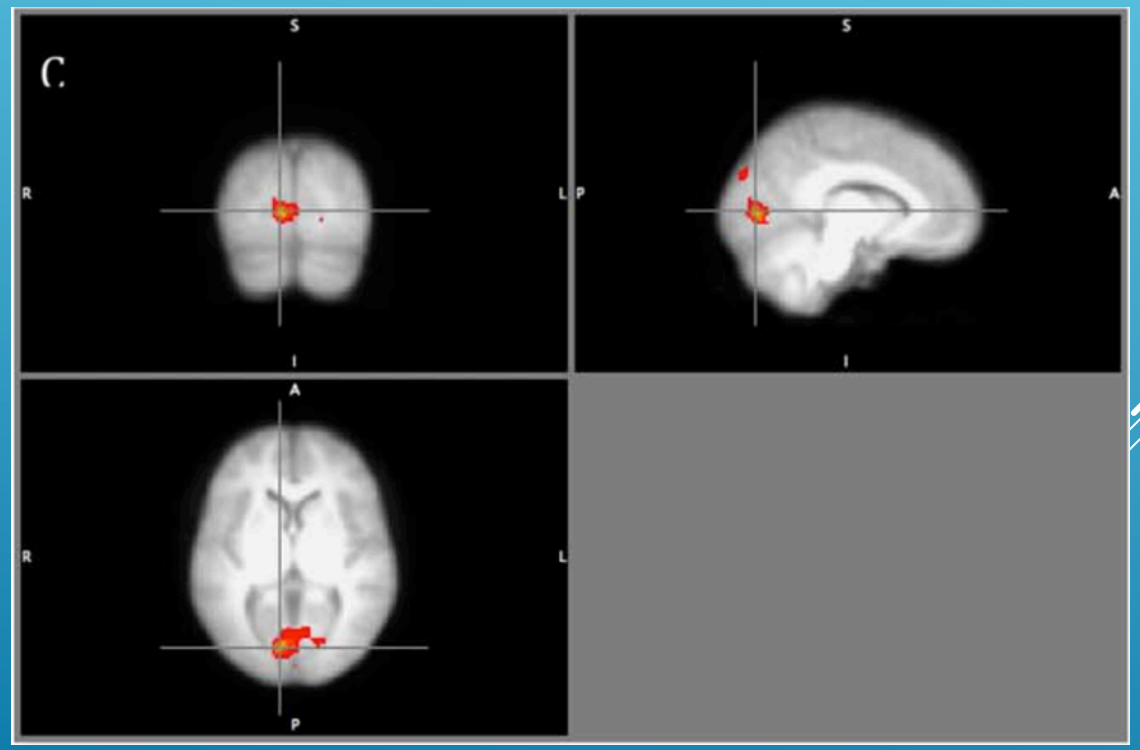
- Obesity affects >30% of the population
- The brain responds to food cues similarly to drugs of abuse
  - Reward
  - Especially in pathological overeating
- fMRI measures blood flow, as a correlate of neural activity

THE DATA

- Conditions

	Baseline	After-surgery
Hungry	Lean/Obese	Lean/Obese
Satiated	Lean/Obese	Lean/Obese

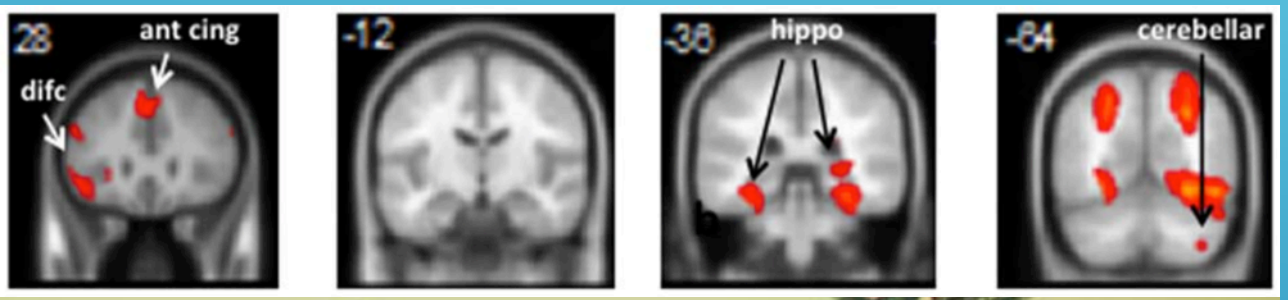
- Contrasts of
  Food Cues > Neutral Cues



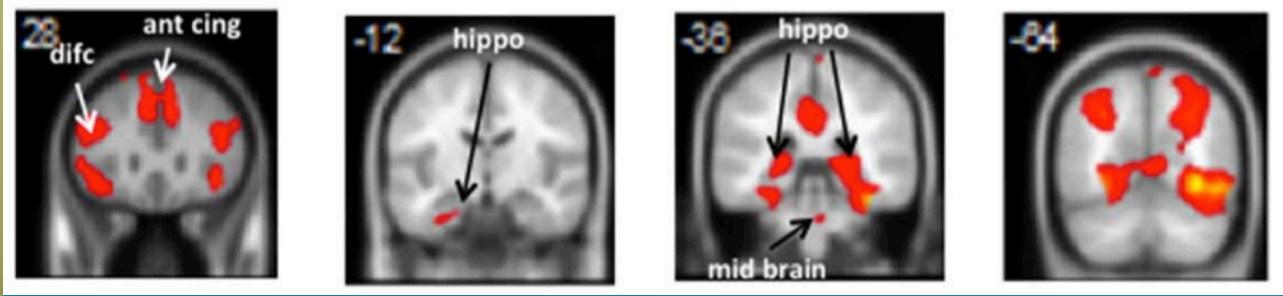
- Almost a million measurements per subject per time point

BACKGROUND: NEURAL PROFILE OF SATIETY

- Obese patients will demonstrate reward response to food cues even after eating



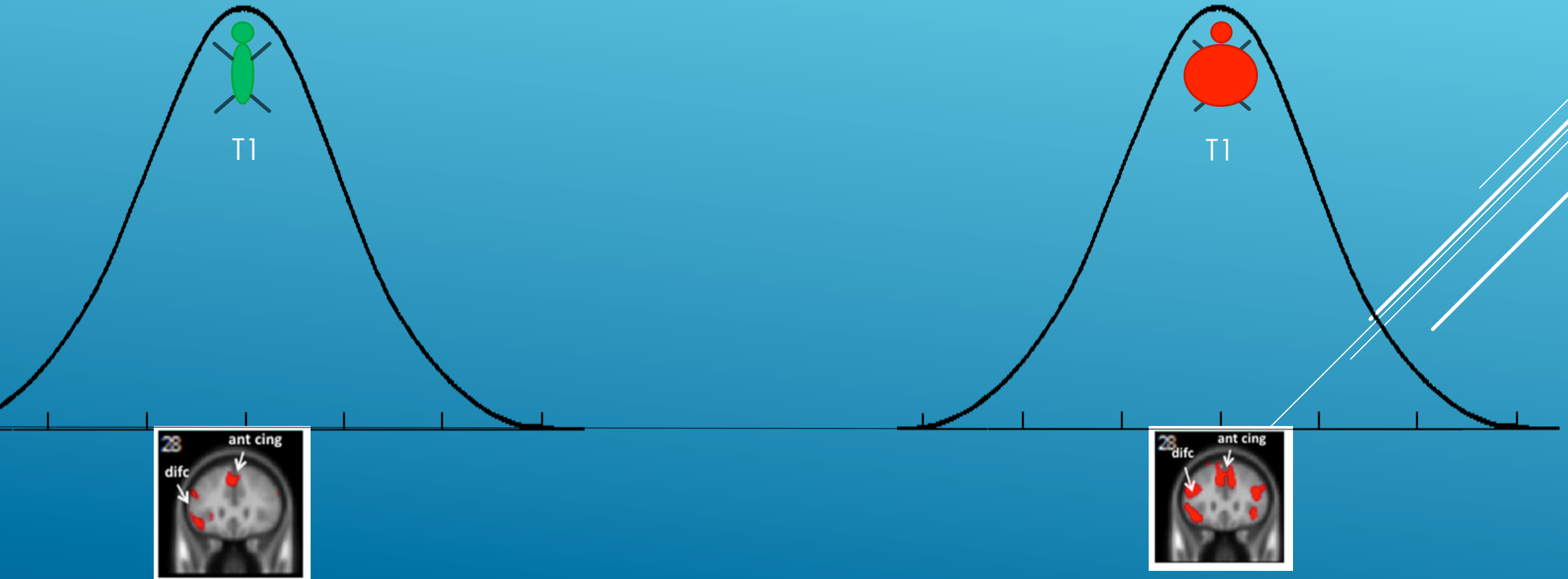
Puzziferri et al. 2016, *Obesity*



BACKGROUND

T1: baseline
T2: 6 months after surgery
T3: 12 months after surgery

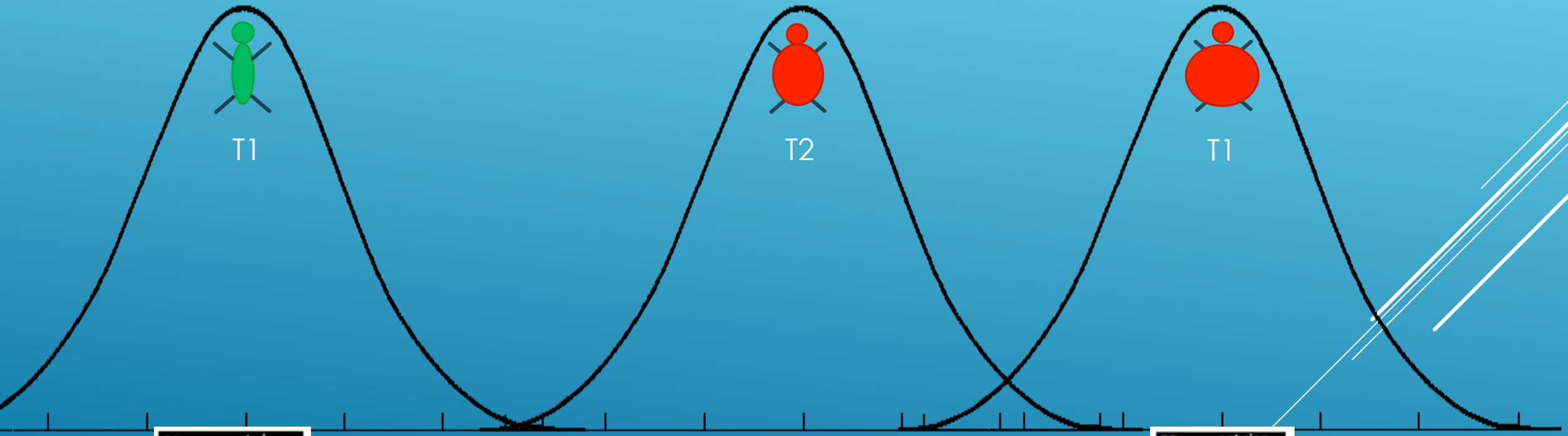
- Obese patients will demonstrate reward response to food cues even after eating

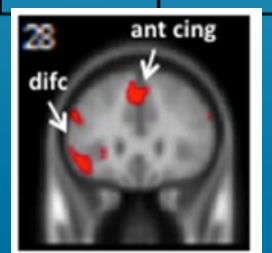


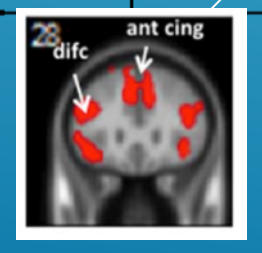
HYPOTHESES: DOES NEURAL RESPONSE CHANGE AFTER SURGERY?

T1: baseline
T2: 6 months after surgery
T3: 12 months after surgery

- Obese patients will demonstrate reward response to food cues even after eating



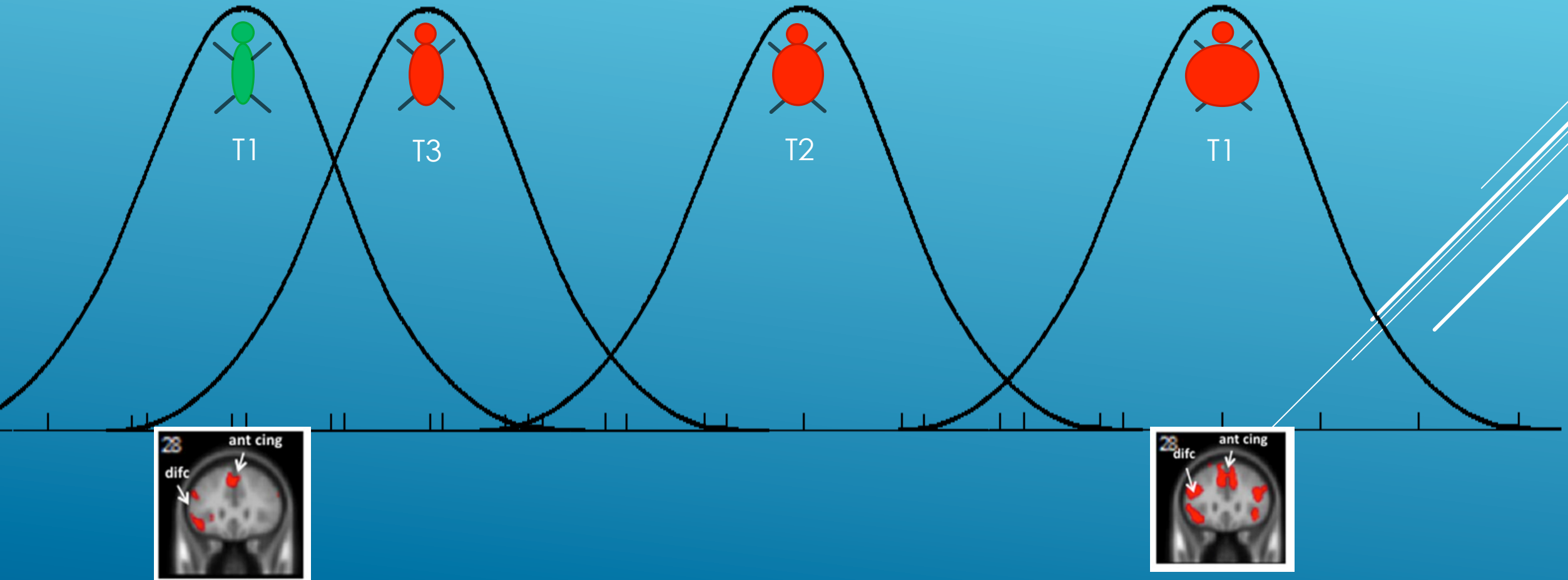




HYPOTHESES REGARDING SATIETY

T1: baseline
T2: 6 months after surgery
T3: 12 months after surgery

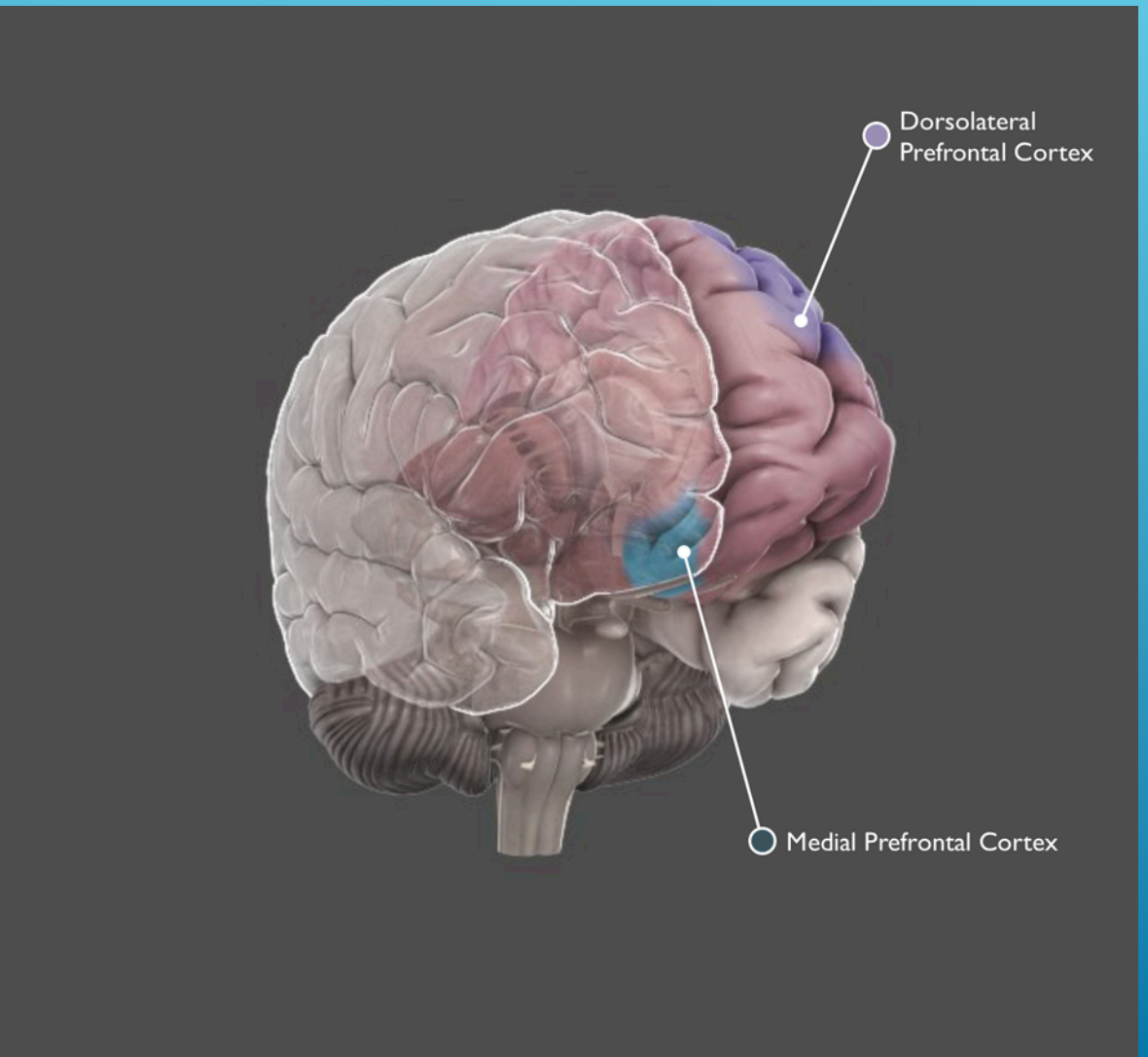
- Obese patients will demonstrate reward response to food cues even after eating

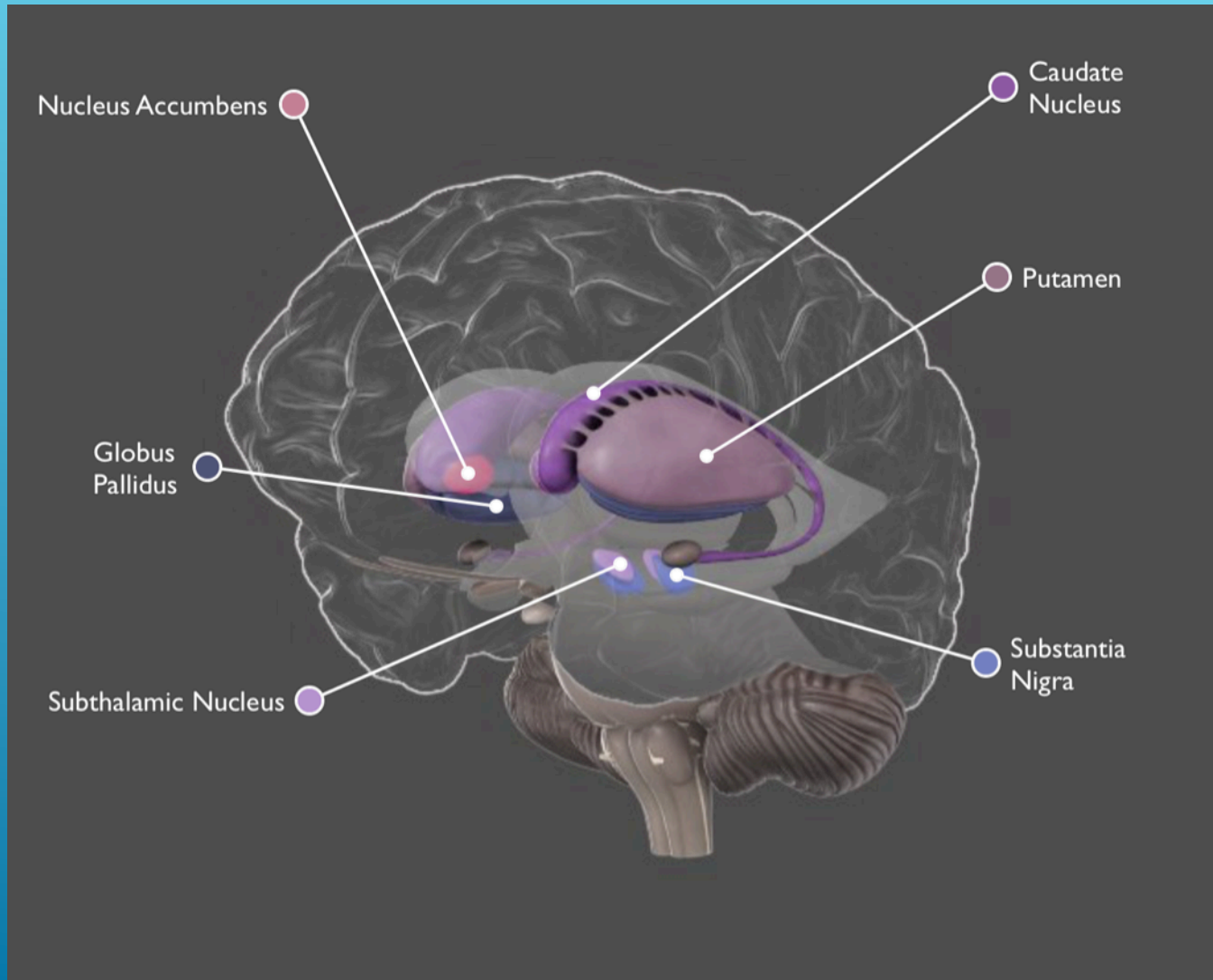


METHODS OVERVIEW

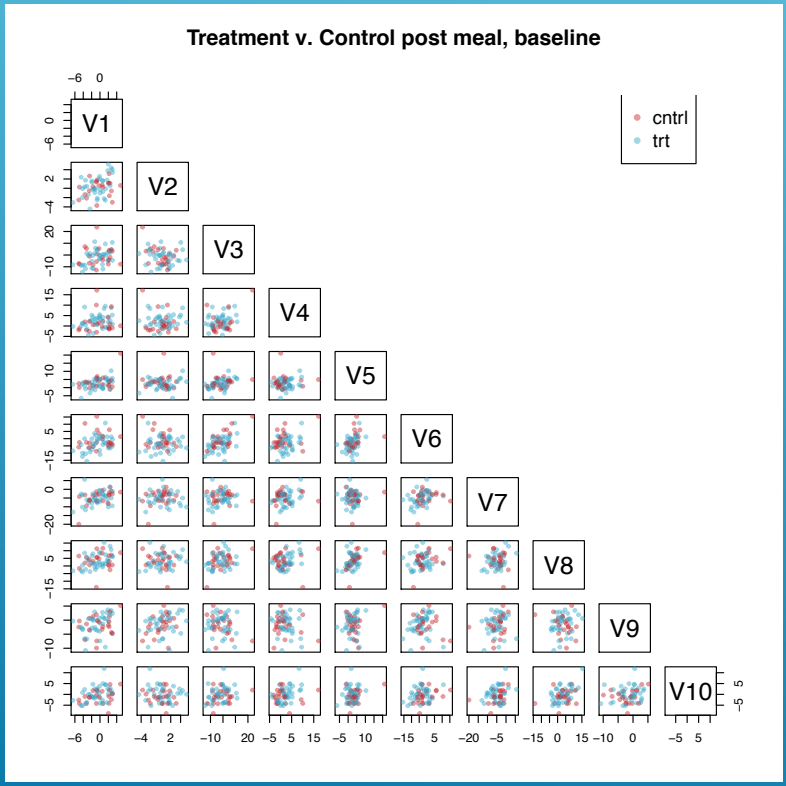
1. Dealing with 1 million dimensions: Pick brain regions of interest based on the literature
2. Identify which of these regions have most distinct differences between lean and obese subjects
3. Silhouette method to determine if there is a difference between activity in these brain regions
4. Use these regions as features to classify people based on these brain regions, this would support our hypothesis
    1. E.g. decision trees

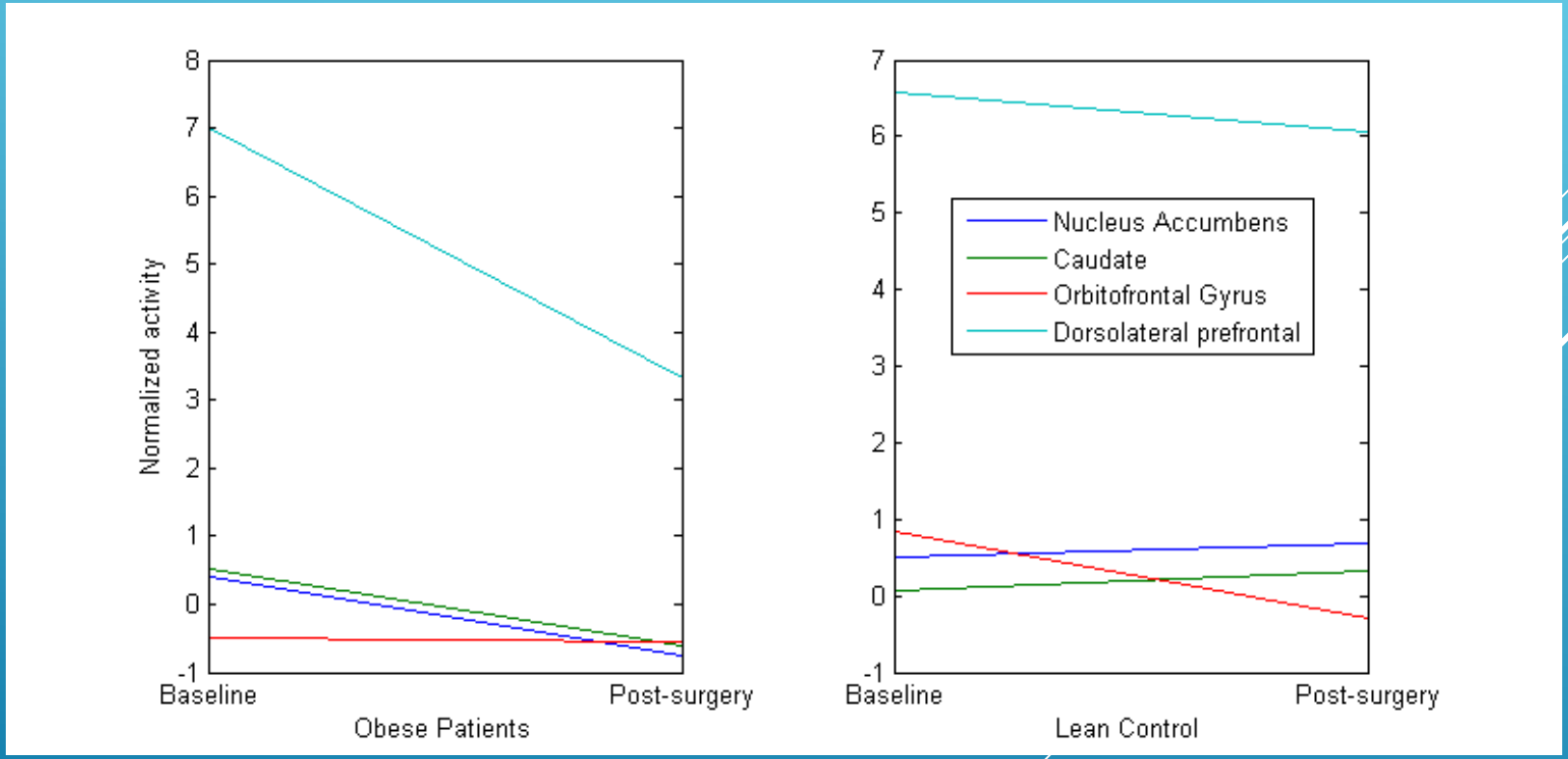
METHODS STEP 1: REGIONS OF INTEREST & REFINING SELECTION





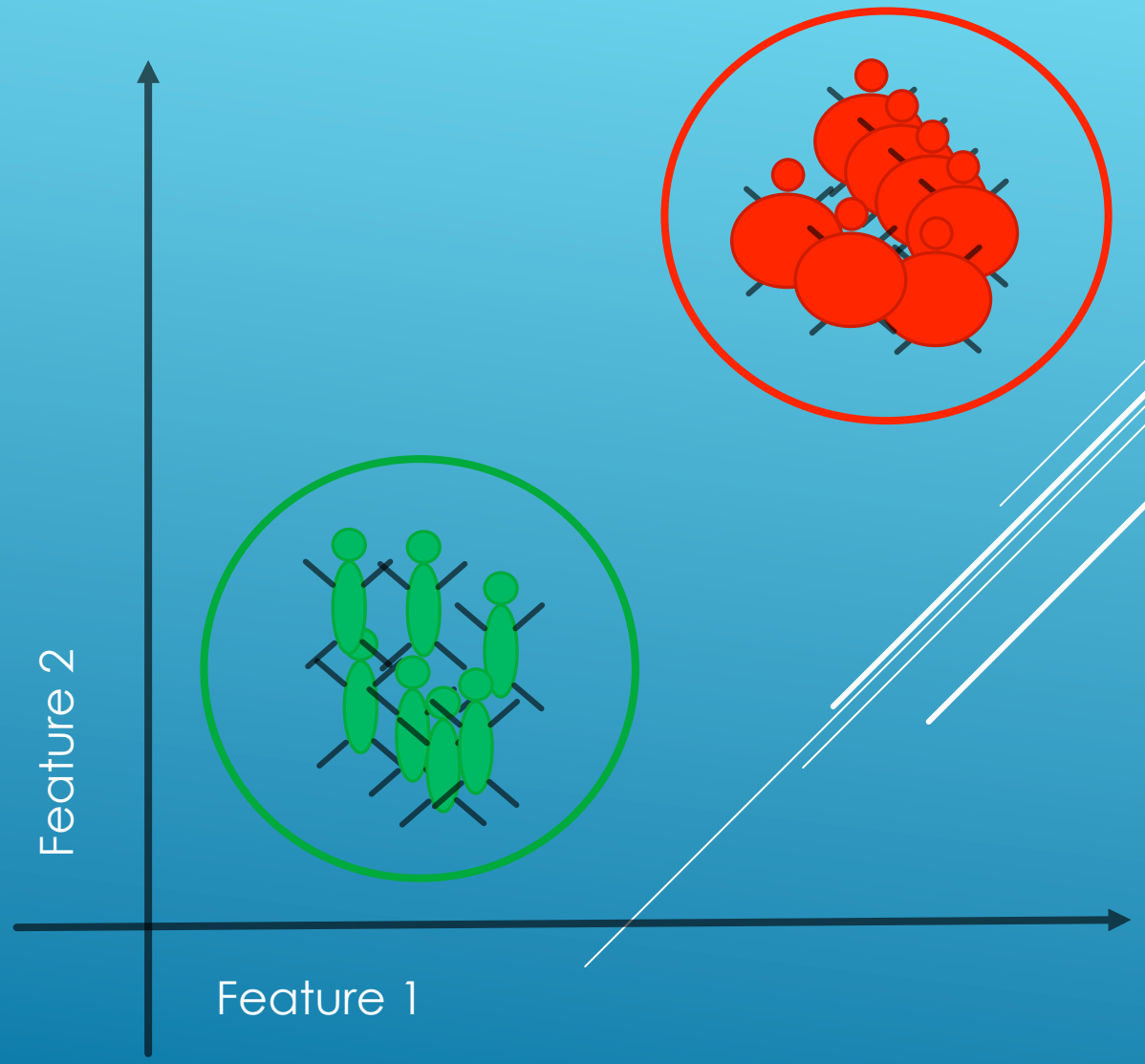
METHODS STEP 2: FEATURE DIFFERENTIATION





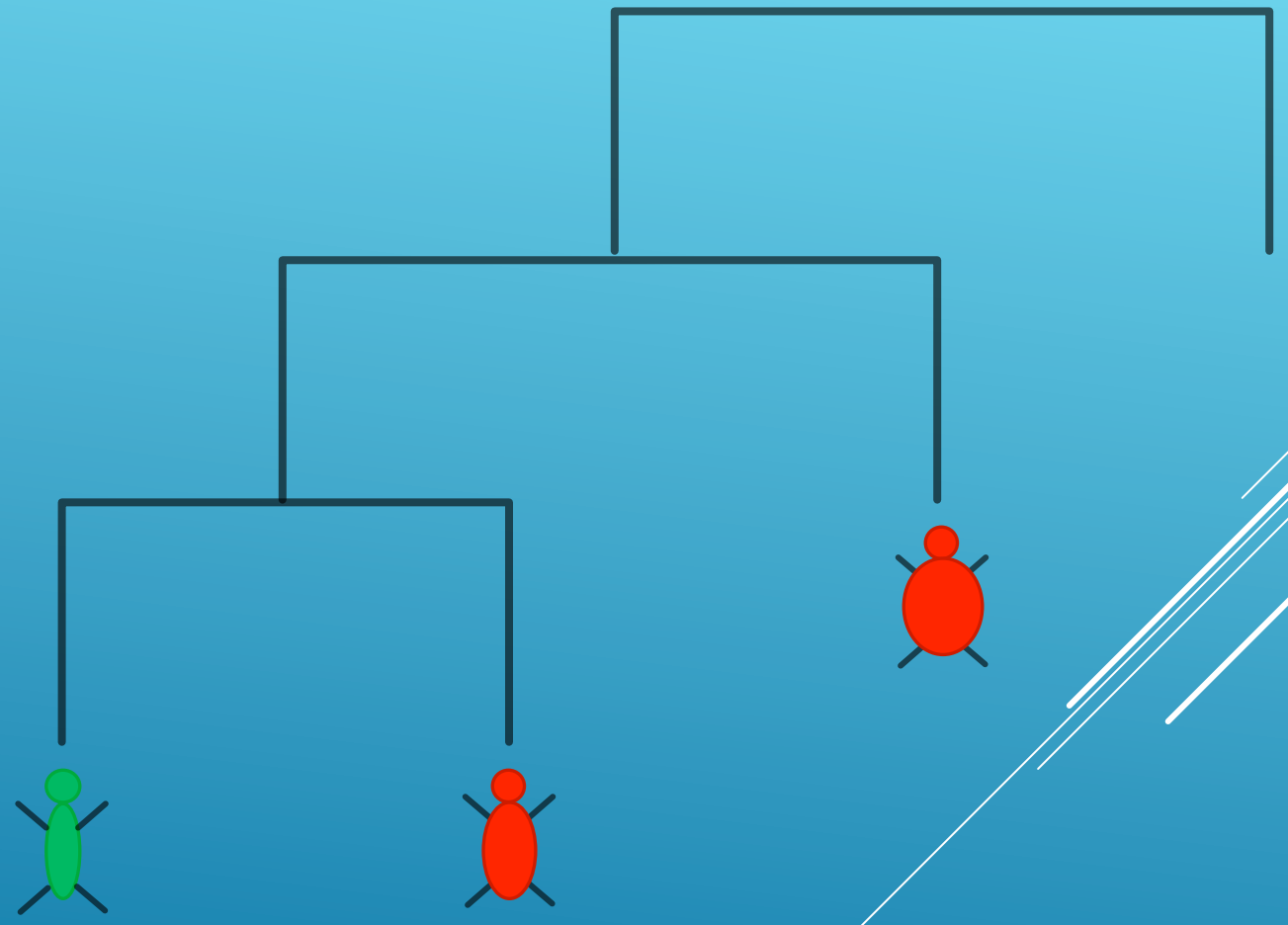
METHODS STEP 3: DETERMINING SEPARABILITY OF GROUPS

- Can we distinguish between lean controls and surgery patients based on brain activity in key regions?
  - Method: Silhouette Metric for Purity of Clusters
  - Compared to random permutations



METHODS STEP 4: (FUTURE DIRECTIONS)

- Build a classifier to distinguish if people are obese/not from neural data
- using the decision tree
- ...to be continued...



LIMITATIONS

- Small sample size – use time series to generate more measurements/user
- Lack of behavior measures to corroboroate

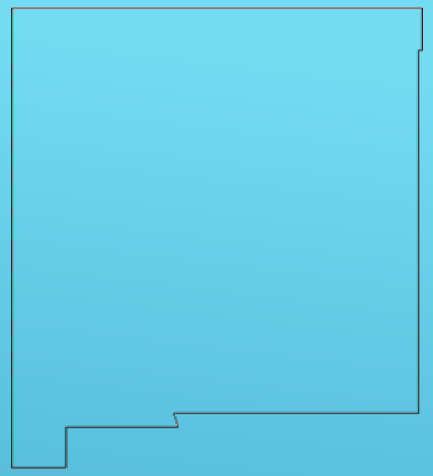
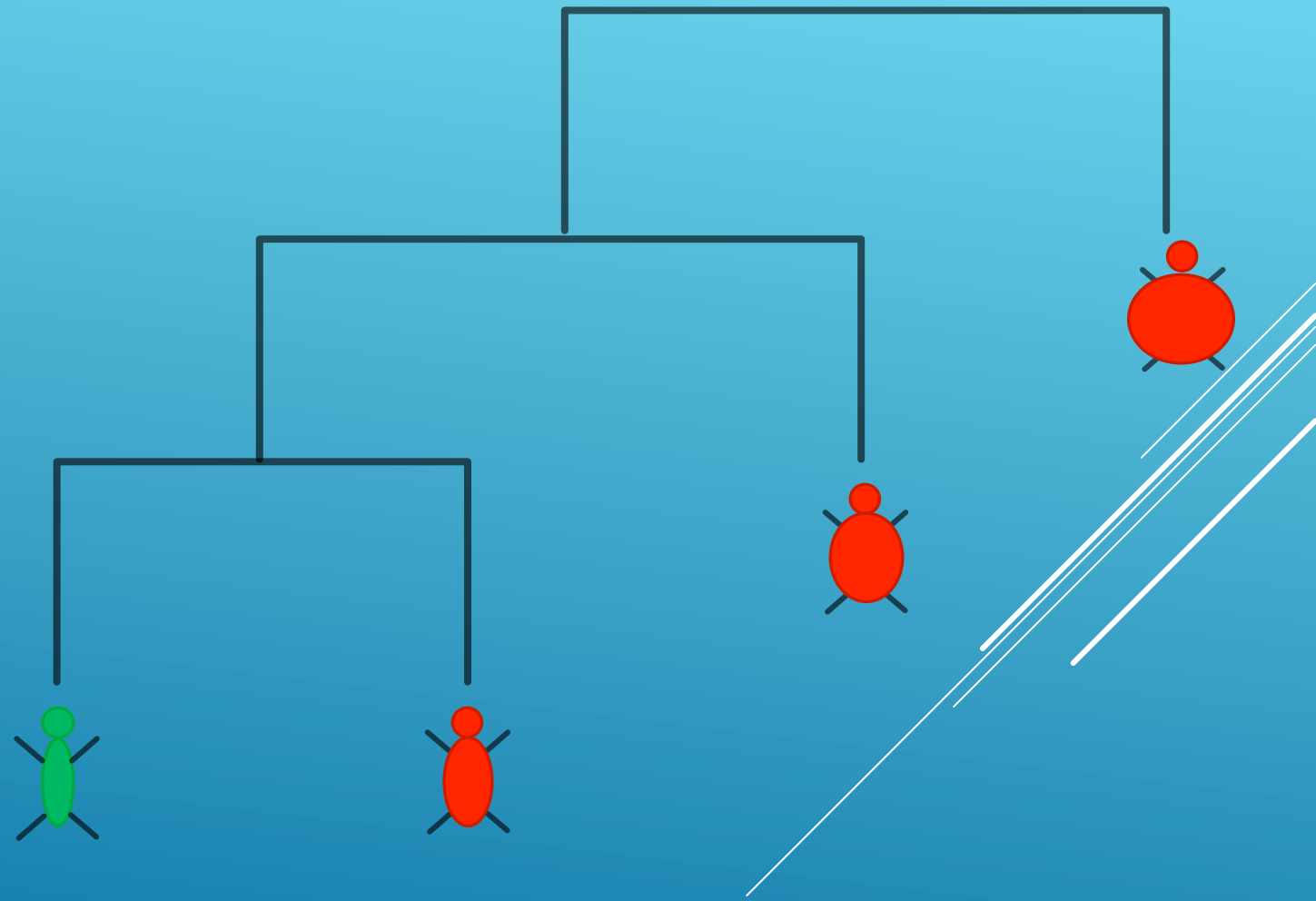
CONCLUSIONS & FUTURE DIRECTIONS

- Prior FMRI analysis focuses on single regions – we're testing hypotheses with statistical methods for multiple regions
- We can extend these to other studies (eg.) and plan to produce an R package for high-dimensional FMRI data analysis for others to use

THANK YOU

- Brent Ladd
- Center for Science of Information
- National Science Foundation
- Francesca Filbey, PhD
- Nancy Puzziferri, MD
- All of our advisors

METHOD 3



- We have a similar dataset from New Mexico, N=18
- Train a decision tree on one of these
- Test this tree on the other
- Determine if we can predict changes in neural activity