SOS LASSO: A new method for finding distributed representations in fMRI data.

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Background

- PDP models have been gainfully used to develop theory regarding variety of behaviors cognitive phenomena.
- The way in which information is encoded in these models—in the form of **distributed representations**—is responsible for why the models behave as they do.
- However, there is limited neural evidence for distributed representation in the brain.
- **This may be largely for methodological reasons.** The assumptions inherent in many neuroimaging methods make them ill-suited to discovering distributed representations in neural data.

Method

1. We generated data

Challenges of distributed representation

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2. Activation of individual units may not be interpretable independent of other units.

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4. The network of interest in any given study co-exists in the brain with many other networks, all subserving other functions that may not be of interest.

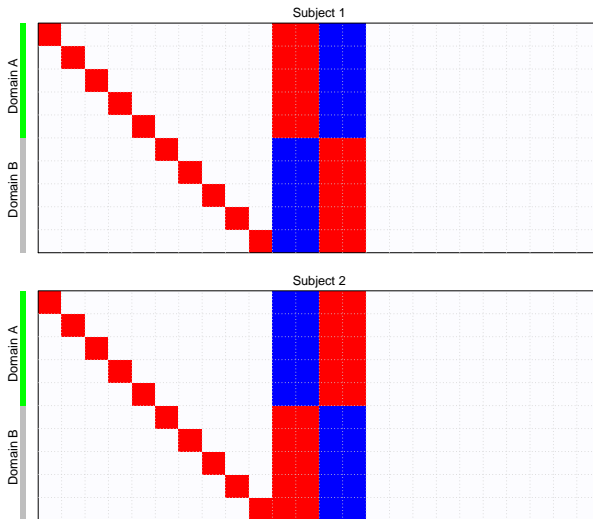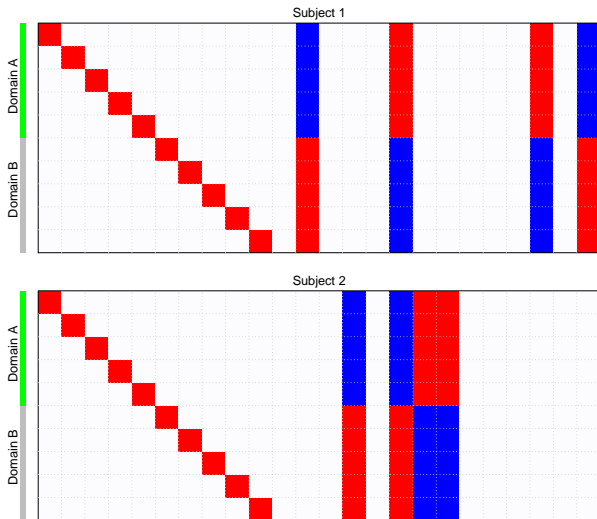# A small glimpse of the problem
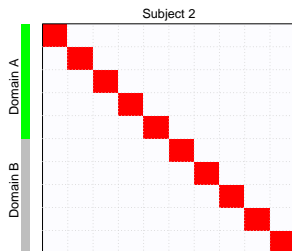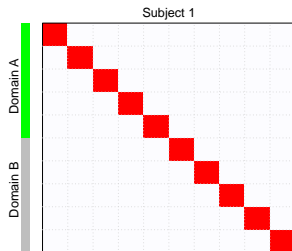
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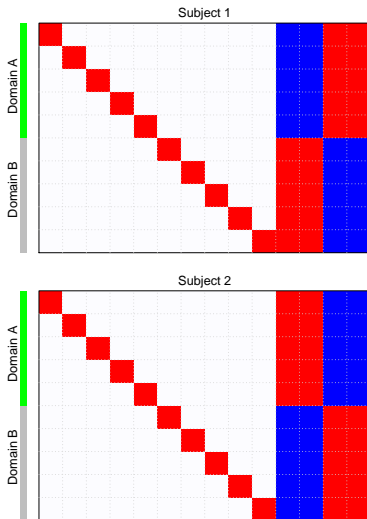
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Method

1. Generate data that instantiates these challenges. Some units in each dataset adhere to standard assumptions about how neural units behave (neighboring units activate in similar ways; units activate similarly across subjects), and other units that participate in distributed representations that violate these assumptions.

2. Analyze these datasets with a set of methods that make different assumptions about the underlying signal. The different outcomes follow directly from these assumptions, and what structure in the data the method is sensitive to.

3. Through this analysis, the relative strengths and weaknesses for each method are illustrated.
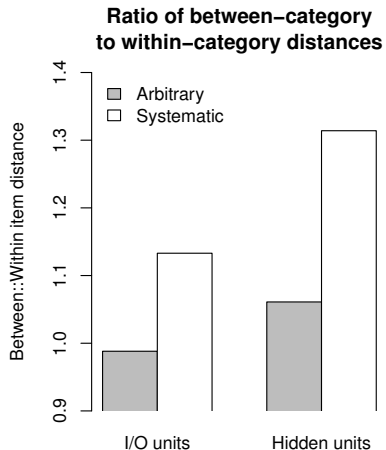
Overview

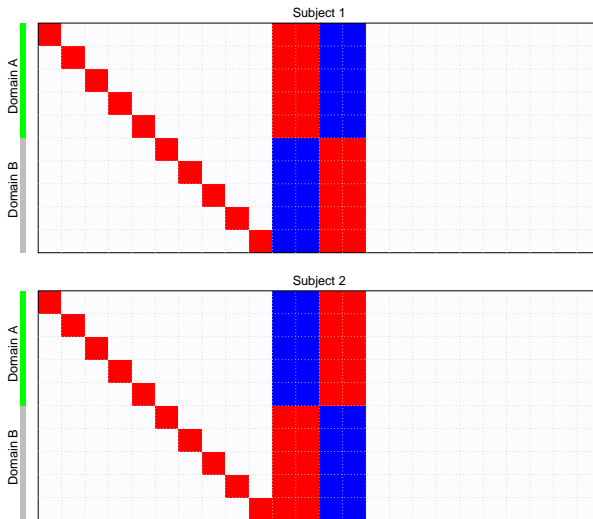|	Assumes same ...		Provides ...	
	Location	Encoding	Unit info	Importance
Univariate	✓	✓	✓	✓
Searchlight		✓		✓
Ridge			✓	
LASSO			✓	✓
SOS LASSO	✓		✓	✓

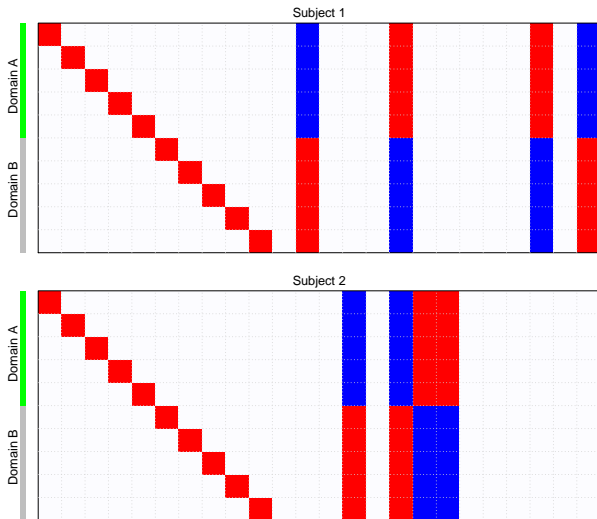# A model to simulate our data
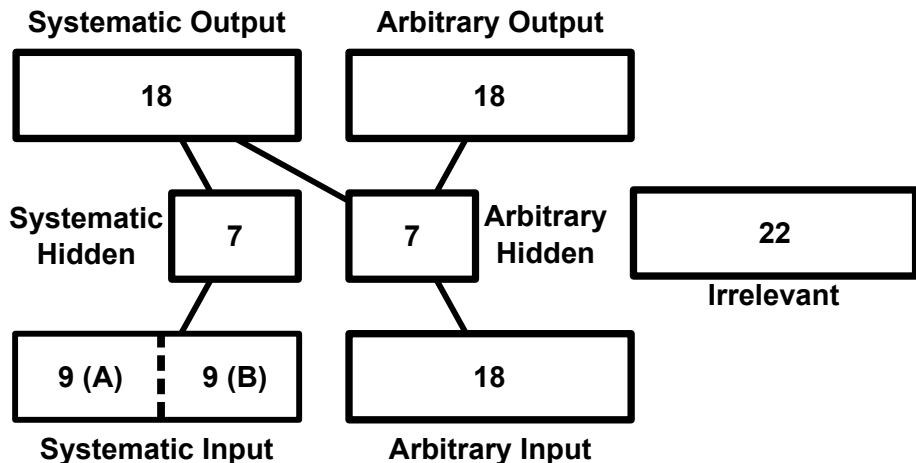
Where information is located
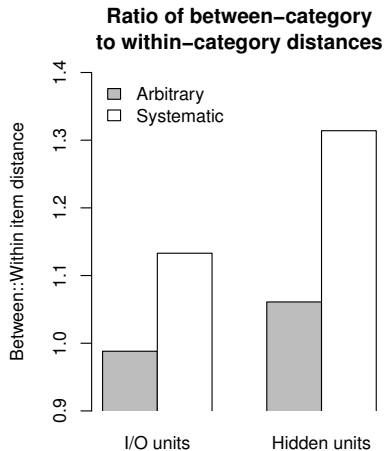
"Localized" distributed representations
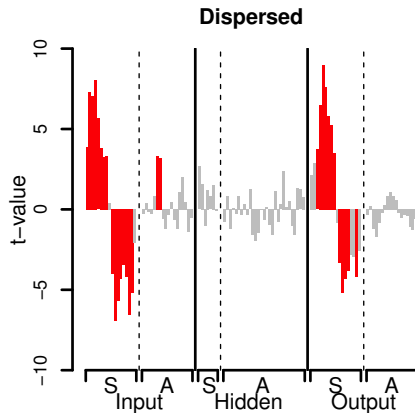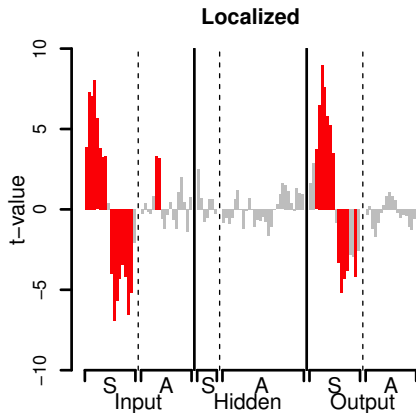
"Dispersed" distributed representations
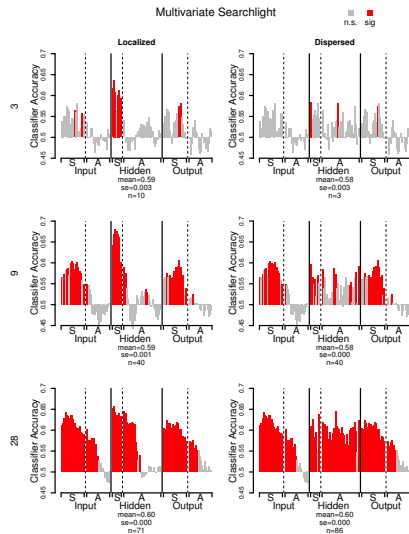
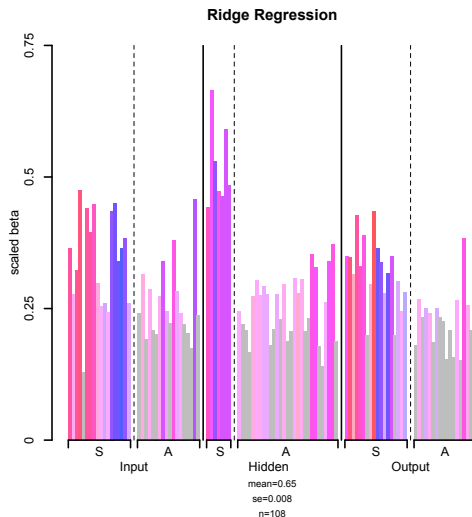# Where information is located

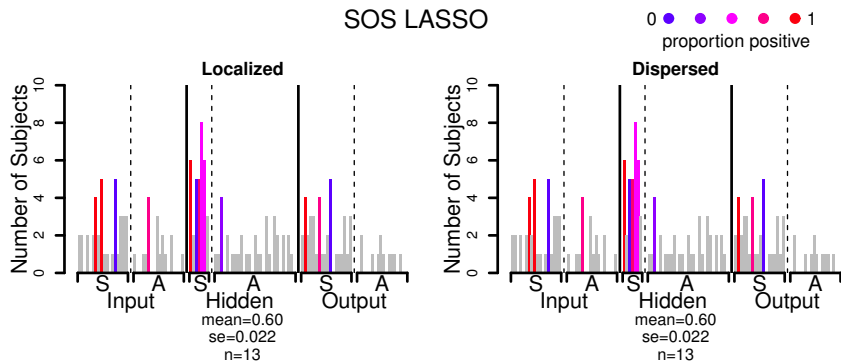# Strong localization assumption, within and across

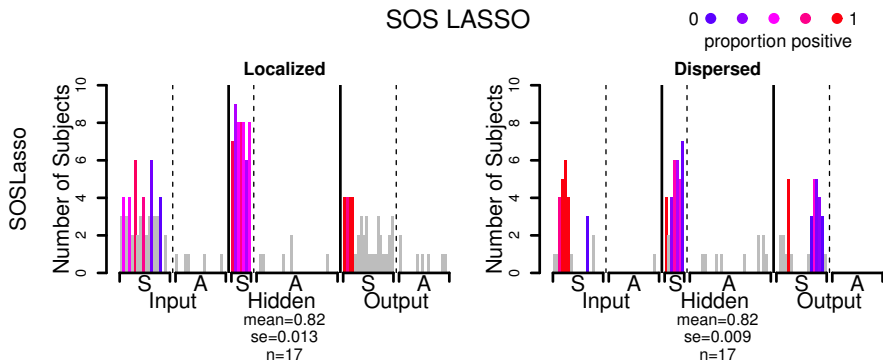# Less strong localization assumptions (but still there)

No localization assumption (and no feature selection!)

No localization assumption, with feature selection

Relaxed localization assumption + feature selection

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Conclusions

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2. The assumptions that an method makes about how information is encoded has a large effect on what will be found.
3. Different methods provide different levels of information about the signal it does identify.
4. SOS LASSO appears uniquely suited to test hypotheses about distributed representations in the brain.