# Role of the Frontal Polar Cortex in Category Learning:
## Rule Integration or Switching?

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## Introduction

**Category learning** is a critical neurobiological function that allows organisms to simplify a complex world

Category learning involves:
- Striatum
- Medial temporal lobes
- Other brain regions

One of the less investigated brain regions involved into category learning is the rostrolateral frontal polar cortex (FPC). It is often associated with:
- Representational switching (like switching rules in Wisconsin Card Sorting Test)
- Representational integration

The goal of the current study was to find out the precise role of FPC by comparing two common rule-based category learning tasks:
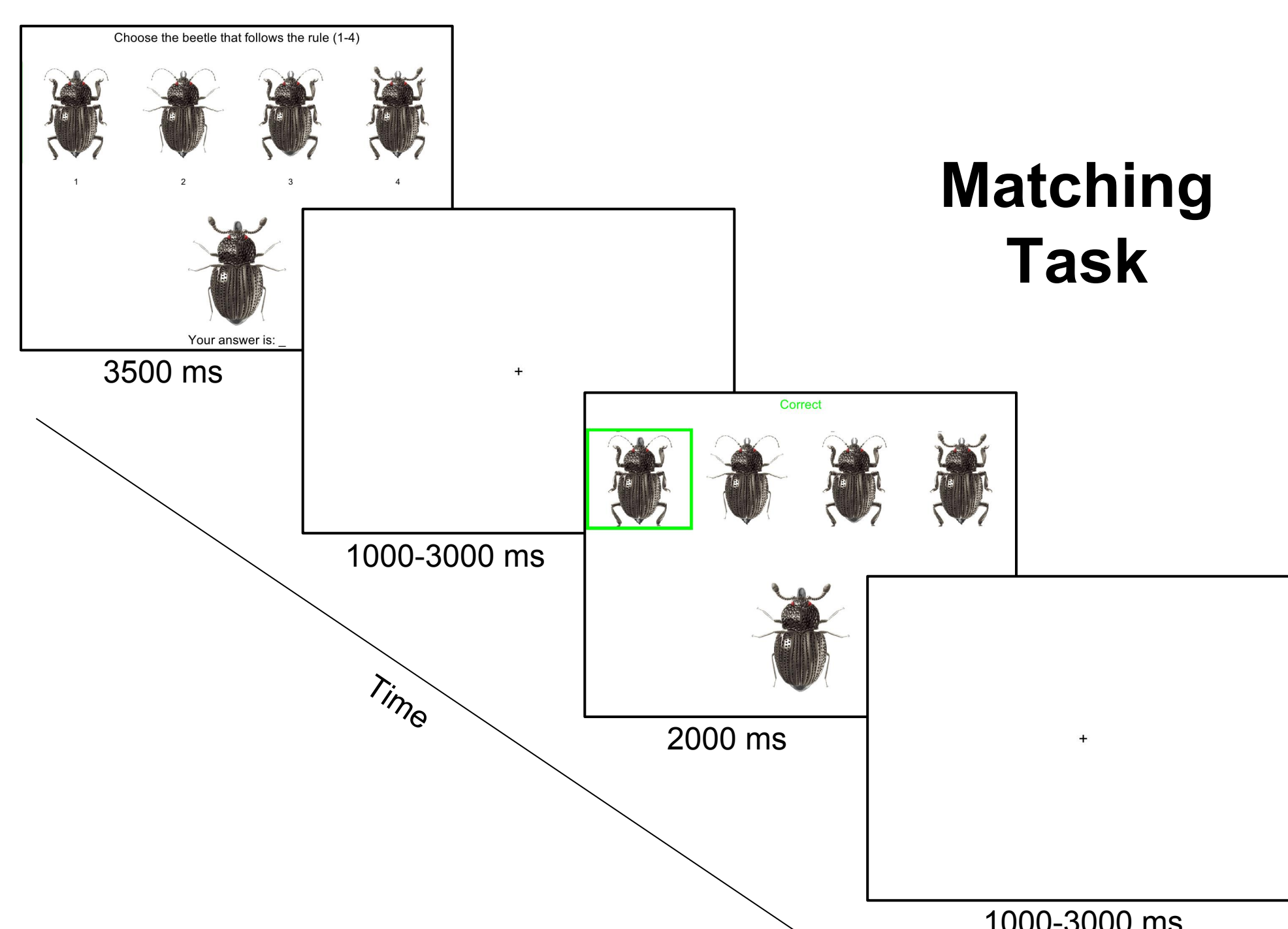- Matching
- Classification

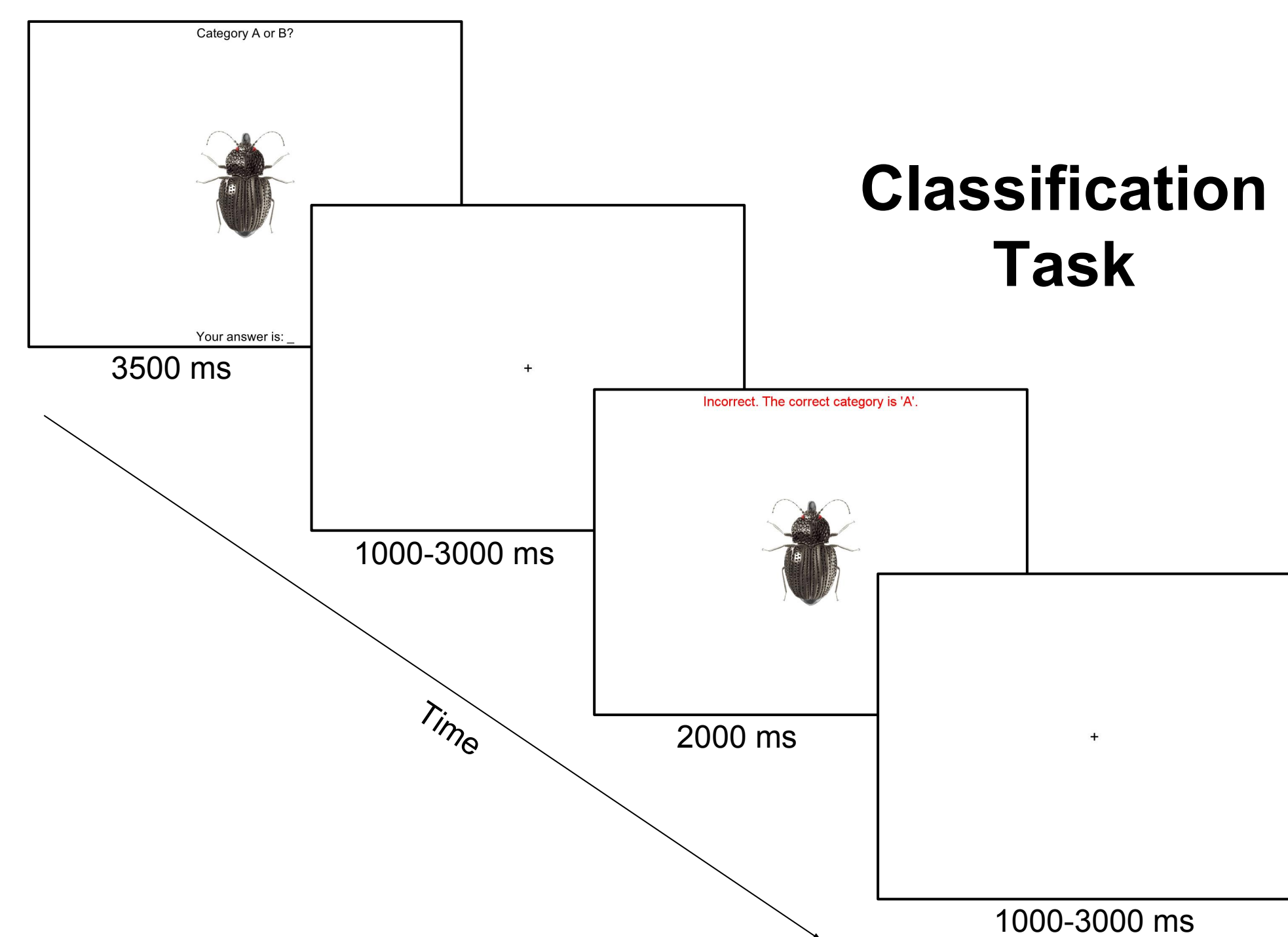## Tasks and Predictions

### Matching Task
- Match a reference stimulus to 4 target stimuli on a single dimension
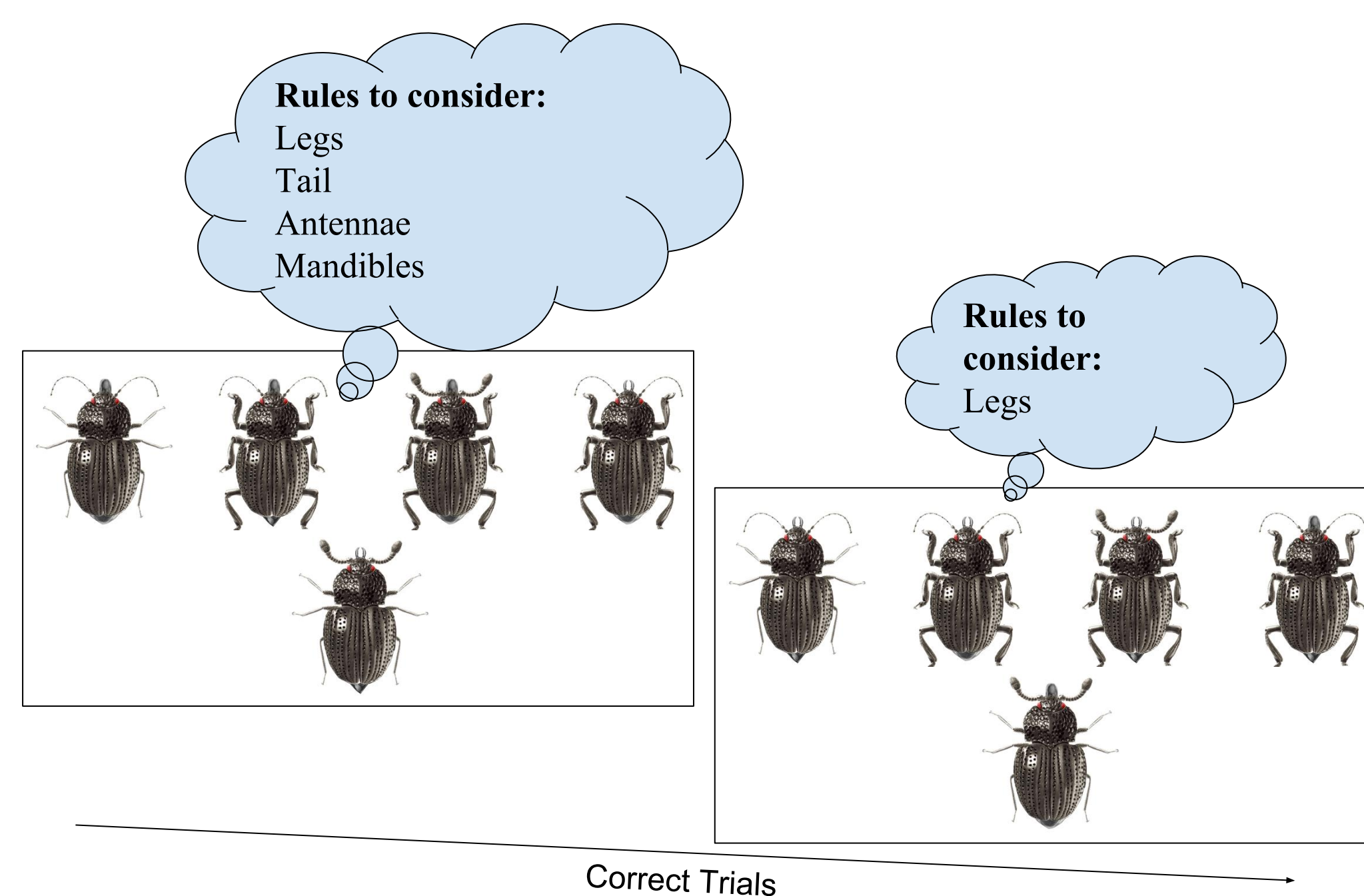- Rule switch after 4 correct trials

### Classification Task
- Classify one stimulus to category A or B
- Rule switch after 4 correct trials



**Matching Task**

## Tasks and Predictions



**Classification Task**

- Matching and classification place **different demands on switching and integration**:
- In matching, a rule can be known with certainty after a single correct answer



- In classification, participants may need to integrate evidence for the rule even after an initial correct response
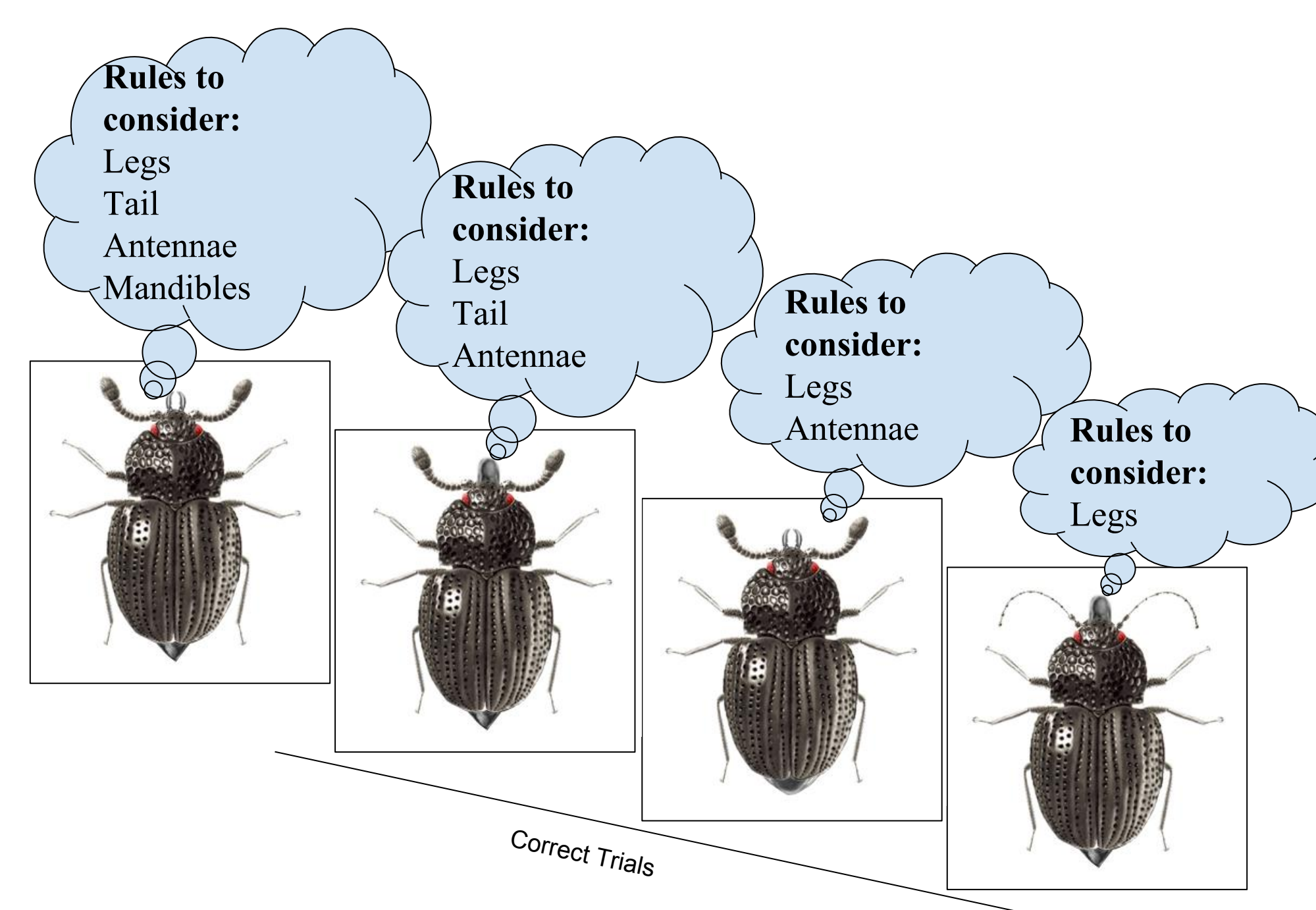


## Tasks and Predictions

All trials were divided into two phases:
- Rule Application - last 4 and more correct trials
- Rule Learning - all other trials

### Predictions

**Switching** demands should be equal in rule application (no switching) as well as in rule learning trials across the tasks
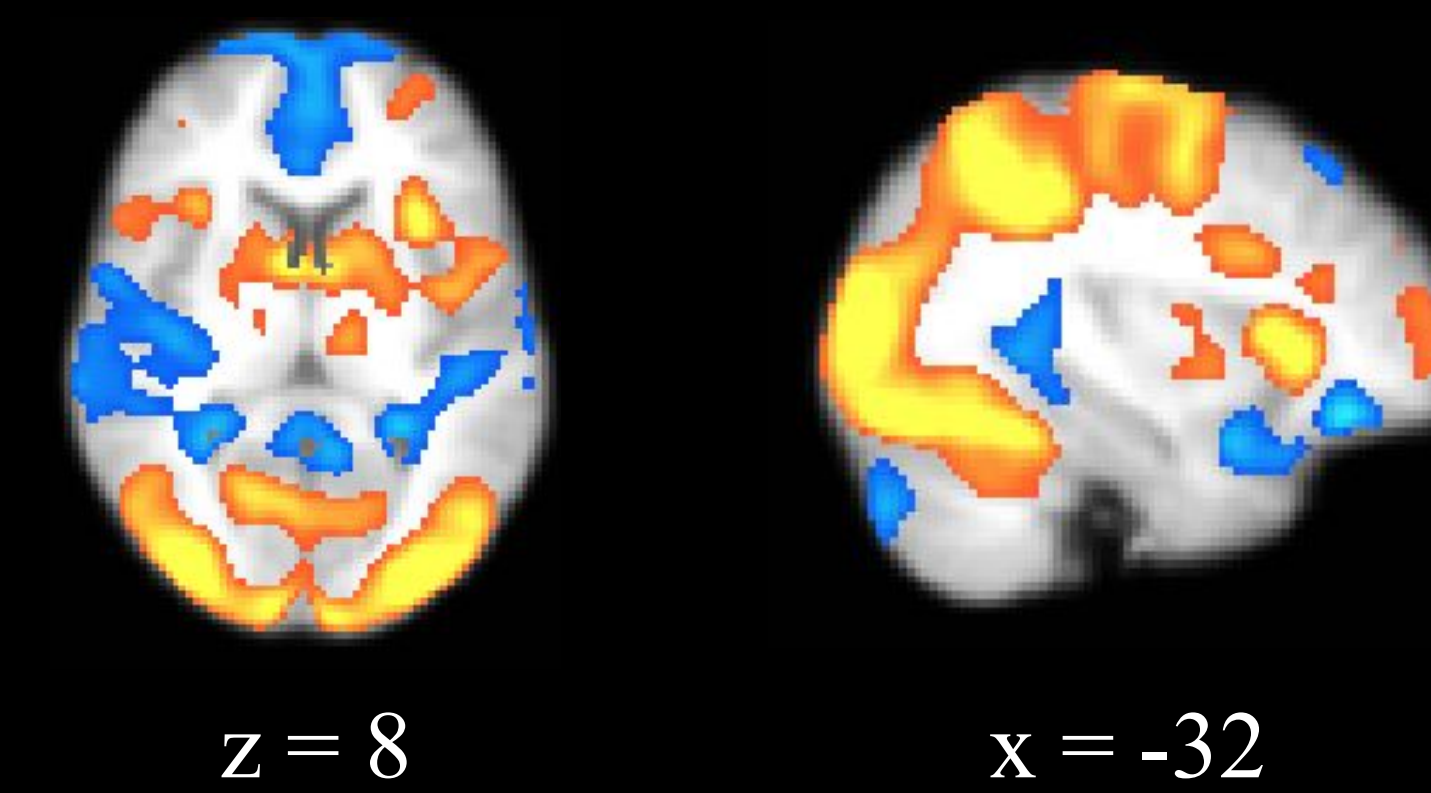
**Integration** demands should be different in rule application and may be different in rule learning across the tasks

### Method
- N = 27 (2 non-learners) at Siemens Skyra 3T
- 4 scanning runs per each task
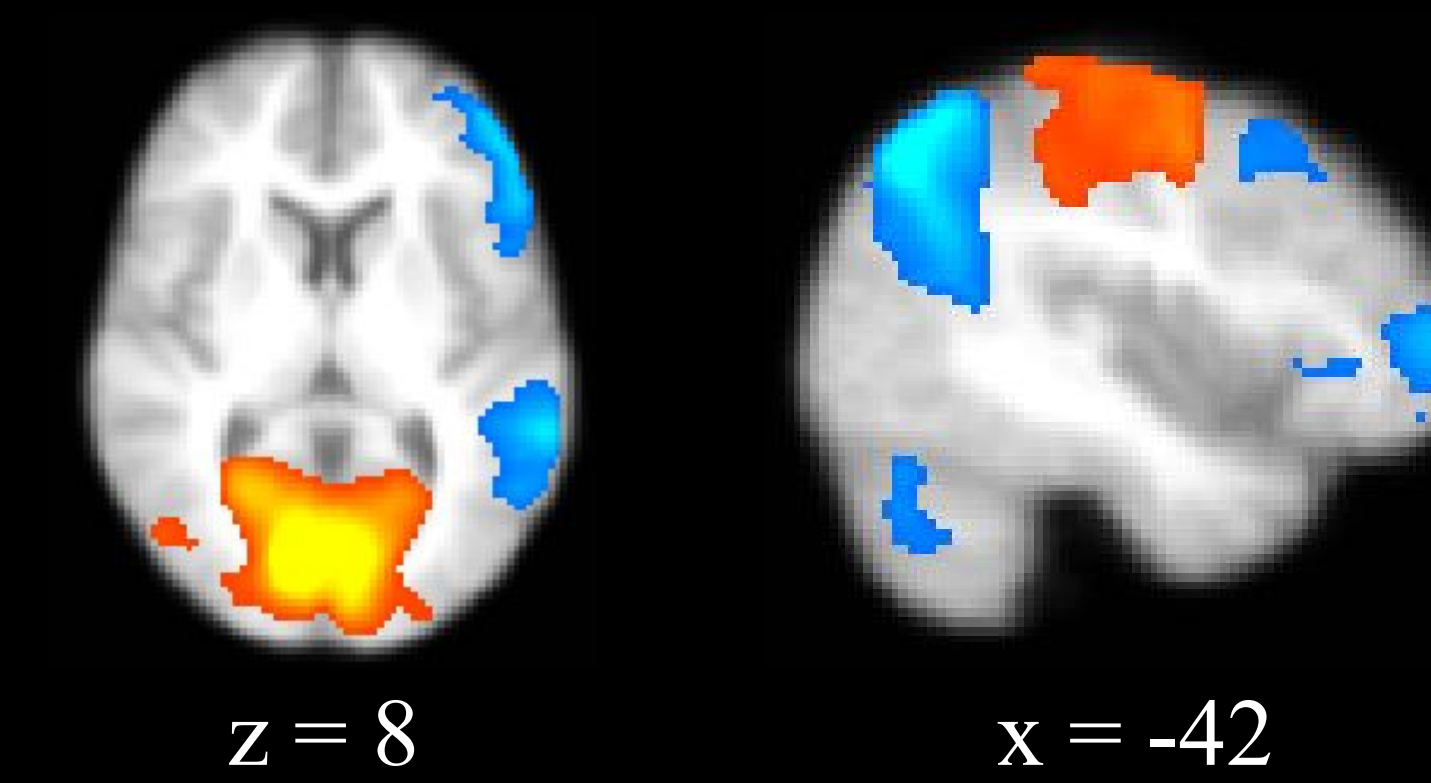- FSL+ANTs+Nipype+Randomise

## Results

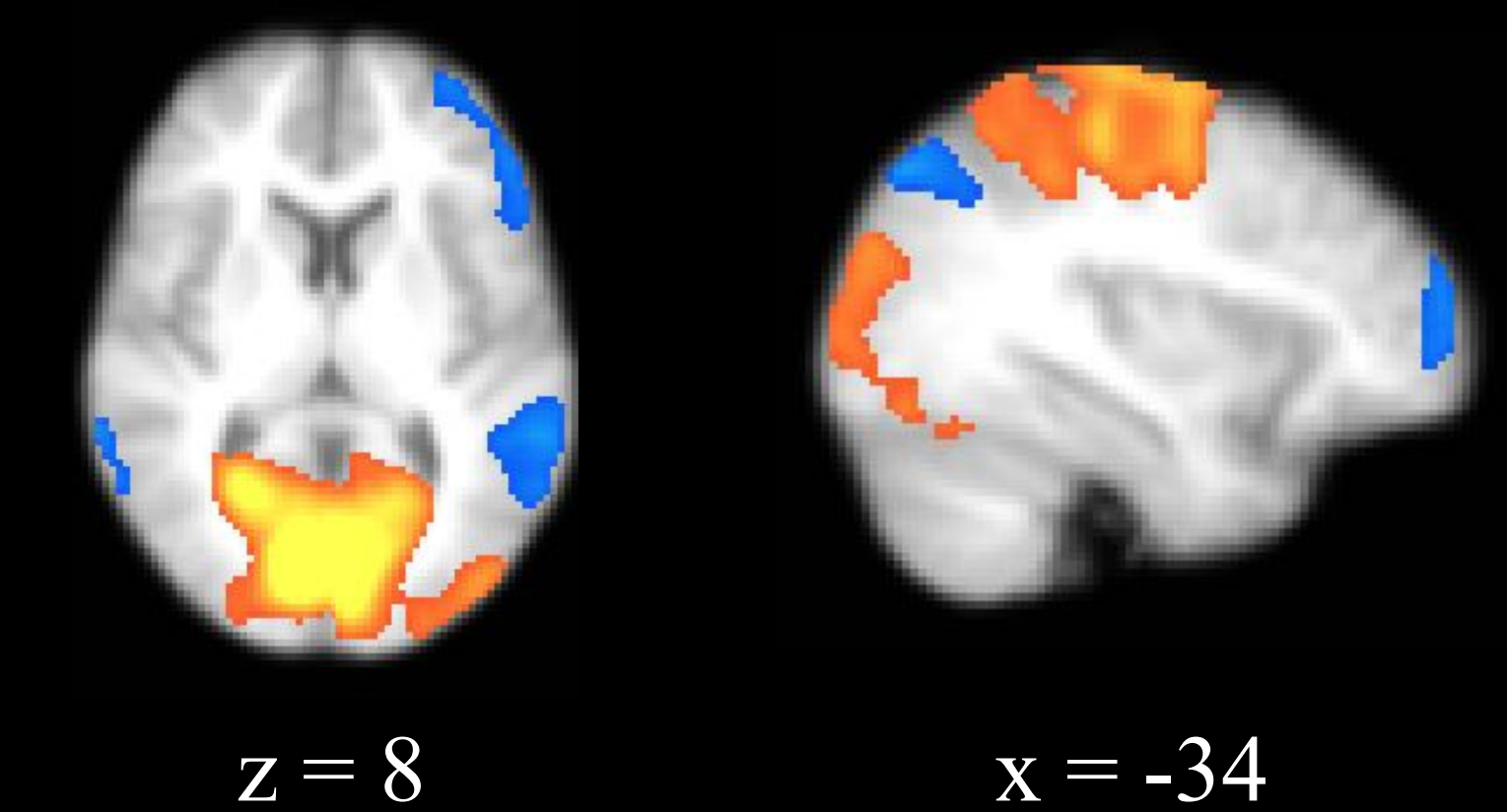Rule Application in Classification > Baseline
Whole Brain mask



z = 8          x = -32

Significant for Rule Learning > Application in Matching with the Frontal Pole mask

Rule Learning in Matching > Classification
Whole Brain mask



z = 8          x = -42

## Results

Rule Application in Matching > Classification
Whole Brain mask (*p*=.07)
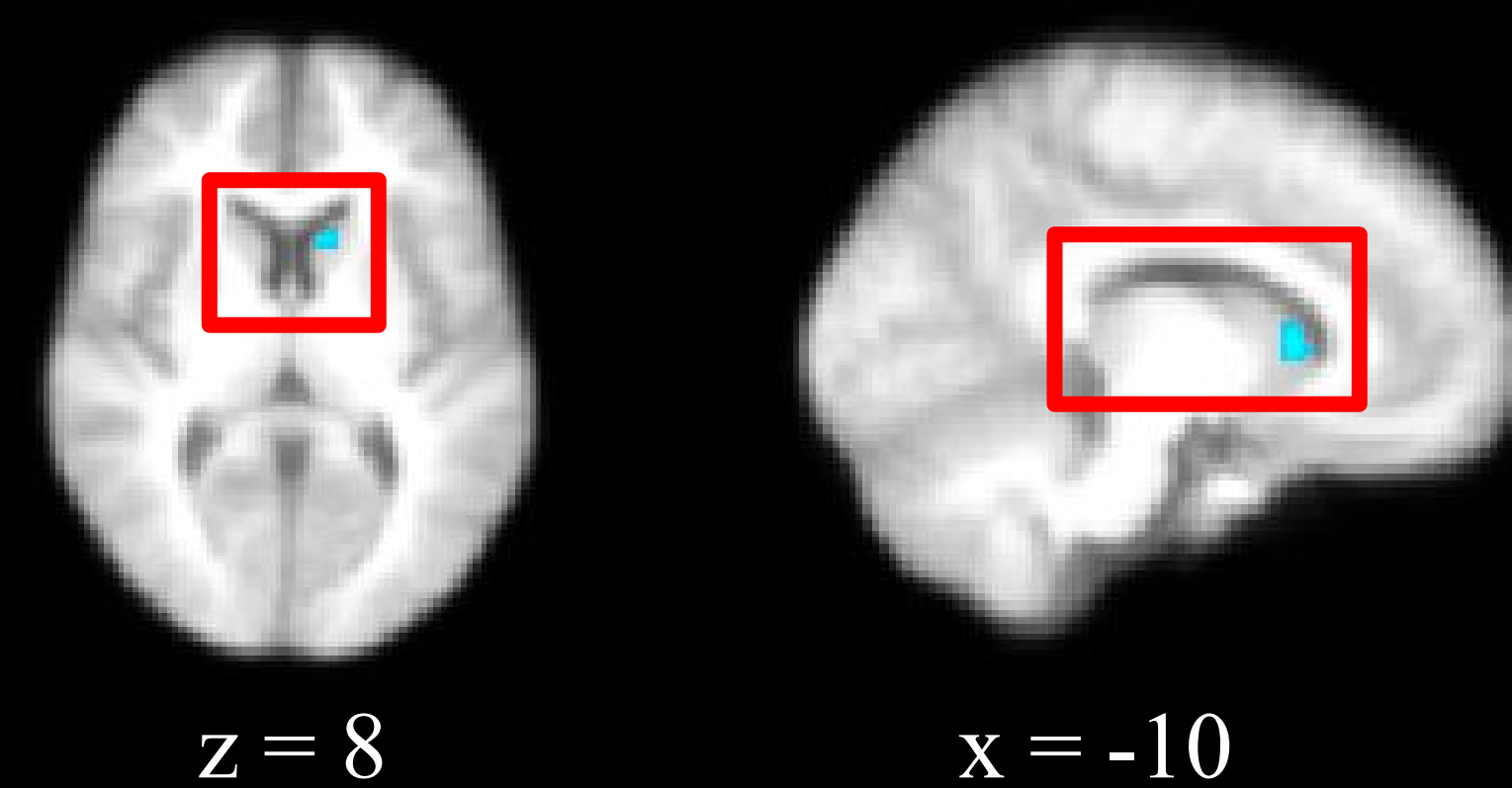


z = 8          x = -34

Significant for Rule Application in Classification > Matching with the Frontal Pole mask (*p*<.05)

### Connectivity (PPI)

FPC was used as a seed region to explore its connection with the caudate, which was previously associated with integration

Rule Application in Matching > Classification
Caudate mask



z = 8          x = -10

## Conclusions

- Frontal polar cortex was associated with rule integration in rule-based category learning
- FPC was connected to the caudate that was previously associated with rule integration

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