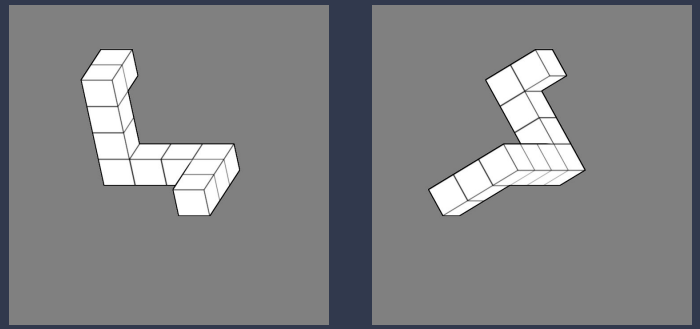
Mental Rotation Task

Analysis w/ Linear Mixed Effect Models (LMMs)

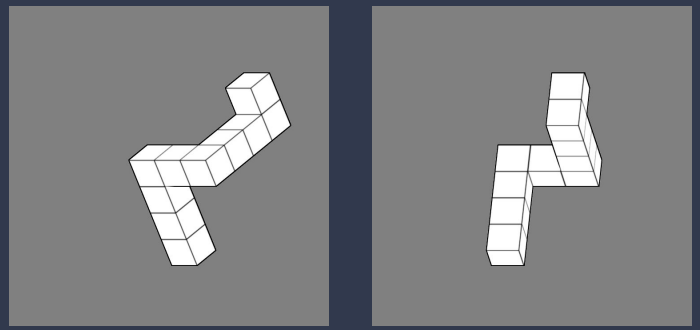
To what extent do **problem attributes** affect **response time** and **accuracy** in the mental rotation task?

The Mental Rotation Task

True



False



- 204 Subjects, 84 Trials

- Two 3D objects are displayed on screen

Problem Attributes:

- **Trial type:** True or False
- **Angle Difference:** 0, 50, 100, 150
- **Object arm length:** equal or unequal
- **Axis of rotation:** X-axis or Z-axis

Outcomes

- Response time (ms)
- Accuracy

What is nested data?

```
## # A tibble: 6 x 13
##   Subject Trial Angle BaseImage eq_armlength Direction bin_dir_x LeftImage
##     <dbl> <dbl> <dbl>     <dbl>        <dbl> <chr>         <dbl> <chr>
## 1    2019     1   150        14            1 x                 1 14_x_335~
## 2    2019     2   150         9            1 x                 1 9_x_170_a
## 3    2019     3   150        10            1 z                 0 10_z_25_a
## 4    2019     4   150         7            0 x                 1 7_x_255_a
## 5    2019     5   100        14            1 x                 1 14_x_145~
## 6    2019     6   100         5            0 z                 0 5_z_120_a
## # ... with 5 more variables: RightImage <chr>, TrialType <chr>,
## #   CorrectResponse <lgl>, Accuracy <dbl>, Stimuli.RT <dbl>
```

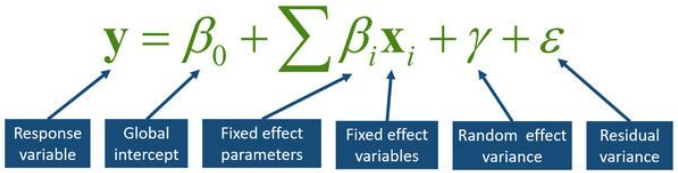
- We have 84 trials, nested within 204 subjects; 17,522 observations

- Each observation is not statistically independent

- We are introducing the random effect of Subject ID

- Some of the variation in our outcomes is being explained by the differences between subjects, which we need to control for.

Linear Mixed Effect Models



- Fixed Effects: Test for the effect of the parameter

    - ex: Coefficients for **angle difference**, **rotation axis**, **trial type**, and **arm length**

- Random Effects: Controls for the effects of subgroups on our dependent variables

    - ex: The effect of **Subject ID** on **response time** and **accuracy**

    - LMM Visual

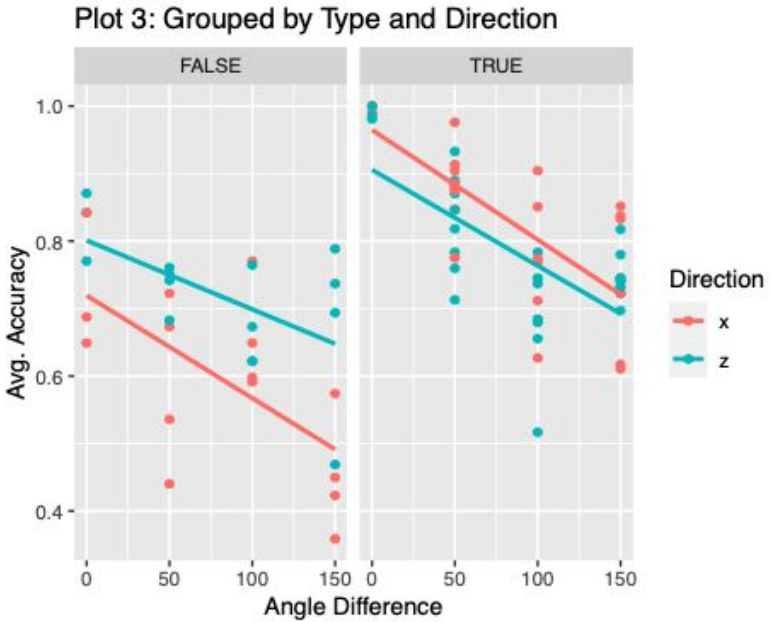
Results: Response Time

- **Angle difference** increases response time (= 7.120, P = 0.000+) *
- Subjects respond faster to **true trials** than false trials (= -552.543, P = 0.000+) *
- Subjects respond slower to objects with **equal arm lengths** (= 56.700, P = 0.0016) *
- Subjects respond faster to **x-axis trials** than z-axis trial (= -17.807, P = 0.3217)

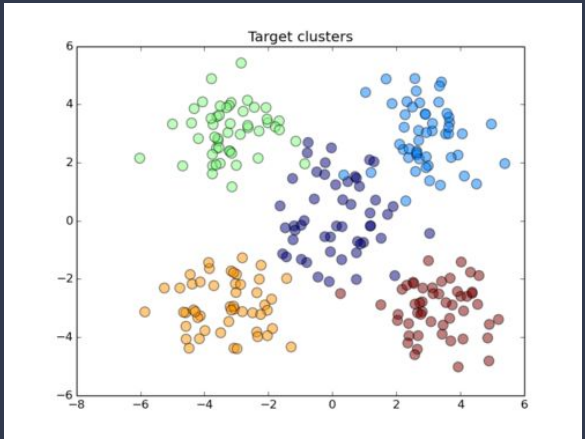
Results: Accuracy

- **Angle difference** decreases the log odds of getting the trial correct by 0.85% (P = 0.000+) *
- The odds of getting the trial correct are 88.56% higher for **true trials** (P = 0.000+) *
- The odds of getting the trial correct are 10.45% lower for **x-axis trials** (P = 0.00489) *
- The odds of getting the trial correct are 27.34% lower for **equal-arm trials** (P = 0.000+) *

Interactions



Future Questions



- To what extent do changes in problem attributes from one problem to the next impact response time and accuracy?
- Are there meaningful clusters/groups of individual differences in the degree to which specific problem attributes matter?
- Are there differences by cluster/group in activation of spatial brain regions during MRT problem solving?