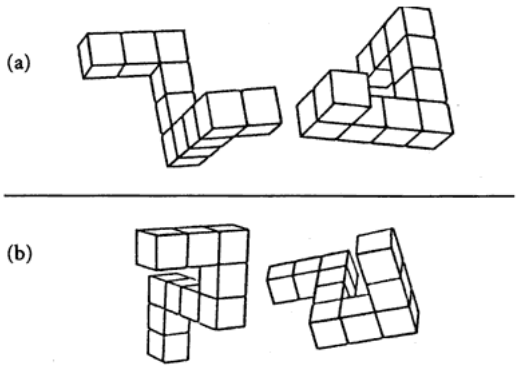
Mental Rotation Task

Background

Visual cognition is a widely studied field. One key aspect of human visual information processing is recognition of the same (3-dimensional) object from different locations in space. Here we will look at a classic task in which subjects are presented with similar or identical 3-dimensional objects and are required to judge 'sameness' or 'difference'. An example pair of stimuli for such an experiment is below.



Mental Rotation Test—Are these two figures the same except for their orientation?

A leading theory about these judgements of 'same' or 'different' maintains that human performance involves **mental rotation**: to judge whether two pictures show the same or a different object, humans mentally rotate an internal representation of one picture in a "3-dimensional visual headspace" until it is sufficiently aligned with the other to make a judgement with sufficient confidence.

Q: How could we test (some of the predictions of) this (verbal) theory in a laboratory experiment?

A. Hypotheses

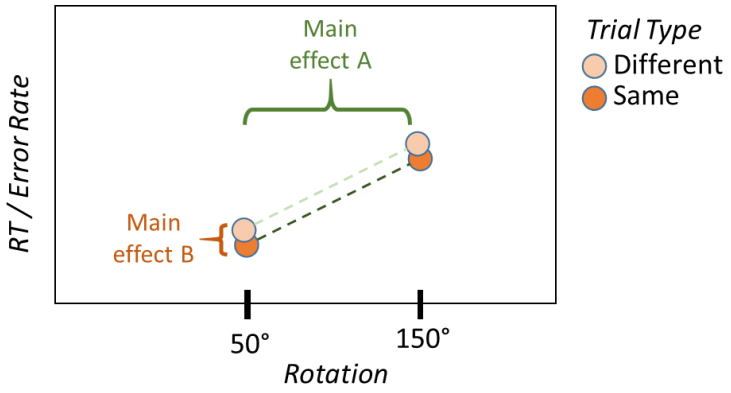
1. *Hypotheses of relationships between variables:*

1.1. Response times increase linearly with the angular disparity between the two objects
1.2. Error rates increase linearly with the angular disparity between the two objects
1.3. Different trial types have longer reaction times than same trial types
1.4. Different trial types have higher error rate than same trial types

Factor B

Factor A

		Trial type		Main effect A
		Same	Different	
Rotation	50°	RT_{ij}	RT_{ij}	$RT_{50°}$
	150°	RT_{ij}	RT_{ij}	$RT_{150°}$
Main effect B		RT_{Same}	$RT_{different}$	



B. Methods

1. *Design*

1. 2 (Trial type: same, different) x 2 (Rotation: 50°, 150°) factorial within-subject design

		Trial type	
		same	*different*
Rotation	*50°*	RT (ER)	RT (ER)
	150°	RT (ER)	RT (ER)

2. Independent variable: *Reaction time (and error rates)*
3. Dependent variables: *Angles (Levels: 50°, 150°) and Trial type (Levels: same, different)*

2. *Planned sample*

[This is here just a rough example of how this section could be filled. It is not so important for us because we will not actually execute this experiment. But you will have to write something like this for your eventual study, which *will* be executed.]

1. Participants of this study will be English-speaking (possibly non-native) adults with normal or corrected-to-normal vision.
2. Participants will be recruited among Cognitive Science Bachelor students of the university of Osnabrück during the summer semester 2019. Participants will be recruited via e-mail announcement with a link that provide participation at the online experiment.
3. We will collect data from as many participants as we can recruit over a period of two weeks.
   - Ideally, we should here justify the so-called planned sample size, e.g., by calculating the number of participants we would need to keep certain types of statistical errors below a reasonable threshold. We will, however, not do this routinely for this course.
4. *Data collection termination rule:* After time limit (two weeks) has been reached.

3. *Exclusion criteria*

1. Describe anticipated specific data exclusion criteria. For example:
   a. Only correct trials go into RT-analysis
   b. Trials are removed from the analyses for each participant if they are not within plus or minus two standard deviations of the mean, calculated for each level of rotation and trial type separately

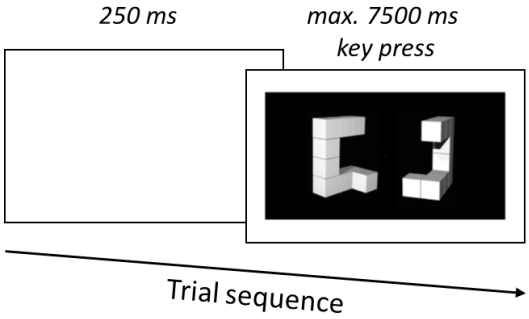
4. *Materials*

- We will use the pictures provided by Ganies & Kievit (2015); see list of stimuli below.
  - Ganis, G and Kievit, R (2015), "A New Set of Three-Dimensional Shapes for Investigating Mental Rotation Processes: Validation Data and Stimulus Set." Journal of Open Psychology Data, 3: e3, DOI: http://dx.doi.org/10.5334/jopd.ai

5. *Procedure*

- Instructions:
  - Participants are shown written instructions about the task. Instructions include a visual example of a trial, illustrating the way the instructions should be followed. Instructions emphasize that participants should strive to optimize speed and accuracy.
- Practice phase:
  - Participants will start by completing 12 practice trials. These will use the 12 designated pictures numbered 13-15 shown below. Pictures are shown in entirely random order (randomized iid for each participant).
  - The practice trials are exactly like the main test trials (see below), except that after each key press feedback is provided as to whether the response was "correct" or "incorrect".
- Main test phase:
  - Trial sequence:
    - Each trial starts with a 250 millisecond (ms) blank screen, after which one of the stimuli is presented until participants respond by pressing one of two buttons, with a time limit of 7500 ms.

- Participants realize 48 trials of the main test pictures (see set of stimuli below). Test items are randomized completely at random (iid for each participant).
- Participants use their dominant hand to respond, pressing the “b” key if they decide that the objects in a pair are the same and the “n” key is they decide the two objects are different.



C. Analysis plan

[We will spell this out later.]

D. List of Stimuli

Total: 48 Main-Stimuli + 12 Test-Stimuli

		Trial type	
		same	*different*
Rotation	*50°*	12x	12x
	150°	12x	12x

Main:

1_50_different

1_50_same

1_150_different

1_150_same

2_50_different

2_50_same

2_150_different

2_150_same

3_50_different

3_50_same

3_150_different

3_150_same

4_50_different

4_50_same

4_150_different

4_150_same

5_50_different

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9_150_different

9_150_same

10_50_different

10_50_same

10_150_different

10_150_same

11_50_different

11_50_same

11_150_different

11_150_same

12_50_different

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12_150_different

12_150_same

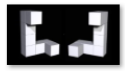
Test:

13_50_different

13_50_same

13_150_different

13_150_same


14_50_different

14_50_same

14_150_different

14_150_same

15_50_different

15_50_same

15_150_different

15_150_same