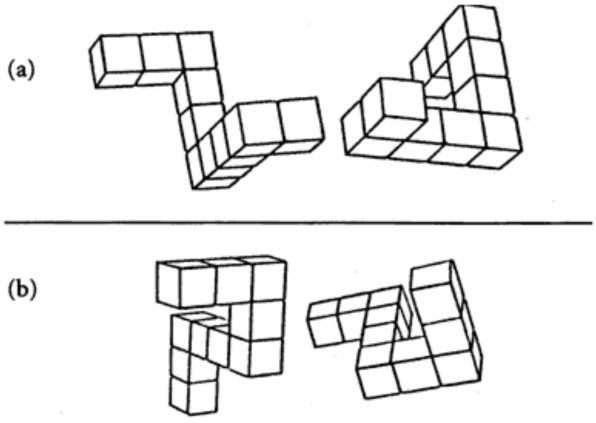
Design for a ”Mental Rotation” experiment

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 shown 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. This entails that the angular disparity between two representations should matter for success and swiftness of judgements of ‘same’ or ‘different’.

Hypotheses

We are here concerned with some specific predictions derivable from this (verbal) theory of mental rotation. In particular, we are going to address the following **research hypotheses**:

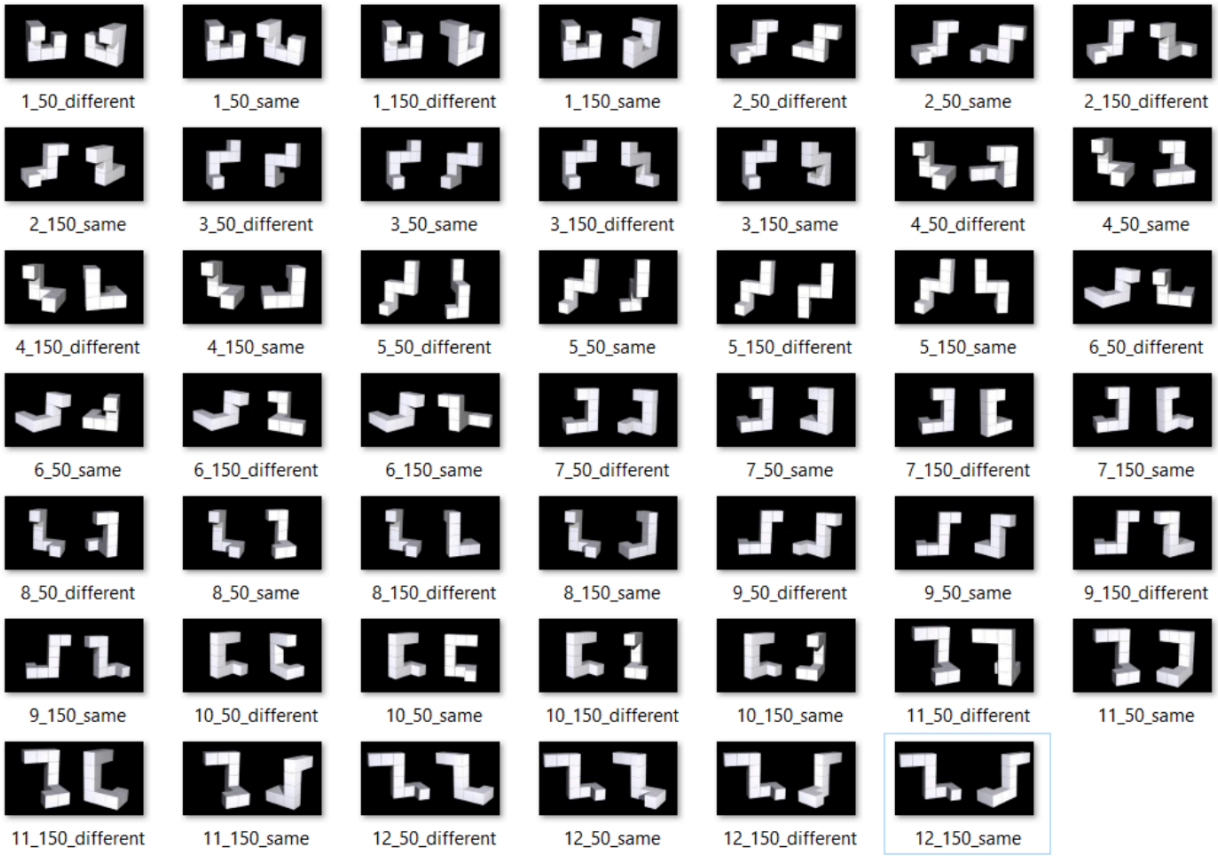
1. Response times increase with the angular disparity between the two objects.
2. Error rates increase with the angular disparity between the two objects.
3. Different trial types have longer reaction times than same trial types.
4. Different trial types have higher error rate than same trial types.

Design

Materials. We will use the pictures provided by Ganies & Kievit (2015). There are 60 in total, 48 of which are used for main trials and twelve pictures for practice trials. Each picture shows two representations of 3-dimensional objects in different spatial orientation (see example above, or the full list below). The representations shown are either of the same or of different objects. The representations in each scene are rotated along the horizontal axis either 50º or 150º, no matter when they are of the same or of different objects. Taking main and test trials together, there are 12

instances of each type of situation, where a situation is a pair of ‘same’ or ‘different’ and the rotation degree 50º or 150º. The full set of the stimuli used in shown below.

Main trials:



Practice trials:

Procedure. The experiment consists of four parts:

(i) introduction & instructions

(ii) practice phase

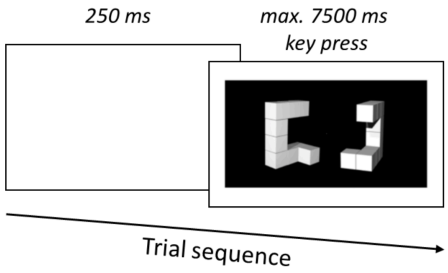
(iii) main test phase

(iv) post-experiment questionaire

First, 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.
Next, during the practice phase participants will get accustomed to the task by completing the twelve practice items shown above. Pictures are shown in random order (randomized on the fly

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”.
After the practice session, the main test phase begins. Each trial is structured as follows (see also picture below):

- Each trial starts with a 250ms blank screen, after which one of the stimuli is presented until participants respond by pressing one of two buttons (“J” of “F”), with a time limit of 7500 ms.
- Participants realize 48 trials of the main test pictures (see set of stimuli above). Test items are presented in a completely random order (shuffled on the fly for each participant).



Finally, the experiment terminates with a post-experiment survey asking participants to optionally supply socio-demographic information and feedback.