Study Information

Title: Mental Rotation: a basic demonstration

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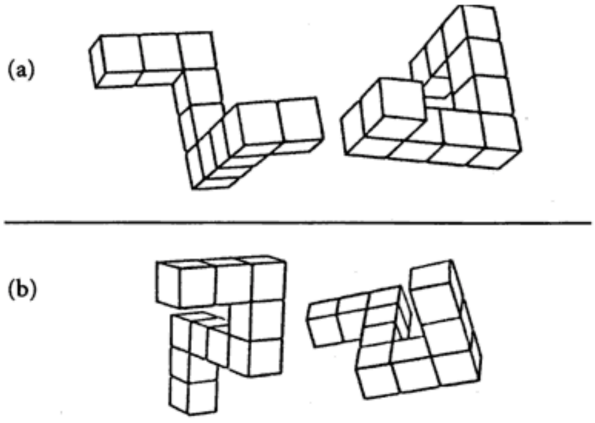
Description (optional):
[NB this is recycled from the previous document "mental-rotation-hypotheses-design"; there is nothing wrong with reusing such material at different stages of the workflow]

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:

1. Response times increase with the angular disparity between the two objects.
2. Error rates increase with the angular disparity between the two objects.

[MF: We had two more hypotheses in the 'design' document. These are preregistered here as 'exploratory' research (all the way at the end), just to give an example of how confirmatory and exploratory testing can both be preregistered formally.]

Design Plan

Study type: Experiment

Blinding: The relevant manipulation is within-participants. Participants are not informed about this manipulation. The experiment is conducted via the internet. No direct contact between experimenters and participants will take place.

Study design: The experiment is within-subjects design with one factor (two levels: angle=50, angle=150). A full description is given in the attached document “design and hypotheses”).

Randomization (optional): All participants see all experimental items, each in completely, *ad hoc* determined random order.

Sampling Plan

Existing data: Data from a previous pilot study (N=36) was available and guided the specification of statistical models.This data is not included in the final analysis. No data from the experiment to be preregistered here was available at the time or preregistration.

Explanation of existing data (optional): Existing data does not enter into future analysis.

Data collection procedures (required): Participants will be drafted through social media and direct email contact. Participation is voluntary but will not be compensated. Every participant is allowed to take part only once. We will wait for 10 days after having sent the initial invitations through social media and email, before closing data collection.

Sample size (required): We are aiming to recruit as many participants as possible.

Sample size rationale (optional): Since our pool of reachable participants is limited and we have no monetary or other incentives to offer, and since time is critical (project deadline) we cannot state a minimum number of participants to draft.
[MF: This is probably what you will (have to) write, but it is actually really bad. Here you should ideally conduct a **power analysis** if this was real research. Although highly recommended that you do this (even if you cannot draft enough participants), you are encouraged to conduct a power analysis if you can. But this is optional, also because a power analysis is a difficult enterprise (especially for state-of-the-art statistical models) and not in the scope of this course.]

Stopping rule (optional): We will stop data collection on midnight of the 10th day after starting the collection through announcements on social media and email.
[MF: This is just an example.]

Variables

M**anipulated variables (optional):** We manipulate the angle of rotation between the two objects shown. This variable, ANGLE, has two values: 50º and 150º of rotation. Concretely, ANGLE will be treated as a 2-level factor with default / reference level 50º.

Measured variables (optional): We measure whether the answer given (objects are identical vs objects are different) was correct or not (binary choice), and the reaction time between trial onset and button press. Concretely, variable RT is a metric variable capturing reaction times; variable CORRECTNESS is discrete, binary variable registering whether the choice of a trial was correct or not with default / reference level 'incorrect'.

Indices (optional): We do not consider any indices.

Analysis Plan

Statistical models: We will run two Bayesian regression models, once with variate CORRECTNESS (wether the given choice was correct or not) and once with variate "T (the reaction time). In each case, the covariate is the factor ANGLE. We use a logistic regression model for binary choice variable CORRECTNESS as covariate.
Our analysis will use the statistical programming language R and rely on the `brms` package. We will use the default (flat) priors of the `brms` package for the effect coefficients.
The attached script "05-mental-rotation-analysis.Rmd" contains the analysis as planned.

Transformations (optional): Not transformations will be applied. Categorical variables will use treatment coding with reference levels as specified above.

Inference criteria (optional): We will use a posteriori credible values for the effect coefficient for factor ANGLE. We judge there to be a credible effect of the manipulation 50º vs 150º if the 95% credible interval of the posterior for the ANGLE:150º coefficient contains only positive values (for the RT analysis; hypothesis 1) and only negative values (for the CORRECTNESS analysis; hypothesis 2).
[MF: This is only one example of how you can test your hypotheses. Ideally, discuss this issue for your specific project.]

Data exclusion (optional): We exclude every participant who completed the whole experiment in less than one minute. We also exclude every individual trial faster than 300 ms and slower than 5000 ms. (See attached analysis script.)

Missing data (optional): Should a data set not be recorded completely, we will use all data available from that participant.

Exploratory analysis (optional): We intend to investigate also the following questions of interest:

3. Trials showing different objects have longer reaction times than trials showing the same object.
4. Trials showing different objects have higher error rates than trials showing the same object.