**Project METATRACE: Metacognition and line tracing task**

Pilot study: feasibility of the task

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**Registration Metadata**

**Title**

Metacognition and line tracing task.

**Description**

This is a pilot study: we want to check the feasibility of the task (is it too easy, too difficult...) and the relevance of our stimuli before starting an experiment.

In this online task, participants will have to trace a figure with their mouse (line tracing task). In each trial, they will see two rectangular panels. In the first panel (the "drawing panel"), participants will move the mouse cursor; the "figure panel" in which there is the figure to retrace and where they will see their mouse movements as they trace the figure.

Participants will obtain a score: the percentage of tracing made within the lines of the figure. Before and after the task, participants will have to predict their score in "percentage of tracing made within the lines". We are interested in the comparison between the predictive judgments (prospective and retrospective) and the actual score. We will also manipulate the difficulty of the task by modifying the thickness of the line of the figure: in the "easy condition", the thickness is 45pixel and in the "hard condition", the thickness is 15pixel. In total, 40 figures (20 of each condition) will be presented in random order. At the end of the task, we will collect demographic data.

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**Subjects**

Psychology, Social and Behavioral Sciences, Cognitive Psychology.

**Tags**

Metacognition.

**Hypothesis**

This is a pre-test: our main objective is to check the feasibility of the task and the relevance of our stimuli. We will be interested in both the first-order performance (how well they manage to draw the figure) and the second-order performance (how well they manage to predict their performance). Our aim is to observe enough variability in performance to make the task relevant (if participants perform all the figures perfectly, they will predict very well on each trial, which is not desirable). In addition, we want to check that the figures we describe as "easy" are indeed easier to reproduce than those we describe as "difficult".

We also expect to observe:

- Main effect of "type of judgment": retrospective judgments will be more precise than prospective judgments

- Main effect of "difficulty": we do not have a directional hypothesis

**Design Plan**

**Study type**

Experiment - A researcher randomly assigns treatments to study subjects, this includes field or lab experiments. This is also known as an intervention experiment and includes randomized controlled trials.

**Blinding**

No blinding is involved in this study.

**Study design**

Within subjects design with two factors:

- Type of judgments: prospective vs. retrospective

- Difficulty of figures: easy vs. hard

**Randomization**

In this study, we present 40 figures in random order.

*The participants have to reproduce them as accurately and quickly as possible with their mouse/touch pad. Before and after copying the figure, participants are asked to predict how successful they think they will be at the task (prospective judgments) or how successful they have been at the task (retrospective judgments).*

**Sampling Plan**

**Existing data**

Registration prior to creation of data: no data have been collected for this study yet.

**Data collection procedures**

Participants will be recruited through advertisements on the website of LPNC (Laboratoire de Psychologie et Neurocognition).

Participants will receive course credit in exchange of their participation (they are students in psychology).

Participants will be at least 18 years old, have a good comprehension of French, have a normal or corrected to normal vision, with no developmental coordination disorder. Participants must run the online experiment on a computer.**Sample size**

Our target sample size is 100 participants for this pretest. We will be recruiting 110 students in order to anticipate the cancellation of some participants.

**Sample size rationale**

We used the software program G\*Power to conduct a sensitivity power analysis.

With 100 participants, we have 80% power to detect an effect size of dz = 0.28 at the standard .05 alpha error probability.

**Variables**

**Manipulated variables**

We manipulate the type of metacognitive judgments. Participants will have to predict their performance before (prospective judgment) and after the task (retrospective judgment).

We also manipulate the difficulty of the task: some figures are easy to reproduce (thickness of the line = 45px) and other are difficult to reproduce (thickness of the line = 15 px).

**Measured variables**

The measured variable is the precision of the metacognitive judgments: the difference between the prediction and the actual score. Participants will have to indicate how much they think they reproduce efficiently the figure (i.e., the percentage of tracing made within the lines of the figure) on a scale of 0-100%. This judgment will be compared with their actual score.

**Indices**

To create a metacognitive score, we will compute a substraction between the predictive judgment (prospective or retrospective) and the actual score for the two levels of difficulty (easy and hard).

We will compute 4 means by participants (one by condition): easy/prospective, easy/retrospective, hard/prospective and hard/retrospective.

**Analysis plan**

**Statistical models**

We will use a 2 X 2 repeated measures ANOVA with both factors within subjects : : Judments (prospective vs. retrospective) and Difficulty (easy vs. hard). These two predictors will be contrast-coded (see below).

We will follow the recommendations of Judd, McClelland, & Ryan (2017) to conduct our analysis.

The models will be specified the following way (lm formula syntax):

lm(W\_judgment ~ 1 , data = dataset\_analysis)

lm(W\_difficulty ~ 1 , data = dataset\_analysis)

lm(W\_interaction ~ 1 , data = dataset\_analysis)

If possible, we will conduct a mixed model analysis with two within-participants factors: Judgments (prospective vs. retrospective) and Difficulty (easy vs. hard). These two predictors will be contrast-coded in the mixed-model.

The model will be specified the following way (lme4 formula syntax):

score ~ 1 + Judgment \* Difficulty +

(1 + Judgment \* Difficulty | Participant) +

(1 + Judgment \* Difficulty | Stimulus)

We will simplify the model following Bates et al. (2015)'s recommendations. More precisely, we will first run the full model, and then we intend to drop every non-significant variance component in order to reach a parsimonious mixed model.

**Transformations**

We are going to use the following coding scheme in order to conduct the ANOVA following Judd, McClelland, & Ryan (2017) recommendations:

W\_judgment = - 1 \* easy\_prospective + 1 \* easy\_retrospective - 1 \* hard\_prospective + 1 \* easy\_retrospective, (for the main effect of "Judgment")

W\_difficulty = - 1 \* easy\_prospective - 1 \* easy\_retrospective + 1 \* hard\_prospective + 1 \* easy\_retrospective, (for the main effect of "Difficulty")

W\_inte = 1 \* easy\_prospective - 1 \* easy\_retrospective - 1 \* hard\_prospective + 1 \* easy\_retrospective, (for the interaction "Judgment\*Difficulty")

**Inference criteria**

We will use the standard alpha = .05 threshold.

**Data exclusion**

The outliers were defined according to two methods, namely (a) participants with a mean deviating by more than 3 standard deviations from the overall mean and (b) participants whose residuals have an SSR > 4 and Cook's d and levers with significant gaps with the other participants.

All the training responses will also be excluded of the analysis.

**Missing data**

If a participant do not answer to all of the trials, his/her data will be excluded.

**Exploratory analysis**

We expect that certain demographic variables may be related to metacognitive judgments. Therefore, we will look for relationships between demographic variables (age, gender, laterality) and the measure.

**Other**

Our task (coded in javascript and html) is freely inspired by the one used in the following article:

Cusack M, Vezenkova N, Gottschalk C, Calin-Jageman RJ. 2015. Direct and Conceptual Replications of Burgmer & Englich (2012): Power May Have Little to No Effect on Motor Performance ed. J.M. Haddad. PLoS One 10: e0140806. PMID: 26536592. http://dx.plos.org/10.1371/journal.pone.0140806.