## Design

The purpose of this research is to establish motion tracking as a better measure for unconscious processing (specifically semantic priming) when compared with keyboard response.

To do so we use a priming paradigm:

The prime and target are words describing natural / artificial items.

They can be either **congruent (same word**, e.g., prime=RADIO, target=radio) or **incongruent (Prime is a different word from a different category**, e.g., prime=CLOUD, target=radio).

The subject is asked to classify the target as natural / artificial.

In the keyboard condition the subject responds using a keyboard, while in the motion tracking condition the subject responds by touching the correct answer on the screen while we track his finger's location.

Then the subject is asked to recognize the prime between two possible words,

And finally rate the visibility of the prime.

The number of trials for each subject will range between 240 - 480 for each measure (the final number hasn't been decided yet).

As can be understood, this is a within-subject design, so each subject performs both congruent and incongruent trials with each of the measures (keyboard / motion tracking).

Diagram

Description automatically generatedGraphical user interface

Description automatically generated

**Congruent:** same word

**Incongruent:** different word from a different category.

## Extracted parameters

We ran 3 pilot studies that included solely motion tacking. The future experiment will also include keyboard response.

The analysis of the pilots is exploratory so we wish to see this effect in any of the parameters we extract from the subject's motion.

We tracked the subject's movement trajectory and extracted multiple movement parameters from it (velocity, trajectory…).

When analyzing these parameters we look for a congruency effect: significant difference between the congruent condition and the incongruent condition.

Since each subject has a different number of valid trials, we tried using a mixed model with subject as a random factor.

The extracted parameters and their current results are:

#### Trajectory

Chart, diagram

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**Average of all subjects:**

Diagram

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#### X Deviation

Deviation from the center line on the X axis, at each point along the Z axis.

X deviation is marked with blue arrows below.

200 values for each trial.

Diagram

Description automatically generated

Model of "x deviation" with congruency as a independent variable and subject as a random factor.

A model was created for each point along Z index and their p-values are displayed below:

Reaches to the left target are displayed separately from those to the right one.

(Exp 2)

Chart

Description automatically generated

Chart, surface chart

Description automatically generated

#### Reach area

The area circumscribed by the average left trajectory and the average right trajectory.

Single value for each subject.

Diagram

Description automatically generated

Diagram

Description automatically generated

**Paired t test result:**

Chart

Description automatically generated

Avg reach area when using subjects as a random factor in Exp 2:

(plotted to see if subject should be sed as a random factor)

Chart, box and whisker chart

Description automatically generated

Modeling reach area in a LMM with subject as a random factor:

Text

Description automatically generated

Text

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Paired t-test = random effect

#### MAD

MAD = Maximal absolute deviation.

The biggest distance from the optimal path.

("optimal path" = the shortest path from the starting point to the target)

A single value for each trial.

Diagram

Description automatically generated

#### AUC

Area circumscribed by the "optimal path" and the actual path.

There are 2 versions:

* Use only the area that exceeds the optimal path towards the unselected answer.
* Area that exceeds the optimal path towards the unselected answer is considered positive, while area that exceeds towards the selected answer is considered negative.

A single value for each trial.

Diagram

Description automatically generated

### Questions

Are in Trello 🡪 Exp 4 – PreReg 🡪 Consultation with statistics center.

And:

1. **What effect size parameter should be used in a mixed model?**  
   Papers that might include an answer:  
   [Power Analysis and Effect Size in Mixed Effects Models: A Tutorial](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6646942)  
   [Statistical power and optimal design in experiments in which samples of participants respond to samples of stimuli](https://psycnet.apa.org/doiLanding?doi=10.1037%2Fxge0000014)  
   [A practical guide to calculating Cohen’s f2, a measure of local effect size, from PROC MIXED](https://www.frontiersin.org/articles/10.3389/fpsyg.2012.00111/full)  
   [Mixed Models: Testing Significance of Effects](https://www.ssc.wisc.edu/sscc/pubs/MM/MM_TestEffects.html)

1. **Is it comparable to Cohen's dz?**  
   We would like to compare it to previous papers and also to a keyboard condition in our experiment.
2. How can we statistically compare effect sizes?

Graphical user interface, text, application

Description automatically generated

1. **Do you need multiple observations in order to use subject as a random factor?**  
   We wish to do so since each subject has a different number of valid trials.  
   Articles that might include an answer:  
   [Mixed model with 1 observation per level](https://stats.stackexchange.com/questions/65371/mixed-model-with-1-observation-per-level)  
   [How will random effects with only 1 observation affect a generalized linear mixed model](https://stats.stackexchange.com/questions/242821/how-will-random-effects-with-only-1-observation-affect-a-generalized-linear-mixe)
2. If so, assuming our observation represents an average of some trials, **is it valid to use bootstrapping and average different trials each time to generate data for the LMM?**
3. **What is the best way to correct for multiple comparisons when looking for a congruency effect in the trajectory itself (has 200 samples)?**
4. **What assumptions should the data keep in order to use LMM?**
5. **How do you perform power analysis (sample size estimation) for LMM?**  
   [Power analysis and effect size in mixed effect models: a tutorial](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6646942/)  
   [Mixed Models: Testing Significance of Effects](https://www.ssc.wisc.edu/sscc/pubs/MM/MM_TestEffects.html)  
   [A practical guide to calculating Cohen’s f2, a measure of local effect size](https://www.frontiersin.org/articles/10.3389/fpsyg.2012.00111/full)  
   [Online calculator for power analysis in LMM](https://jakewestfall.shinyapps.io/crossedpower/)  
   [Using simulations to conduct power analysis in LMM](https://besjournals.onlinelibrary.wiley.com/doi/10.1111/2041-210X.12504)  
   [Tutorial on power analysis in LMM](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6646942/)
6. **Should we use non-parametric power analysis** since our power analysis will be based on a pilot with 20 subjects.  
   It might have 10 subjects if we base it on exp 2.
7. When doing power analysis, does it matter that we have only 10 participants in our pilot? It’s a small number.