### Study Information

1. Title:  
   Inhibition of manual gestures by salient distractor stimuli
2. Authors:  
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3. Description   
   In this project, we want to estimate the effect size and variability of the inhibition of hand movements through salient distractors in the environment. We will conduct an online study with two tasks that are known to elicit saccadic inhibition, adapted for hand movements.
4. Hypotheses  
   After a salient distractor was shown, the rate of hand movement drops relative to trials where no distractor was shown.   
   After changes of the display configuration, the rate of hand movements drops relative to trials where the configuration does not change, but the effect is smaller than the effect for salient distractors.

### Design Plan

1. Study type
   1. Experiment
2. Blinding
   1. Participants are not aware of the effect we measure in the study but are aware of the manipulations (salient distractors and display arrangement changes). Each participant will be tested in all conditions of this experiment. The experimenter will not be blinded towards which data was generated by which condition.
3. Study design (required)
   1. We will run two tasks – both tasks have 2 factors of interest that are manipulated – flashes and configuration changes – and one continuous independent variable: the time at which flashes and/or display changes happened. The tasks are described in detail below.
   2. *Task 1 – Jump:* Participants start by placing their index finger on a central dot on the screen. After a delay between 200 and 1000ms, this dot jumps to the left or to the right of the screen. This jump is the “go” signal. Participants must touch the jumped dot as quickly as possible. At a random time up to 100ms after the “go” signal a visible or invisible configuration change happens. Visible configuration changes are additional jumps of the target dot, either towards the center of the screen or outwards. At the same time, a visible or invisible flash appears in the upper and lower part of the screen. The visibility of flashes and configuration changes are independent of each other. We instruct participants to ignore the flashes and to adapt their response to the configuration changes without slowing down. The task is successfully completed if participants made a touch response within 100 – 500ms after the go signal and landed within a 150 pixels radius around the target.

* 1. *Task 2 – Serial:* Participants have to collect a series of 6 dots from left to right as fast as possible. On average, the dots are spaced apart by 80 pixels horizontally and are aligned vertically to the center of the screen. On every trial, a random jitter between -20 and 20 pixels is added to both the horizontal and vertical component of each individual dot. The trial starts when the first dot was touched. After a delay of up to 700ms from the start, a visible or invisible configuration change happens. During visible configuration changes, the random jitter assigned to each dot changes such that the dots jump to a different location. At the same time, a visible or invisible flash appears in the upper and lower part of the screen. The visibilities of flashes and configuration changes are again independent. The task is successfully completed, when all 6 dots are collected in the correct order within 1.5 seconds. Dots that were touched disappear from the display.

1. Randomization
   1. For each task, we create a list of parameters for every single trial. This list includes the same number of trials for each experimental manipulation (specified in section ‘manipulated variables’). The trials are run in randomized order. We will counter-balance the order in which the two tasks were run by first collecting half of the data with one task order (task 1, task 2) and then collecting the second half of the data with the inverse task order (task 2, task 1), excluding participants who already participated in the first study.

### Sampling Plan

1. Existing data
   1. Registration prior to creation of data: As of the date of submission of this research plan for preregistration, the data have not yet been collected, created, or realized.
2. Data collection procedures
   1. We will recruit participants through the platform prolific. We will screen them for normal vision and known reliable participation in other online experiments (>75% valid submissions). We will require them to speak English fluently (to make sure they’ll understand the instructions). We will not restrict any other parameters. Prolific is available for participants in OECD countries (i.e. Europe, Japan, Australia, North America). The duration of the experiment is estimated to be 40 minutes, participants will be paid 6.30€ (5.4£) for their participation.
3. Sample size (required)
   1. We will collect data from 20 participants (10 for each task order). In task 1, we will collect 192 data points (48 trials per condition of interest). In tasks 2, we will collect 200 data points (50 trials per condition of interest).
4. Sample size rationale (optional)
   1. We chose the number of individual trials per task such that each task would last ~15 minutes and all conditions were counterbalanced. The number of subjects was chosen based on the number of subjects we would usually recruit for a psychophysical study (~10) and doubled, because of shorter duration of the task compared to lab-based experiments and unknown variability of the task.
   2. Please note that the aim of this study is to estimate the effect size and standard deviation to determine the sample size for a follow-up study.

### Variables

1. Manipulated variables (optional)
   1. *Task 1 – Jump:*   
      Manipulated variables of interest:

Flash

*Flash visible:* The upper and lower part of the screen turn white for 50ms, producing a short and salient flash. (50% of all trials)

*Flash invisible:* The upper and lower third of the screen display a fully transparent flash for 50ms. This is invisible to the observer. (50% of all trials)

Configuration change

*Change visible:* The position of the jumped dot is reassigned to a new position, 50 pixels left or right to its current position. (50% of all trials)

*Change invisible:* The position of the jumped dot is reassigned to its current position. This is not perceived by the observer. (50% of all trials)

Flash/Change onset

The onset of the above changes is drawn randomly from a uniform distribution between 0 – 100ms after the “go” signal in the task.

Manipulated variables that are not of interest:

Direction of the initial jump

The initial jump could be either to the left (50% of all trials) or to the right (50% of all trials) of the screen relative to the central fixation point.

Direction of the configuration change

The configuration change can happen in the same direction as the first jump (towards the border or the screen – 50% of trials with a configuration change), or in the opposite direction (towards the screen center – 50% of trials with a configuration change).

* 1. *Task 2 – Serial*

Flash

*Flash visible:* The upper and lower part of the screen turn white for 50ms, producing a short and salient flash. (50% of all trials)

*Flash invisible:* The upper and lower third of the screen display a fully transparent flash for 50ms. This is invisible to the observer. (50% of all trials)

Configuration change

*Change visible:* Each dot on the screen is replaced by a dot with a different randomly drawn jitter added to the mean location. These changes will only be noticeable in points that have not yet been touched. Touched disappear and remain invisible during a configuration change. (50% of all trials)

*Change invisible:* Each dot on the screen is replaced with a dot with the same location as the initial dot. This results in not visible change to the observer. (50% of all trials)

Flash/Change onset

The onset time ranges between 0 and 700ms. To make sure that the full range between 0 and 700ms is covered even with a low number of trials, we create 10 equally sized time bins over this interval. For every trial, the onset time is drawn from a uniform distribution across one of these time bins. Each bin is sampled from in 10% of all trials.

1. Measured variables (required)
   1. X & Y coordinates of each touch onset
   2. X & Y coordinates of each touch offset
   3. X & Y coordinates of elements on the screen (these are defined by us, but we measure them online, too)
   4. Timestamps of touch onsets
   5. Timestamps of touch offsets
   6. Timestamps of events (like flashes)
   7. Technical specifications of the used devices (platform, device, pixel depth, color depth, screen orientation, screen width & height, screen resolution)

### **Analysis Plan**

You may describe one or more confirmatory analysis in this preregistration. Please remember that all analyses specified below must be reported in the final article, and any additional analyses must be noted as exploratory or hypothesis generating.

A confirmatory analysis plan must state up front which variables are predictors (independent) and which are the outcomes (dependent), otherwise it is an exploratory analysis. You are allowed to describe any exploratory work here, but a clear confirmatory analysis is required.

1. Statistical models (required)
   1. To check the quality of the data, we will use ordinary least squares linear regression analysis to see if the position of elements on the screen predicts the position of participants’ responses.
      1. For the *Jump* task, we will compute the model only for the x-coordinate of the response (because the y-coordinate is the same for every element on the screen). We will use the x coordinate of the target after the configuration change. The model we will compute will be:

x position (touch response) = a + b \* x position (dot on screen)

* + 1. For the *Serial* task, we will compute two models – one to predict the x position of the response, and one to predict the y position of the response. We will use only data from trials where the configuration has not changed. Those two models are formulated as:

x position (touch response) = a + b \* x position (dot on screen)

y position (touch response) = a + b \* y position (dot on screen)

* + 1. The intercepts (a) and slopes (b) will be fitted using the OLS function in the python library “statsmodels” (<https://www.statsmodels.org/stable/generated/statsmodels.regression.linear_model.OLS.html>)
    2. The OLS linear regression as implemented in the statsmodels computes t-tests for each parameter of the model. We will use the p-statistics for the slope to make an inference about the significance of the slope with an alpha level of 0.05.
  1. To compute the effect size, variability and the number of participants needed for a power level of 0.8 in the planned follow-up study, we will compute the difference between movement rates after visible and invisible flashes (collapsed across configuration changes). At the maximum value of the difference curve we will compute effect size and variance. We will use the TTestPower( ) function from statsmodels to compute the needed sample size (https://www.statsmodels.org/stable/generated/statsmodels.stats.power.TTestPower.html). TTestPower() performs a paired samples t-test.
  2. We expect the configuration change to also impact the movement rate in a similar way as the salient distractor. If the above analysis shows that more than 200 subjects would be needed for a statistically significant effect, we will repeat the analysis above, contrasting the movement rates between trials where both the distractor and the configuration change were visible and those where both were invisible.

1. Transformations (optional)
   1. We will center the coordinates of all responses and elements to the center of the screen.
   2. We will collapse responses across left and right targets in *Jump* tasks by taking the absolute value of the distance from the screen center.
   3. In *Serial* tasks, we will collapse responses across all dots on the screen. We will mean-center all dots to the average location at the respective position in the series. The same logic will be applied to touch responses – they will be mean centered to the average touch response on the respective position in the series.
2. Inference criteria (optional)
   1. We will use the p<0.05 criteria to determine if the slopes of our linear regression models are significant.
   2. For the power calculation, we will equally use a p-value of 0.05 and statistical power of 0.8.
3. Data exclusion (optional)
   1. We will exclude participants when:
      1. They report that they have been unconcentrated during the experiment.
      2. They report that they have used a different finger then their index finger. (Exceptions from this rule can be made for participants who don’t have an index finger).
      3. Their touch responses were not predicted from the location of elements on the screen (there was no significant, positive slope in the linear regression models).
4. Missing data (optional)
   1. When participants fail to complete the study, we will collect another data set. The data will only be analyzed once we have 20 datasets. Incorrect trials will be repeated during the experiment, thus there should be no missing data in the completed data sets.
   2. Individual trials will be excluded if the end point of the touch response deviates by more than 3 standard deviations from the average response.
5. Exploratory analysis (optional)
   1. We expect an influence of the flash on the precision of responses when the display configuration changed along with the flash. However, we have no specific hypothesis as to when and how fast this effect will occur. We will explore the collected dataset in that direction to generate a testable hypothesis that will be strictly tested in the follow-up study.
   2. We also expect that the configuration change itself will elicit

**Other**

1. Other (Optional)
   1. The full data quality check and analysis plan is implemented here:

The author has collected the data used for the implementation of this notebook on herself. The data will not be included in the analysis of the data.