Testing Framework Protocol

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ABSTRACT

This protocol describes a method to test experimental setup in cognitive neuroscience

MATERIALS

Photodiode

5.1 Number of tested events conditions

Note

Conditions here refer to any unique combination of experimental conditions in case of nested designs. If presented stimuli are of different categories (e.g. faces and objects) and presented in different contexts (e.g. task relevant and irrelevant), a condition would be 'stimulus of a given category in a given context' (i.e. task relevant faces and task irrelevant faces are interpreted as two different conditions)

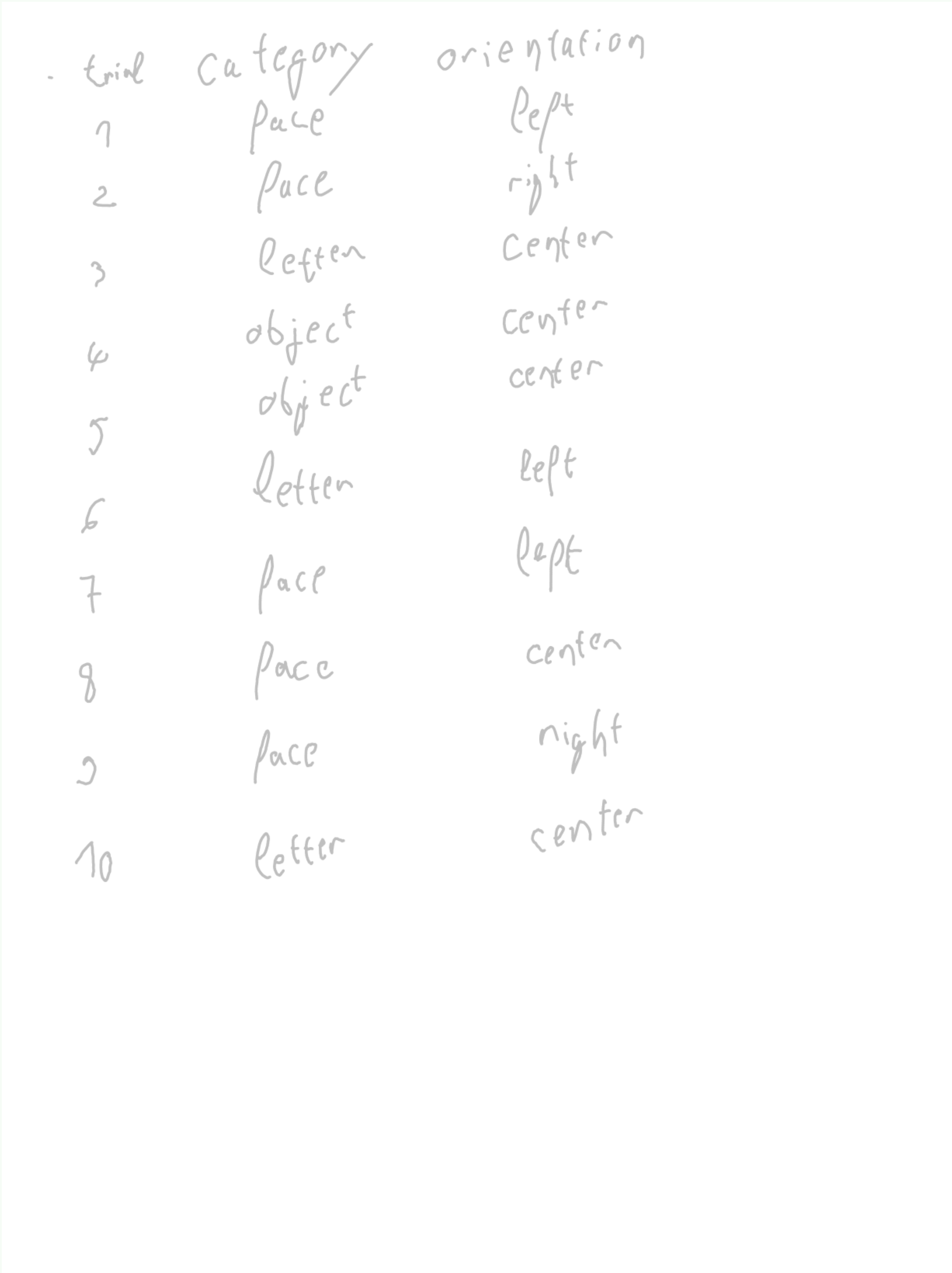
Required

M = 20

5 Describe method used to test:

Note

The experimenter ran the experiment in the exact same way it would have run for a subject. As the experiment progressed, the experimenter noted down all features of each stimulus being presented in the order they were presented. Each noted event was compared to the log file to ensure that logging was correct.



trial	category	orientation
1	face	left
2	face	right
3	letter	center
4	object	center
5	object	center
6	letter	left
7	face	left
8	face	center
9	face	right
10	letter	center

Example of notes that can be taken during the experiment. Importantly, each feature of the presentation relevant to the experiment should be noted

5.2 Number of tested events per condition:

Required

N = 5

7 Describe method used to test:

Note

A black square (RGB: 0, 0, 0) was turned to white (RGB: 255, 255, 255) on the bottom right corner of the screen for 3 frames on the exact same frame as an event was displayed and then turned back to black. A photodiode device was placed on top of this square and the signal was recorded to a file.

7.1 Select threshold k for binarization:

k = 0.18

7.7 Compute and report the log file average timing inaccuracies (μ)
$\mu(\Delta_{log} - \Delta_{photo})$

Required

mu = 0.0

1 Adjust the experiment scripts to conduct the testing protocol

7.2 Binarize the signal:
$y_{bin} = x > k$
Where x is the recorded signal

7.4 Detect event observed onset (t_{photo}):
$t_{photo} = y_{diff\ i} = 1, for\ i = 1:n$

7.5 Compute Δ_{photo}:
$\Delta_{photo} = t_{photo\ k+1} - t_{photo\ k}, for\ k = 1:n$
Where n is the number of detected photodiode events

7.6 Compute Δ_{log}:
$\Delta_{log} = t_{log\ k+1} - t_{log\ k}, for\ k = 1:n$
Where t_{log} is the log file time stamp of all events (n) in the log file

11 Peripherals that will be used to collect data during the experiment should be tested and reported according in the step case below.

12 The experiment was conducted entirely while recording data on the Eyetracker. For each event, a trigger was sent from the experimental computer to the device's computer to identify each event's content as well as timing. The triggers' timing accuracy was computed by comparing them to the photodiode. The triggers' content accuracy was computed by comparing them to the log file event content.

12.1 Compute finite difference of each Eyetracker trigger time stamp $Device_t$:
$\Delta_{ET} = t_{ET\ i+1} - t_{ET\ i},\ for\ i = 1:n$

12.2 Compute and report the device triggers average timing inaccuracies (μ):
$\mu(\Delta_{ET} - \Delta_{photo})$

Required

mu =

Where Δ_{photo} is the finite difference of photodiode onsets computed in step 3.4

12.3

Compute the log file file timing inaccuracies standard deviation (σ)
$\sigma(\Delta_{ET} - \Delta_{photo})$

Required

sig =

12.4

Compare the $ET_{triggers}$ information to the log file using scripted test

Note

All triggers recorded in one run of the experiment should be parsed and automatically compared to the information stored in the log file. All events in one run should therefore be tested.

12.5

Tested events counts (should be equal to the total number of events in one experimental run):

Required

N =

12.6

Confirmation that the test was performed and that no discrepancies remain (between the logged responses and the planned response sequence)

Required

I hereby confirm that the test was conducted and that no discrepancies remain

12

The experiment was conducted entirely while recording data on the EEG system. For each event, a trigger was sent from the experimental computer to the device's computer to identify each event's content as well as timing. The triggers' timing accuracy was computed by comparing them to the photodiode. The triggers' content accuracy was computed by comparing them to the log file event content.

12.1

Compute finite difference of each EEG trigger time stamp EEG_t:
$\Delta_{EEG} = t_{EEG\,i+1} - t_{EEG\,i}, for\ i = 1:n$

12.2

Compute and report the device triggers average timing inaccuracies (μ):
$\mu(\Delta_{EEG} - \Delta_{photo})$

Required

mu =

Where Δ_{photo} is the finite difference of photodiode onsets computed in step 3.4

12.3

Compute the log file file timing inaccuracies standard deviation (σ)
$\sigma(\Delta_{EEG} - \Delta_{photo})$

Required

sig =

9.1 Select threshold k for binarization:

0.1 Select threshold k for binarization.

k =

0.2 Binarize the signal:

$S_d = Signal_n < k, for\ n = 1 : n\_samples$

Where $Signal_i$ is the recorded signal

0.3 Detect event observed onset ($Photo_{onset}$):

$Photo_t = n | S_d[n] = 1, for\ n = 1 : n\_samples$

0.4 Compute δ_{photo}:

$\delta_{photo} = Photo_{t\ i} - Photo_{t\ i-1}, for\ i = 1 : n\_events$

0.5 Compute δ_{log}:

$\delta_{log} = Log_{t\ i+1} - Log_{t\ j}, fori\ \ = 1 : n\_events$

Where Log_t is the log file time stamp of a given event t

0.6 Compute and report the log file average timing inaccuracies (μ)

$\mu(\delta_{log} - \delta_{photo})$

Required

mu =

0.7 Compute and report the log file timing inaccuracies standard deviation (σ)
$\sigma(\delta_{log} - \delta_{photo})$

Required
sig =

0.3 Tested events counts:

Expected result
N=

0.1 Compute the log file file timing inaccuracies standard deviation (σ)
$\sigma(\delta Device - \delta photo)$

Expected result
$\sigma =$

0.2 Compare the $Device_{triggers}$ event content and the Log file:

0.4 Incorrect trigger event content count:

Expected result
0

2 Create a pre-defined response sequence to be executed during the test run to compare against the log file to identify any log file issues. The event sequence must sample all possible answers, as well as unexpected button presses to assess the robustness of the experiment.

3 Prepare for a test run:

1.1 Present a black square on a corner of the screen that switches to white on the same frame as the stimulus onset and then turns back to black after three frames.

1.2 Add functionality to record sound from a microphone during the execution of the experiment to record button presses - "click" sounds - to assess response box latencies.

3.1 Attach a photodiode recording device (see material) over the displayed black/white square flashed upon stimulus onset and record the measured voltage to a file for later processing

3.2 Place a contact microphone (see materials) on the response devices used to record the sound made by button presses and ensure quietness in the room (avoid speaking, opening/closing doors, etc.) to facilitate later processing stages

3.3 Prepare to take notes of the presented events on the screen for assessing logging content accuracy. In the case of a fast paced experiment, set up a camera to capture the screen for slow paced annotations of events presentation.

12.4 Compare the $EEG_{triggers}$ information to the log file using scripted test

Note

All triggers recorded in one run of the experiment should be parsed and automatically compared to the information stored in the log file. All events in one run should therefore be tested.

12.5 Tested events counts (should be equal to the total number of events in one experimental run):

Required

N =

12.6 Confirmation that the test was performed and that no discrepancies remain (between the logged responses and the planned response sequence)

Required

I hereby confirm that the test was conducted and that no discrepancies remain

12 The experiment was conducted entirely while recording data on the MEG system. For each event, a trigger was sent from the experimental computer to the device's computer to identify each event's content as well as timing. The triggers' timing accuracy was computed by comparing them to the photodiode. The triggers' content accuracy was computed by comparing them to the log file event content.

12.1 Compute finite difference of each EEG trigger time stamp MEG_t:
$\delta_{MEG} = MEG_{t\ i-1} - MEG_{t\ i}, for\ i = 1 : n\_events$

12.2 Compute and report the device triggers average timing inaccuracies (μ):
$\mu(\delta_{MEG} - \delta_{photo})$

Required
mu =

Where δ_{photo} is the finite difference of photodiode onsets computed in step 3.4

12.3 Compute the log file file timing inaccuracies standard deviation (σ)
$\sigma(\delta MEG - \delta photo)$

Required
sig =

12.4 Compare the $MEG_{triggers}$ information to the log file using scripted test

Note

All triggers recorded in one run of the experiment should be parsed and automatically compared to the information stored in the log file. All events in one run should therefore be tested.

12.5 Tested events counts (should be equal to the total number of events in one experimental run):

Required
N =

12.6 Confirmation that the test was performed and that no discrepancies remain (between the logged responses and the planned response sequence)

Required
I hereby confirm that the test was conducted and that no discrepancies remain

4 The visual angle of each stimulus of interests was tested using by measuring the size of the stimulus presented on the screen with a ruler. The size of each stimulus was converted to degrees of visual angle using this converter: **https://www.sr-research.com/visual-angle-calculator/** with the participant's expected distance from the display. The eccentricity was computed using the same converter (if applicable).

4.3 Distance between participant nasion and screen

Required
d (cm)

60

4.4 Measured stimuli sizes (if more than one, comma separated)

Required
Expected width (d.v.a.)

6.0

Required
Measured width(d.v.a)

6.01

Required
Expected height (d.v.a.)

6.0

Required
Measured height (d.v.a)

6.01

4.5 Eccentricity (if more than one, comma separated)

Required
Expected horizontal offset (d.v.a.)

0

Required
Measured horizontal offset (d.v.a.)

0

Required
Expected vertical offset (d.v.a.)

0

Required
Measured vertical offset (d.v.a.)

0

8 The experiment was conducted entirely while a human actuator executed a pre-defined sequence of button presses. Each press content and timing was saved in the log file. In addition, a contact microphone was located close to the keys to be pressed and recorded on the experimental computer. The response devices' latencies were computed as the difference between the detected onset of button press in the response device and the recorded and parsed sound file.

8.1 Select threshold k for binarization:

k =

100

8.2 Binarize the signal:
$y_{bin} = x_{audio} > k$
Where x_{audio} is the recorded audio signal containing the button presses sounds

8.5 Compute Δ_{audio}:
$\Delta_{audio} = t_{audio\,k+1} - t_{audio\,k},\ for\ k = 1:n$

Where n is the number of detected audio events

8.6 Compute Δ_{log}:

$\Delta_{log} = t_{log\ k+1} - t_{log\ k}, for\ k = 1 : n$

Where t_{log} is the log file time stamp of response events (n) in the log file

8.7 Compute and report the log file average timing inaccuracies (μ)

$\mu(\Delta_{log} - \Delta_{audio})$

Required

mu = 0

8.8 Compute and report the log file timing inaccuracies standard deviation (σ)

$\sigma(\Delta_{log} - \Delta_{audio})$

Required

sig = 0.004

6 The experiment was conducted entirely while a human actuator executed a pre-defined sequence of button presses. Each press content and timing was saved in the log file. In addition, a contact microphone was located close to the keys to be pressed and recorded on the experimental computer. The response devices' latencies were computed as the difference between the detected onset of button press in the response device and the recorded and parsed sound file.

6.1 Compare the logged response description against the planned response sequence. An inaccurate response logging would be identified as a discrepancy between the two, such as the log file recording a response as "No" when in fact the button mapped to the "Yes" logging was pressed for example. Such issues must be addressed before data collection and the report i below must be 0.

6.2 Number of tested responses types:

Required

M =

3

6.3 Number of tested responses per response types:

Required

N =

5

6.4 Confirmation that the test was performed and that no discrepancies remain (between the logged responses and the planned response sequence)

Required

I hereby confirm that the test was conducted and that no discrepancies remain

True

5.3 Confirmation that the test was performed and that no discrepancies remain

I hereby confirm that the test was conducted and that no discrepancies remain

True

7.8 Compute and report the log file timing inaccuracies standard deviation (σ) $\sigma(\Delta_{log} - \Delta_{photo})$

Required

sig =

0.003

7.3 Compute discrete difference on the binarized photodiode signal:

$y_{diffi} = y_{bin\,i+1} - y_{bin\,i}, for\ i = 1 : n$

Where n is the number of samples in the signal

8.3 Compute discrete difference on the binarized audio signal:

$y_{diffi} = y_{bin\,i+1} - y_{bin\,i}, for\ i = 1 : n$

Where n is the number of samples in the signal

8.4 Detect event observed onset (t_{audio}):

$t_{audio} = y_{diff\,i} = 1, for\ i = 1 : n$

4.1 Obtain Screen Height and Width in pixels

Required

Screen height (px)

1920

Required

Screen width (px)

1080

4.2 Measure screen height and width in cm

Required

Screen height (cm)

33.78

Required

Screen width (cm)

56.9

9 Test Experiment counter-balancing

9 Test Experiment counter-balancing

Describe method used to test:

Note

To test that the expected counter-balancing was correct, the total number of trials and the number of trials per condition in a full experimental run were counted based on the log file and compared to the expected number of trials according to the experimental design

9.1 Total number of trials

Required Expected number of trials (total)	40
Required Observed number of trials (total)	40

10 Test observed stimulus duration against the expected stimulus duration

Describe the method used:

Note

To test the observed duration of the stimuli against the expected duration, we compared the duration of each stimulus calculated based on the photodiode recording against the expected duration stored in the log file.

9.2 Number of trials per condition

Required
Number of conditions

4

Required
Expected number of trials (per condition)

10

Required
Observed number of trials (per condition)

10

10.1 Compute observed stimulus duration:
$Obs\ Duration_{\ k} = t_{offset\ k+1} - t_{onset\ k},\ \ for\ k = 1 : n_{\ trial}$

10.2 Compute and report the mean difference between observed and expected (μ):
$\mu(ObsDuration - Planned\ duration)$

Required
mu =

0.0

10.3 Compute and report the standard deviation of the difference between observed and expected (μ):
$\sigma(ObsDuration - Planned\ duration)$

Required
sig =

0.003