**SFU Religious Study: Summary of Experimental Setup**

Version 4.0

Aug 1, 2024

Main computer task (participant completes this for both MRI and MEG scan):

1. **\*\*Stimulus Types and Images:\*\***

- 4 types of stimulus images:

- God

- Humans

- Supernatural beings (“super” for short)

- Inanimate objects (“inan” for short)

|  |  |
| --- | --- |
| MEG set up | MRI set up |
| 35 images for each category (i.e. 35 God images, 35 supernatural images, 35 humans, 35 inanimate objects  - total number of trials for each MEG scan: 420 trials  - One MEG scan psychopy slide run has 3 “sessions”. Each session contains 140 trials. For each session, 35 images from each category are shown in randomized order. Each image is randomly linked to one of three question types (for more information on questions asked, please see below).  Number of times each question slide shows up in each session is randomized.  One trial = question slide (1 second) + image stimulus slide (2.5 seconds) + fixation cross (timing duration randomized between 1.0 to 1.2s) | 18 images for each category (i.e. 18 God images, 18 supernatural, 18 humans, 18 inanimate objects)  - total number of trials for each MRI scan: 216 trials  - One MRI scan psychopy slide run has 3 “sessions”. Each session contains 72 trials. For each session, 18 images from each category are shown in randomized order. Each image is randomly linked to one of three question types (for more information on questions asked, please see below).  Number of times each question slide shows up in each session is randomized.  One trial = question slide (1 slide) + image stimulus (2.5 seconds) + fixation corss (timing duration randomized for either 3s, 5s, or 10s). |

A painting of a person holding a hammer

Description automatically generated “God” image stimulus

A person with smoke coming out of their face

Description automatically generated with low confidence “Supernatural” image stimulus

A picture containing human face, person, person, eyebrow

Description automatically generated “Humans” image stimulus

A cartoon of a robot

Description automatically generated with low confidence “Inanimate Thing” image stimulus

2**. \*\*Questions:\*\***

- 3 types of questions (same for MRI and MEG scan)

Questions are:

|  |  |
| --- | --- |
| **Full question** | **Shortened Question slide** |
| "To what extent do you think the thing in the picture has (mind) thoughts/feelings/beliefs?” | Extent of MIND? |
| "To what extent do you think that the thing in the picture is a source of morality?” | source of MORALITY? |
| "To what extent do you feel an emotional connection to the thing in the picture?” | extent of CONNECTION? |

We have 4 image categories: god, super, humans, things

Each image stimulus is randomly linked (“paired”) to one of 3 questions.

For each question, participant is instructed to give an answer on a 1-4 rating scale where 1 is NONE and 4 is HIGH.

|  |  |
| --- | --- |
| **Participant button press** | **Psychopy records button press in MEG** |
| 1 | 0 |
| 2 | 1 |
| 3 | 2 |
| 4 | 3 |

For the MEG psychopy settings, if a participant presses multiple buttons, all button presses are recorded but we only take the first response in our data analysis.

For the MRI psychopy setting, only the first button press is recorded.

|  |  |
| --- | --- |
| **Participant button press** | **Psychopy records button press in MRI (data collected after July 17 2024)** |
| 1 | 0 |
| 2 | 1 |
| 3 | 2 |
| 4 | 3 |

|  |  |
| --- | --- |
| **Participant button press** | **Psychopy records button press in MRI (data collected prior to July 17 2024)** |
| 1 | 1 |
| 2 | 2 |
| 3 | 3 |
| 4 | 4 |

3**. \*\*Trials:\*\* (one trial: question slide, image slides, fixation cross)**

- MEG: there are a total of 420 trials for one entire MEG scan (session 1, session 2, session 3).

In each session, there are 140 trials. In each session (140 trials in total for one session), there are 35 God images, 35 supernatural images, 35 human images, and 35 inanimate objects.

Each image is randomly linked to one of three question slides (see above).

The total number of times each question slide is asked per session is randomized.

4. **\*\*Summary:\*\***

- MEG study set-up: In each session (140 trials in total for each session) 140 images are presented in random order, 35 from each of the 4 stimulus types.

MRI study set-up: In each session (72 trials in total for each session) 72 images are presented in random order, 18 from each of the 4 stimulus types. A total of 216 trials for the entire MRI scan.

Naturalistic Task (MEG only)

- Participant watch 4 video clips, one from each category (God, Supernature, Humans, Inanimate Objects). The videos are shown in randomized order. No questions are asked during the naturalistic task.

Resting State (MEG Scan)

- Takes 5 minutes

- Participant instructed to look at a fixation cross slide for 5 minutes

Resting State (MRI Scan)

- Takes about 8 minutes

- Participant instructed to look at a fixation cross slide for about 8 minutes

**EVENT IDS:**

**Protocol for Trigger Numbers for MEG data**

(note: Psychopy log files are still recording offsets for images and questions stimulus but the trigger offsets are not recorded in the actual MEG data)

Protocol for trigger numbering for MEG:

\*\*Note:  The trigger code for trial start is the QUESTION ON.

Trial duration is randomized because the fixation cross duration is randomized. Question slide is on screen 1s. Image slide on screen for 2.5s. For the MEG session, fixation cross duration is randomized from 1.0s to 1.2s. Question + image + cross = 1 trial.

We have 12 individual channels and one summation channel STI101.

STI001 to STI008 are used for stimulus presentation triggers and STI 009 to STI012 are used for button presses.

The trigger numbers are as follows:

- \*\*Response for button numbering from 1-4\*\*

Response button 1 press – (STI 009) 256

Response button 2 press - (STI 010) 512

Response button 3 press – (STI 011) 1024

Response button 4 press – (STI 012) 2048

Summation channel is STI101 (look at this channel for the Event ID).

Some notes: If you see 1536, it is an overlapping button press response.

- \*\*Question numbering\*\*

We have three types of questions:

“Source of MORALITY?” - 4

”Extent of ATTACHMENT?” - 5

“Extent of MIND?” - 6

\*\*Trigger start and end of question\*\*

Start “onset” - 1

End “offset” - 2

Example:

Question 1 (morality) - onset - 41 \*( number of ‘41’, where ‘4’ - number of the question ‘morality’ see above, and ‘1’ - is the number of the trigger start)\*

Question 1 (morality) - offset - 42 \*( number of ‘42, where ‘4’ - number of the question ‘morality’ see above, and ‘2’ - is the number of the trigger end)\*

- \*\*Group numbering\*\*

“God” - 11

“Inan” - 12

“Human” - 13

“Super” - 14

\*\*Trigger start and end of group\*\*

Start “onset” - 1

End “offset” – 2

Example:

Group 1 “God” - onset - 111 \*( Ex., number of ‘111’, where ‘11’ - number of the group ‘\*God\*’ see above, and ‘1’ - is the number of the trigger start)\*

Group 1 “God” - offset - 112 \*( Ex., number of ‘111’, where ‘11’ - number of the group ‘\*God\*’ see above, and ‘2’ - is the number of the trigger end)\*

- \*\*Block numbering\*\*

“Block 1” - 15

“Block 2” - 16

“Block 3” - 17

\*\*Trigger start and end of Block\*\*

Start “onset” - 1

End “offset” – 2

- \*\*Resting numbering\*\*

Resting state - 18

\*\*Trigger start and end of resting\*\*

Start “onset” - 1

End “offset” - 2

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Protocol trigger numbering (movie)

- \*\*Movie numbering\*\*

Movie1 “God” - 20

Movie2 “Super” - 22

Movie3 “Inan” - 23

Movie4 “Human” - 24

\*\*Trigger start and end of movie\*\*

Start “onset” - 1

End “offset” - 2

- \*\*Resting numbering\*\*

Resting state - 25

\*\*Trigger start and end of resting\*\*

Start “onset” - 1

End “offset” - 2

**Script for reading individual stimulus channel**

import mne

# Load the raw MEG data first

raw = mne.io.read\_raw\_fif('file\_name\_raw.fif', preload=True)

# List all channel names in the dataset

print(raw.info['ch\_names'])

events = mne.find\_events(raw, stim\_channel= 'STI001', output='onset',

consecutive='increasing', min\_duration=0,

shortest\_event=1/raw.info['sfreq']

, mask=None, uint\_cast=False,

mask\_type='and', initial\_event=False,

verbose=True)

print("Events found:")

print(events)

raw.plot() # a pop up screen will appear; scroll down to the very end and you can see the trigger event from each stimulus channel. You can zoom in/out to see the triggers better

Extra notes:

Original protocol (numbers may have been approximate):

A diagram of a test

Description automatically generated with medium confidence

This was the original protocol for study set up.