

## Memory\_music\_iEEG

In this repository, you will find the implementation of experimental paradigms investigating musical memory and imagery with intracranial EEG and MEG. The experiment consists of three tasks, with versions in English and Spanish:

- 1- A recognition memory task in which participants listen to a short musical excerpt (from a J.S. Bach work) and afterwards are presented with short melodies which could belong or not to the musical excerpt. Participants decide whether each melody is "old" or "new".
- 2- A localizer block in which participants are presented each of the three tones used in task 3 in random order (avoiding consecutive repetitions). After each sound, participants are asked to imagine it very vividly in their minds.
- 3- A working memory and imagery task (maintenance) in which participants are presented with a short three-note melody, then are asked to imagine it vividly on cue, and finally are required to decide if the second melody is the same or different from the first. In this task, there is a second block (manipulation) in which participants need to mentally invert the melody in their minds (e.g. ABC becomes CBA) and judge whether the second melody is an inverted version of the first or not. The two blocks (maintenance and manipulation) are counterbalanced across subjects.

In addition, before the task is implemented, a musical background and imagery questionnaire should be completed by the participants. English and Spanish versions of the questionnaire can be found in these links:

- In English:

<https://survey.au.dk/LinkCollector?key=FH7L913WUNC1>

- In Spanish:

<https://survey.au.dk/LinkCollector?key=PF3V793FLP1N>

For tasks 2 and 3 we have both MEG and iEEG versions. These are the corresponding implementations of each task (add "spanish" as a suffix for the Spanish version):

- task 1: "scripts/LerningBach\_iEEG.py"
- task 2: "scripts/localizer\_iEEG.py" (for iEEG) and "scripts/localizer\_MEG.py" (for MEG)
- task 3: "scripts/manipulation\_task\_iEEG.py" (for iEEG) and "scripts/manipulation\_task\_MEG.py" (for MEG)

The three tasks should be presented in this order: 1, 2, 3 or this order: 2, 3, 1; so that the localizer always precedes the maintenance/manipulation task. These two orders may be counterbalanced across participants.

These are the approximate durations and number of trials in each task:

For iEEG

- task 1: 42 trials (21 old, 21 new) (5 minutes)
- task 2: 120 trials (40 for each tone) (5 minutes)
- task 3: 96 trials (48 maintenance: 24 same, 24 different; 48 manipulation: 24 inverted, 24 not inverted/other) (17 minutes)

For MEG:

- task 2: 180 trials (60 for each tone) (8 minutes)
- task 3: 120 trials (60 maintenance: 30 same, 30 different; 60 manipulation: 30 inverted, 30 not inverted/other) (21 minutes)

Stimuli found under the "stimuli" folder. Log files stored in the "logs" folder.

### Instructions to run the tasks

- 1- Open the link to the online questionnaire provided above and make sure the participant answers all the questions.
- 2- To run the task, open Psychopy 3 (currently works with version 2021.2.3)
- 3- In the coder, open the script "scripts/LerningBach\_iEEG.py" (or its Spanish version), click on the "run" button and write the subject code in the pop up window.
- 4- When the task finishes, open the script "scripts/localizer\_iEEG.py" (or its Spanish version) click on the "run" button and write the subject code in the pop up window.
- 5- When the task finishes, open the script "scripts/manipulation\_iEEG.py" (or its Spanish version) click on the "run" button and write the subject code in the pop up window. Leave the second field blank if you want a random block order or else determine the order yourself (1 = maintenance block first; 2 = manipulation block first).
- 6- After each task finishes, make sure to retrieve and store the corresponding log files. Task 3 has both a default and a custom log file. Task one has only a custom log file.

To take into account: The recognition task (1) can be run after the other two tasks as well. In such case, the current step 3 above would be placed after the current step 5.

Tips and caveats:

Make sure that the participant fully understands the nature of the task. Emphasize that they should imagine the sounds vividly in their minds when indicated to do so. Also emphasize that they shouldn't overtly sing or otherwise reproduce the sounds with their bodies.

If your system requires sending triggers, please make sure to update the parallel port address to match your local machine in the script "triggers.py".

Task 1 on one hand, and task 2-3 on the other hand can be run independently, for example if there is little time or the participant is tired. Task 1 can be a nice and easy addition to any data collection as it only takes 5 minutes.