

Dataset documentation: BCI study

Manuscript: A closed loop, music-based brain-computer interface for emotion mediation

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Introduction

The purpose of this study was to investigate and quantify whether, and to what extent, participants were able to gain control over the music feedback, e.g., voluntarily change the music feedback by modulating their brain activity accordingly. Gaining control over the musical feedback would imply that participants are able to effectively mediate their own emotion states.

Study protocol

Number of participants: 5

Number of sessions: 2 per participant (conducted on different days)

Protocol of a single session conducted in the following chronological order:

Stage	Participant task	Measurement	Duration
1. Mood assessment	Mood self-assessment	Questionnaire	5 min
2. BCI calibration	Passive listening	EEG	3 min
3. BCI online application	Task-based interaction with music feedback	EEG	15 min (S01) 38 min (S02)

1. Mood assessment questionnaire

Participants were asked to perform a self-assessment of their current mood based on a custom made questionnaire with 14 opposing emotional attributes on a 7-point scale (e.g. stressed versus relaxed; in this case a rating of “1” corresponded to “stressed” and a rating of “7” to “relaxed”).

2. BCI calibration

Participants were asked to passively listen to three classes of musical excerpts generated by the composing algorithm, namely sad (low-arousal-negative-valence), neutral (intermediate-arousal-intermediate-valence), and happy (high-arousal-positive-valence). Each excerpt was presented two times for 20 seconds each in a pseudo-randomized order, such that subsequent excerpts were always of different classes. The excerpts were separated by resting periods of 10 seconds. Electrophysiological activity during training was measured via a 14-channel Emotiv EPOC EEG system. The acquired EEG data was subsequently used to build a participant-session specific emotion classification model (for details the reader is referred to the main paper).

3. BCI online application

During online application, the previously built model was used as a translator of EEG signals into input parameter settings for the composing algorithm, meaning, EEG signals were continuously translated into a musical feedback in real-time. This musical feedback was played back to the participants during the experiment. Participants were asked to perform two different tasks: “modulate music feedback towards happy patterns” and “modulate music feedback towards sad patterns”. Each trial was assigned one of the two possible tasks. One trial consisted of a resting-period of 15 seconds and a subsequent action-period of 30 seconds. During the resting-period no music feedback was played back and the participant was asked to relax. During the action-period music feedback was played back and the participant performed the given task. Online application in session S01 consisted of 20 trials and in session S02 of 50 trials.

Dataset organization

The data is exclusively stored in MATLAB® format (.mat) with three individual files per participant P0x and session S0x:

Filename	Description
P0x_S0x_mood_ratings.mat	Matlab struct containing the ratings of the mood self-assessment
P0x_S0x_calibration.mat	Matlab struct containing EEG signals of the calibration phase including supporting data
P0x_S0x_application.mat	Matlab struct containing EEG signals of the online application phase including supporting data

Data: mood_ratings

- *ratings*: 14 individual 7-point scale ratings capturing tendency towards either of two opposing extremes, e.g. stressed vs. relaxed
- *labels*: corresponding labels, e.g. “stresses_vs_relaxed” for each of the 14 mood assessment ratings.

Data: calibration

- *num_channel*: total number of data channels
- *sampling_rate*: EEG data acquisition sampling rate (128 Hz in all cases)
- *simpos*: position of the stimuli markers [total sample count]
- *stimcode*: type of marker at position denoted in variable *simpos*
- *codelist*: list of all marker types appearing in the dataset
 - 131: onset of playback of stimulus low-arousal-negative-valence (sad)
 - 132: onset of playback of stimulus intermediate-arousal-intermediate-valence (neutral)
 - 133: onset of playback of stimulus high-arousal-positive-valence (happy)
 - 199: onset of resting period
 - -1: end of the experiment
- *chan_list*: labels for all data channels
- *sel_chan_list*: labels for EEG data channels only
- *data*: sampled data from all data channels (EEG channels: 4-17)

Data: online application

- *num_channel*: total number of data channels
- *sampling_rate*: EEG data acquisition sampling rate (128 Hz in all cases)
- *simpos*: position of the stimuli markers [total sample count]
- *stimcode*: type of marker at position denoted in variable *simpos*
- *codelist*: list of all marker types appearing in the dataset
 - 100: onset of task indication sound / task preparation
 - 141: onset of music feedback with task “modulate towards happy”
 - 143: onset of music feedback with task “modulate towards sad”
 - 199: onset of resting period
 - -1: end of the experiment
- *chan_list*: labels for all data channels
- *sel_chan_list*: labels for EEG data channels only
- *data*: sampled data from all data channels (EEG channels: 4-17)
- *modelOutput_score*: continuous output of the emotion classification model with 2 data samples per sec (first dimension); marker code [100, 141, 143, 199] at corresponding moment of initiation of classification output (second dimension).