Emotion-Antecedent Appraisal Checks: EEG and EMG data sets for Novelty and Pleasantness

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This document describes the full details of the first data set (Study 1) used in Coutinho et al., to appear. The Electroencephalography (EEG) and facial Electromyography (EMG) signals included in this dataset, and now made public, were collected in the context of a previous study by Peer, Grandjean, and Scherer, 2014 that addressed three fundamental questions regarding the mechanisms underlying the appraisal process: Whether appraisal criteria are processed (a) in a fixed sequence, (b) independent of each other, and (c) by different neural structures or circuits. In that study, an oddball paradigm with affective pictures was used to experimentally manipulate novelty and intrinsic pleasantness appraisals. EEG was recorded during task performance, together with facial EMG, to measure, respectively, cognitive processing and efferent responses stemming from the appraisal manipulations.

In comparison to the data collected and analysed in the original study (Peer, Grandjean, and Scherer, 2014), this dataset contains some differences in both EEG and EMG signals. This is due to changes in the pre-processing steps (i.e., the processing of the raw data), which have had an impact on the signals themselves and also led to the removal of some trials. Full details, including information about data collection, are provided in the following subsections.

Participants

Twenty-six right-handed healthy students from the University of Geneva (12 men, 14 women) participated for financial compensation (45 Swiss francs (CHF)). Inclusion criteria were age 18–35 years, right-handedness, excellent understanding of French, normal vision (no glasses or contact lenses), and good general health (no use of medication, except oral contraceptives). Exclusion criteria were psychological problems, a history of neurological disorders or head trauma, and use of hard or soft drugs. All participants provided written informed consent prior to their participation in the study, which was approved by the local ethical committee.

Materials

Stimuli for the oddball task (Fig. 1) consisted of 78 pleasant, 78 unpleasant, and 78 neutral color pictures selected from the International Affective Picture System database Lang, Bradley, and Cuthbert, 2001. To avoid low-level visual effects on EEG measures, all pictures were automatically corrected to an average luminance value of 0.48, using MATLAB software (version 7.10.0). The corrected pictures were visually inspected to make sure they did not look strange. Statistical analysis further confirmed that the three categories did not differ in high or low spatial frequencies (using the method described in (Delplanque et al., 2007), all $F(2, 222) < 1.37, p > .25$, or in number of humans and faces (human: $Chisq = 2.83, p = 0.24$; face: $Chisq = 2.27, p = 0.32$). Statistical analysis of the normative subjective ratings of the pictures showed that the three categories differed significantly in valence (all pairwise comparisons, $F(1, 148) > 1282.0, p < .001$), and that neutral pictures were significantly less arousing than pleasant and unpleasant pictures (both $F(1, 148) > 153, p < .001$), but pleasant and unpleasant pictures did not differ significantly on arousal ($F(1, 148) = 0.70, p = .40$).

Method

After arrival in the laboratory, participants were given a short introduction and signed the informed consent form. Next, the electrodes for the electrophysiological measurements were placed, and the participants performed the oddball task (approx. 45 min). EEG and EMG were recorded continuously during task performance. During the whole procedure, participants sat in an air-conditioned and sound-attenuated room in front of a computer monitor, and the experimenter sat in an adjacent room, which was connected to the experimental room by a video and intercom system. In the oddball task, stimuli were presented against a medium gray background, with a 16.4° horizontal and 13.4° vertical visual angle at a 65-cm viewing distance. Trials were divided into three types: Novel (20%), familiar (70%), and target trials (10%). Novel trials consisted of 216 pictures that were each presented once. Familiar trials consisted of nine pictures that were each repeated 84 times. Target trials consisted of the direct repetition of a picture in two consecutive trials (one-back task), to which participants had to respond by pressing the space bar with the index finger of their right hand. For all trial types, one third of the pictures were pleasant, one third unpleasant, and one third neutral. The order of the trials was semi randomized, with a maximum of three consecutive pictures of the same pleasantness category, no targets or non-target novel pictures on two consecutive trials. The pictures within each trial type were randomized and balanced across all participants. Participants started with 42 practice trials, which were repeated if they did not reach the required level of 90% accuracy. The experimental part of the task consisted of six blocks of 180 trials, separated by brief rest periods. Each trial started with the presentation of a central fixation cross (randomized duration between 1,000 ms and 1,500 ms), followed by a stimulus picture (500 ms) and a blank screen (500 ms). Stimulus delivery and responses were controlled by E-prime software (Version 1, Psychology Software Tools, Inc., Pittsburgh, PA; Schneider, Eschman, and Zuccolotto, 2002).

EEG Recordings and Pre-Processing

The EEG was recorded at 512 Hz with a Biosemi Active-Two system (BioSemi Biomedical Instrumentation, Amsterdam, the Netherlands) from 64 active electrodes referenced to an active common mode sense (CMS) and with a passive driven right leg (DRL) ground electrode. All electrodes were mounted in an elastic cap and evenly distributed over the head surface according to the international extended 10–20 system. Signals were processed offline using Brain Vision Analyzer software (version 2.0, Brain Products, Gilching, Germany). Bad channels were interpolated using a topographic interpolation (spherical spline; Perrin et al., 1989), with a maximum of six channels for each individual data set. Subsequently, data were downsampled to 256 Hz with a spline interpolation, filtered (high pass: 0.1 Hz, 24 dB/oct; low pass: 30 Hz, 48 dB/oct), and re-referenced to an average reference including all electrodes. Next, data were segmented into epochs ranging from -200 to +800 ms relative to stimulus onset, based on codes synchronized to stimulus presentation. All segments were corrected for the effects of eye blinks and eye movements using a standard procedure Gratton, Coles, and Donchin, 1983, and segments including motor responses or artifacts (amplitude values larger than $75\ \mu V$, a difference $> 100\ \mu V$ between the lowest and the highest amplitude within the segment, a period $> 100\ ms$ with activity $< 0.50\ \mu V$, or a difference $> 50\ \mu V$ between two subsequent sampling points) were excluded. Finally, baseline (-100 to 0 ms relative to stimulus onset) corrected data of the post stimulus time interval were exported for all remaining segments of the six relevant experimental conditions (novelty × intrinsic pleasantness). The data of one female participant were excluded because of an excessive number of artifacts (< 10 trials left per condition). The final number of EEG trials retained (across all participants and conditions) amounts to 16666. Channels of interest were three midline electrodes (Fz, Cz, Pz), for the P3 and LPP event-related potential (ERP) components.

EMG Recordings and Pre-Processing

EMG was recorded from six electrodes using a Biopac amplifier system, with a sampling rate of 1000 Hz and a 1 Hz high pass and a 500 Hz low pass filter. All electrodes were attached to the left side of the face, corresponding to three distinct bipolar montages over the medial frontalis, the corrugator supercilii, and the zygomaticus major regions Fridlund and Cacioppo, 1986. Signals were processed offline using MATLAB software (version 7.12.0.635, The MathWorks, Inc., Natick, MA, USA). All data were band pass filtered from 20-400 Hz, rectified, smoothed with a 40 Hz low pass filter, and downsampled to 256 Hz. Next, data were segmented into epochs ranging from 0 to 1,500 ms relative to stimulus onset, based on codes synchronized to stimulus presentation.

The distribution of EMG values for each muscle region was more closely inspected for outlying values. Given the lack of established methods in the literature, EMG trials were evaluated based on the range of values (maximum - minimum) for each muscle region. Outlying trials were identified using a threshold of twice the upper 75th percentile value of ranges (over all individual trials across participants and conditions) for each muscle region. This level seemed to provide a good balance between excluding clearly divergent recordings (e.g., trials contaminated by movement artifacts) while still including relatively large reactions that contain an important signal of the manipulated appraisal checks. Any trial whose range was greater than this value, for any of the three muscle regions, in either the baseline or post-stimulus period, was removed. If any partic-

ipant had over 50% of total trials outlying, all trials for that participant were removed. This was the case for two participants. This decision was motivated by considering that this excessive activity could be due to movement artifacts and/or misplacement of the electrodes. Finally, all trials were baseline corrected in relation to the average of the pre-stimulus period of 100 ms, and only the post-stimulus period of 1500 ms was exported for further analysis. The final number of EMG trials retained amounts to 21529.

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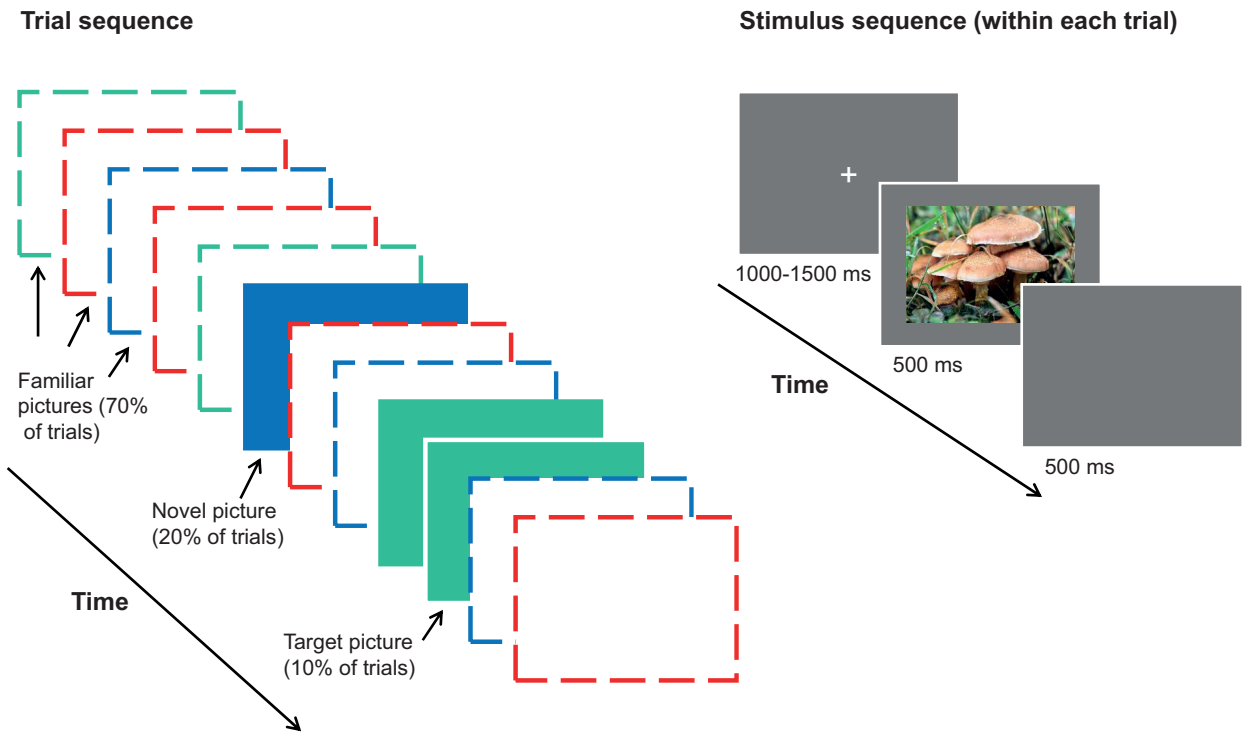

Figure 1: *Example trial sequence and stimulus sequence of the oddball task (Study 1). Trial sequence (left): Three types of trials were presented in semi randomized order: novel (filled squares), familiar (blank squares with dotted lines), and target trials (novel or familiar). Novel trials consisted of 216 pictures that were each presented once. Familiar trials consisted of nine pictures that were each repeated 84 times. Target trials consisted of the direct repetition of a picture in two consecutive trials (one-back task) to which participants had to respond by pressing the space bar. For all trial types, one third of the pictures were positive (green), one third negative (red), and one third neutral (blue). Stimulus sequence (right): Each trial started with the presentation of a central fixation cross (randomized duration between 1,000 ms and 1,500 ms), followed by the stimulus picture (500 ms) and a blank screen (500 ms).*