Dataset documentation: automaticArtifactRemoval

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Introduction

The purpose of the experiment was the systematic recording of common EEG artifacts such as eye movements, yaw clenching, head flexing, etc. from multiple subjects. Thus, this dataset can be used as a basis for the evaluation of various artifact detection and artifact reduction algorithms.

Artifact conditions

- **Baseline (Focusing):** A stationary cross was displayed on the screen. The subjects were asked to focus on the cross and recite the alphabet backwards his mind. This condition was supposed to contain as little artifacts as possible. The reversed recitation of the alphabet was chosen because a task that required focus was needed, otherwise the subject would become drowsy over the course of the condition. Additionally, it had to be a task that could be performed by anyone without any visual aids in order to reduce eye movements and without creating any other artifacts like for example from reading a text.

- **Alpha wave (EyeClosed):** When a stationary cross appeared on the screen the subject was asked to close his eyes and keep them closed until an auditory stimulus was played. The subject was further instructed to refrain from meditating, as this had an adverse e ect. on the recorded data in a previous pilot study.

- **Saccadic horizontal eye movement (SaccadicHorEye):** A white circle appeared for 0.125s in one of three predefined locations on the screen, all of which were on the central horizontal axis of the screen: at the left edge, center and at the right edge of the screen. The subject was asked to attend to the newly appeared circle and shift gaze only upon appearance of a new circle. The circle appeared with a frequency of 1 Hz, the locations were randomized so the subject could not predict its movement, as this would not elicit saccades.

- **Smooth horizontal eye movement (SmoothHorEye):** A white circle moved smoothly on the central horizontal axis between the left and right edges of the screen. The position of the circle was modeled as a sin wave with a period of 2s. The subject was asked to attend to the circle while keeping the position of his head fixed.

- **Saccadic vertical eye movement (SaccadicVerEye):** This condition is the same as the condition saccadic horizontal eye movement with the exception that the circle appeared on the vertical central axis at the top edge, center and at the bottom edge.

- **Smooth vertical eye movement (SmoothVerEye):** This condition is the same as the condition smooth horizontal eye movement with the exception that the circle moved on the vertical central axis between the top and bottom edge

- **Reading (Reading):** A series of words was displayed in the centre of the screen for a period of time calculated on the basis of the length of the words. The subject was asked to read each word out loud. In each condition six words were read. Words consisting of three syllables and

starting with the sounds 'k' and 'p' were used, as done by Brooker et al. [42]. Due to the internationality of the test subjects and for the sake of using the same words for each subject, only English words were used.

- **Clenching (Clenching):** In the center of the screen a shrinking circle was displayed. The subject was asked to clench every time the stimulus disappeared. The circle disappeared with a frequency of 1 Hz. Over the entire course of this condition the subject was asked to keep his mouth closed and teeth together. Every time the circle disappeared the subject was supposed to simply press their teeth harder together. This exact method proved to simulate real chewing the closest, as for example opening and closing one's mouth did not produce electrical activity similar to the one created by chewing. Using food or chewing gums was unfeasible in this design as it would require too many breaks and would not be repeatable, while the exact force of biting teeth together could be trained with each subject to keep consistent.

- **Blinking (Blinking):** The stimuli for this condition was exactly the same as for clenching. The subject was asked to blink every time a shrinking stimulus disappeared.

- **Head flexing (HeadFlexing):** A white circle appeared with a frequency of 0.5 Hz for a short period of time alternatingly on each side of the screen on the central axis. The subject was asked to turn his head to the left when the circle appeared at the left edge of the screen and vice versa. This saccadic stimulus was chosen over a smooth stimulus, where the subject would be asked to follow the stimulus by moving his head, as it elicited fewer horizontal eye movements.

Experimental design

Number of participants:	13	age: 22.9±1.3; 4 female, 9 males
Number of sessions:	1	one session for each subject
Number of trials:	10	per person and artifact condition; only second experiment part was repeated
Number of experiment parts:	2	first part is the baseline condition, second part contains artifacts
Duration first part:	60s	30s x 2 repetitions
Duration second part:	~40-50min	9 artifact conditions x 25-30s x 10 repetitions
Total duration:	~40-50min	Depending on individual pace

Study protocol

The study protocol consist of a calibration phase in the baseline condition followed by a block containing all nine artifact conditions in randomiced order. The second block was repeated 10 times.

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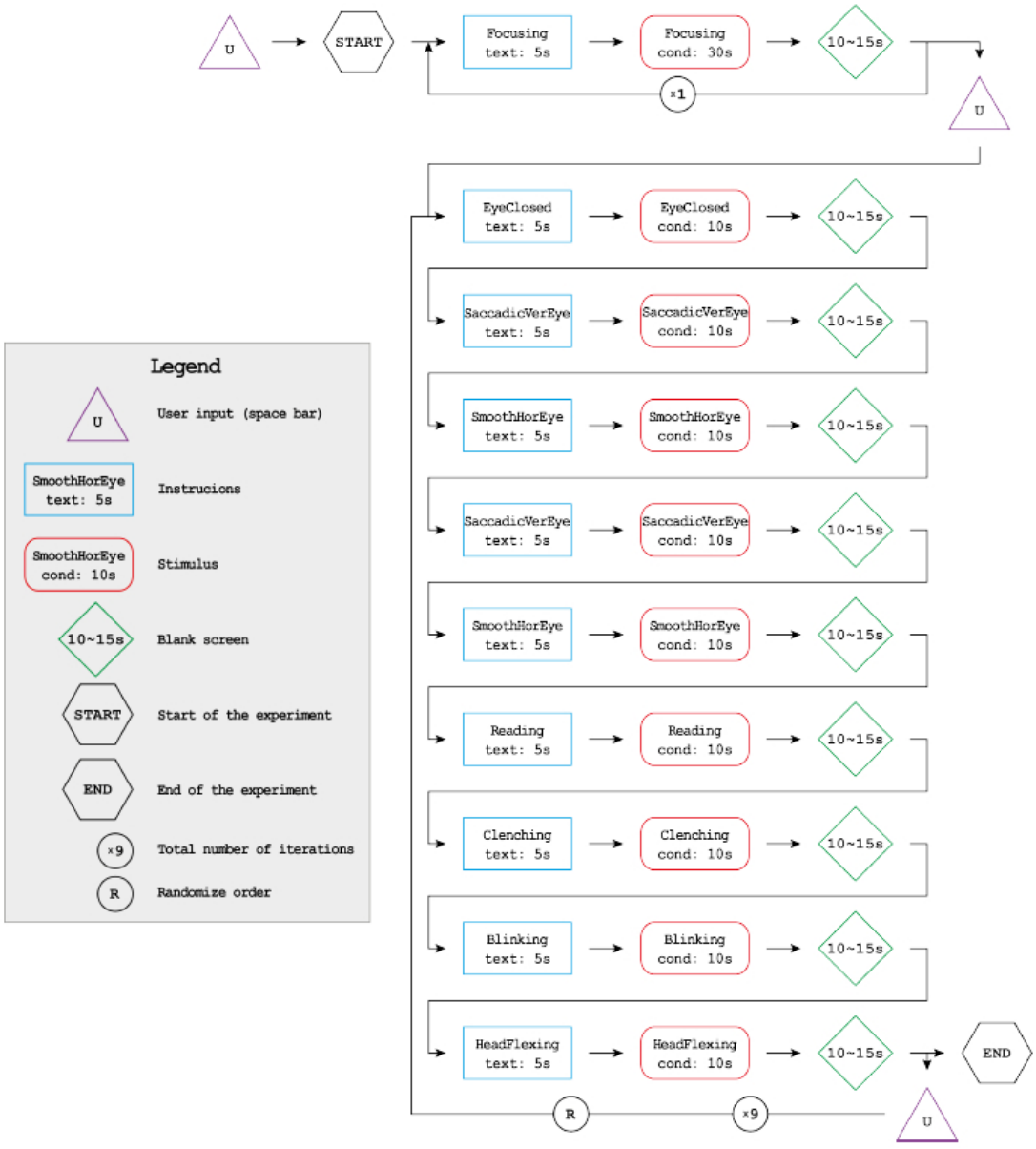

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Hardware

EEG hardware:	Brain Products actiChamp amplifier; 32 active electrodes
Sampling rate:	200Hz *
Number of Electrodes	32 active electrodes (27 EEG and 3 EOG)
Electrode placement:	according to 10-20 System
Referencing:	average of TP9 and TP10 (linked mastoids referencing)
EOG channels:	FT9, FT10 and Oz, placed at (forehead, left and right outer canthi)
EEG channels:	Fp1, Fp2, F7, F3, Fz, F4, F8, FC5, FC2, FC2, FC6, T7, C3, Cz, C4, T8, CP5, CP1, CP2, CP6, P7, P3, Pz, P4, P8, O1 and O2
GND electrode	Fpz

*****The original sampling frequency of the dataset was 1000Hz and can be requested by contacting the author

Trigger information

Type	Event name	Event description	Duration of the conditon
Start of condition	S1	Focusing	30s
	S2	Eyes closed	10s
	S3	Saccadic horizontal eye movement	10s
	S4	Smooth horizontal eye movement	10s
	S5	Saccadic vertical eye movement	10s
	S6	Smooth vertical eye movement	10s
	S7	Talking	10s
	S8	Blinking	10s
	S9	Clenching	10s
	S10	Head flexing	10s
Positions of the stimuli	S11	Stimulus moving to the left/bottom (smooth) or appearing on the left/bottom (saccadic)	N/A
	S12	Stimulus appearing in the middle (saccadic)	N/A
	S13	Stimulus moving to the right/top (smooth) or appearing on the right/top (saccadic)	N/A
End	S15	End of condition	N/A

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