EEG Stimuli for pediatric patients with lobectomy: description and matlab codes

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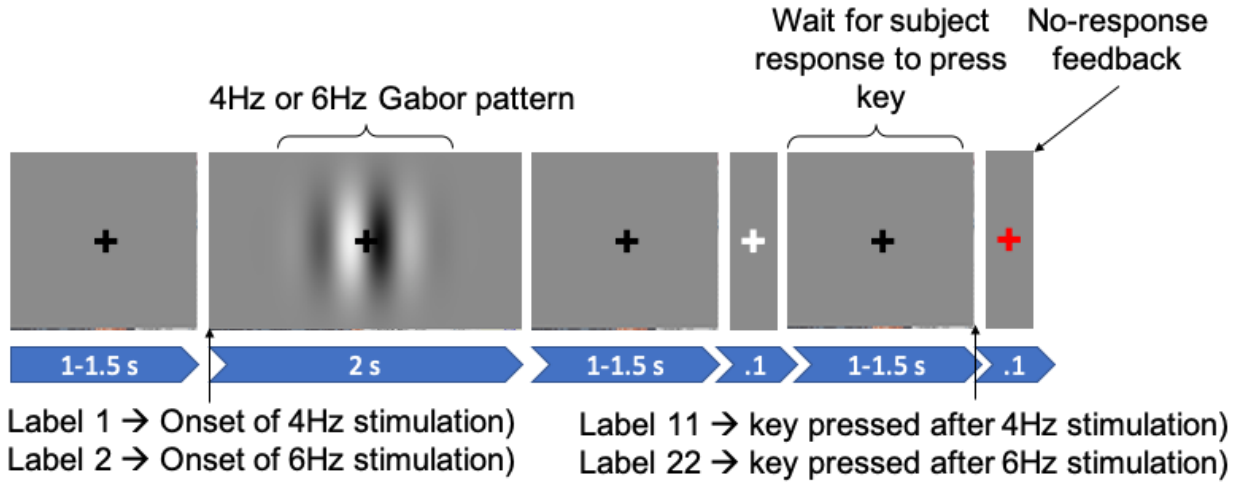
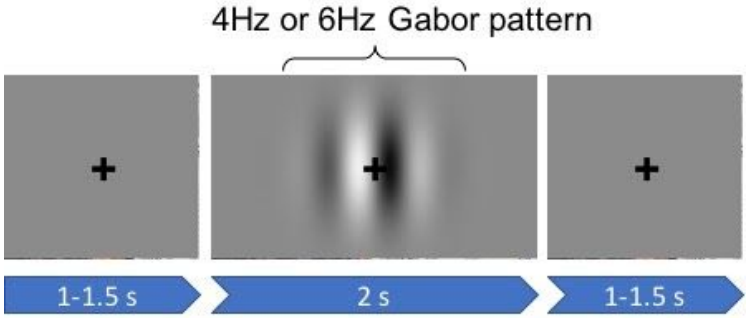
This document explains the visual stimuli we have used for the EEG recording of three patients with lobectomy and a healthy participant. The dataset and all of the stimuli matlab files are available in [1]. Please see the readme.txt file in [1] for more information.

SSVEP: Steady state visually evoked potentials (SSVEP) are signals that are natural responses to visual stimulation at specific frequencies [2]. When the retina is excited by a visual stimulus ranging from 3.5 Hz to 75 Hz, the brain generates electrical activity at the same (or multiples of) frequency of the visual stimulus [3].
This technique is used widely with EEG research regarding vision and attention. SSVEPs are useful in research because of the excellent signal-to-noise ratio [4] and relative immunity to artifacts [5].
For the visual condition, gaussian filtered vertical sine-wave gratings alternated contrast sinusoidally at 4Hz or 6Hz for 2s.

SSVEP trial (with pressing key) [6]:

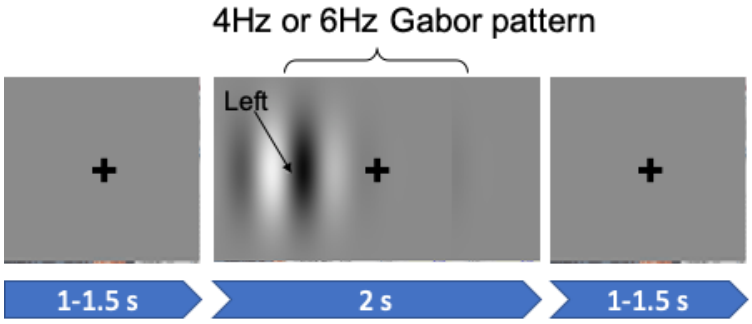


SSVEP trial (without pressing key) [6]:

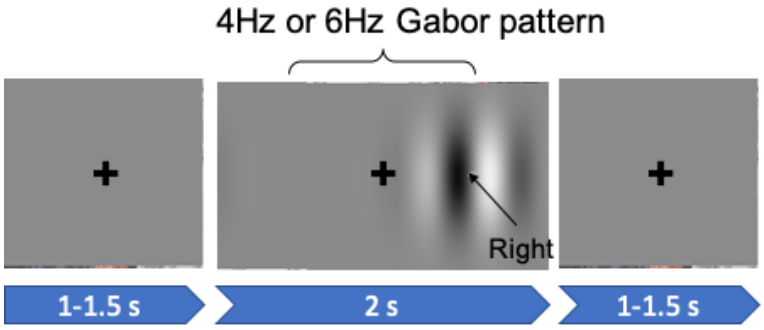


In terms of the epoch labels, we have used labels “1” and “2” for pointing to the onset of the 4Hz and 6Hz stimuli respectively, and “11” and “22” for pointing to the end of the 1-1.5s interval in which a feedback is received (pressed key), after the 4Hz and 6Hz stimuli respectively. We have also designed SSVEPs where the grating pattern is not presented at the center of the display:

SSVEP_L trial (without pressing key):



SSVEP_R trial (without pressing key):



Similar to SSVEP trials, for SSVEP_L and SSVEP_R we have designed trials with pressing a key. In addition, similar epoch labels are used for these trials. These stimuli can be used for patients with visual fields impairment (left or right).

Some hints on how to use the matlab codes:

These codes have comments which helps you understand what is going on in each part of the code.

First you need to download and install the matlab toolbox named as Psychtoolbox from here: http://psychtoolbox.org/download.html#installation

The following codes have been tested on computers with windows OS. You may face some issues with the keyboard inputs if you change the operating system.

Files named "vis_SSVEP.m", "vis_SSVEP_R.m", and "vis_SSVEP_L.m":
In line 7: you specify the name/ID for the subject
In line 14: you can specify the number of blocks/sessions through which a train of trials will be recorded.
In line 15: you can specify the temporal frequency of visual/auditory stimulus (1=4Hz, 2=6Hz)
In line 16: you can specify the trial types (0=without pressing button, 1=with pressing button)
In lines 76 and 78: you can play with the spatial characteristics of the Gabor pattern (spatial frequency, width of the Gaussian filter, etc)

Acknowledgements:

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References:

[1] A. Chaman Zar; M. Behrmann; P. Grover (2020): Pediatric patients with lobectomy (MRI and EEG). Carnegie Mellon University. Dataset. https://doi.org/10.1184/R1/12402416
[2] F. Beverina, G. Palmas, S. Silvoni, F. Piccione, S. Giove (2003). "User adaptive BCIs: SSVEP and P300 based interfaces". PsychNol. J. 1: 331–54.
[3] https://en.wikipedia.org/wiki/Steady_state_visually_evoked_potential#cite_ref-1
[4] D. Regan, Human Brain Electrophysiology: Evoked Potentials and Evoked Magnetic Fields in Science and Medicine, Elsevier, New York, NY, USA, 1989.
[5] K. E. Misulis, Spehlmann's Evoked Potential Primer, Butterworth-Heinemann, Boston, Mass, USA, 1994.
[6] S.M. Haigh, A. Chamanzar, P. Venkatesh, P. Grover, and M. Behrmann, 2019. Altered Visual Processing in Migraine Not Associated with Auditory Abnormalities. Journal of Vision, 19(10), pp.275-275.