Project 9

Experimental paradigm

In this EEG dataset, multitasking mental workload activity has been induced by a single-session simultaneous capacity (SIMKAP) experiment with 48 subjects. The SIMKAP multitasking test requires subjects to cross out identical items by comparing two separate panes, whilst responding to auditory questions which can be arithmetic, comparison or data lookup in nature. Some cases of auditory questions require subjects to respond at a later time, thus requiring them to monitor a clock on the upper right corner. This multitasking component lasts 18 minutes. The order of questions and tasks in this activity are fixed for all subjects, as designed by the developers of the Vienna Test System. EEG data was collected using Emotive EPOC EEG headset with sampling frequency of 128Hz and 16 bit A/D resolution. The device comprises of fourteen electrodes located at AF3, F7, F3, FC5, T7, P7, O1, O2, P8, T8, FC6, F4, F8, AF4, according to the 10-20 international system. A screen shot of SIMKAP multitask test has been shown in Fig. 1.

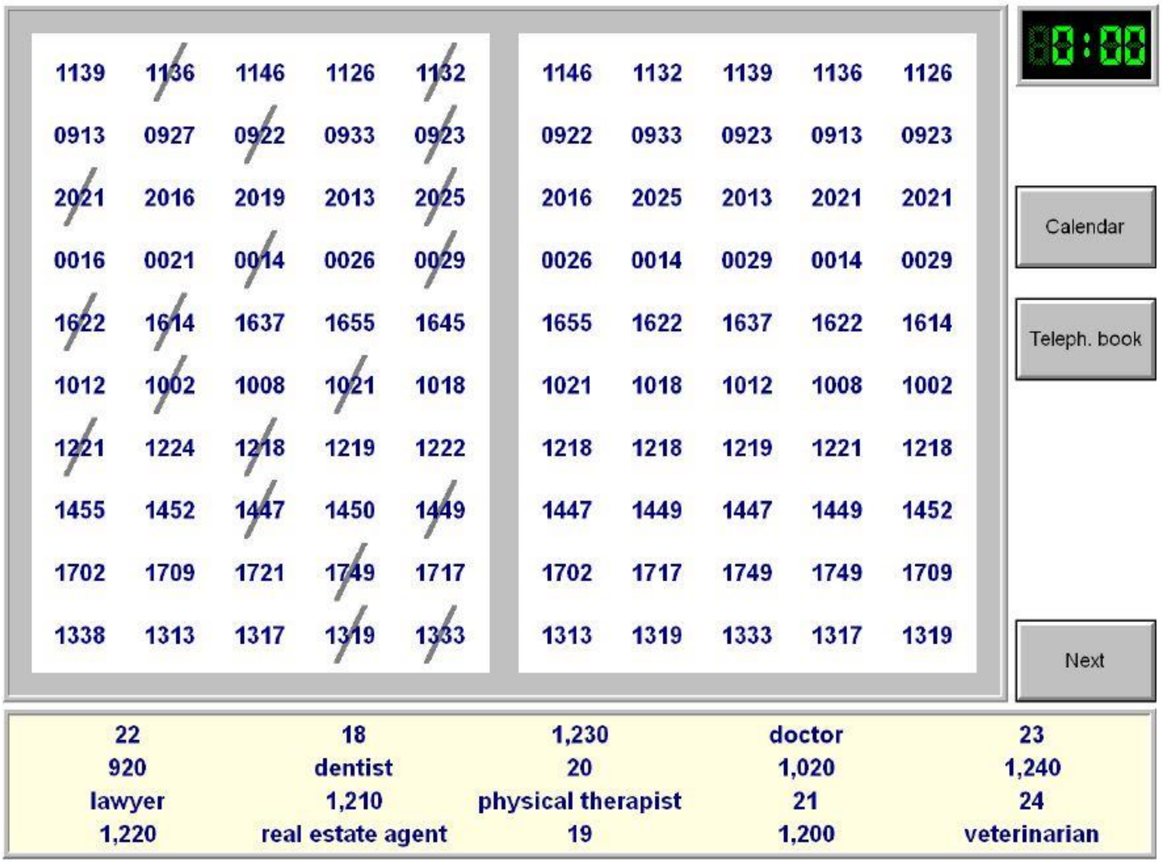

Fig. 1: Screenshot of the SIMKAP multitask test. Subjects are to mark items in the right panel by matching those already crossed out on the left panel. Responses to auditory questions are completed by selecting the correct answer from the bottom panel. Auditory questions include arithmetic problems, comparison problems, and information lookup with calendar or telephone book.

There are two parts to the experiment. First, subjects were asked to maintain a comfortable position with eyes open and not perform any task for 3 minutes. Their EEG was recorded and these 3 minutes of recording is then used as the resting condition. Next subjects were asked to perform the SIMKAP test with EEG being recorded and the final 3 minutes of the recording is used as the workload condition. The first and last 15 seconds of data from each recording was excluded to reduce effects from any between task activity, resulting in recordings of 2.5 minutes. Subjects were asked to rate their perceived MWL after each segment of the experiment on a rating scale of 1 to 9 as shown in Fig. 2. This was performed as a form of subjective validation that the subject indeed experienced an increase in workload while performing the test as compared to the resting condition. One can perceive a rating of 1-3 as low (lo) workload, 4-6 as moderate (mi) workload and 7-9 as high (hi) workload.

Defining **cognitive workload as the amount of mental effort**, on the scale(1-9) below, rate the cognitive challenge involved in the task of this segment with 1 being the lowest and 9 being the highest.

1	2	3	4	5	6	7	8	9

Fig. 2: Questionnaire on a 1-9 scale for rating of mental workload, which subjects were required to fill after completion of each segment of the experiment.

It is to be noted that the data you received has already been pre-processed. The '.mat' file ending with file name 'hi' indicates EEG data associated with high mental workload and file name ending with 'lo' is associated with low mental workload. The data has been filtered with a bandpass filter with a cut-off frequency between 0.5 and 50 Hz.

Project Objective

This project aims to examine how mental workload influences changes in functional brain connectivity. Participants have the flexibility to employ different measures of brain connectivity, such as the phase-lag index, phase lock value, phase linearity measurement, correlation, coherence, or to create their own approaches. Following the project's conclusion, participants should provide insights from a neuroscientific perspective regarding the functional interactions among different brain regions. Additionally, they are expected to present a comparative analysis of different connectivity techniques and the alterations they reveal. Participants can also engage in classification tasks based on network topological measures derived from the connectivity network.

Reference: W. L. Lim, O. Sourina and L. P. Wang, "STEW: Simultaneous Task EEG Workload Data Set," in *IEEE Transactions on Neural Systems and Rehabilitation Engineering*, vol. 26, no. 11, pp. 2106-2114, Nov. 2018. doi:10.1109/TNSRE.2018.2872924