P300 Speller with patients with ALS

Summary

This dataset represents a complete record of P300 evoked potentials recorded with BCI2000[1] using a paradigm originally described by Farwell and Donchin [2]. In these sessions, 8 users with amyotrophic lateral sclerosis (ALS) focused on one out of 36 different characters. The objective in this contest is to predict the correct character in each of the provided character selection epochs.

The paradigm

The user was presented with a 6 by6 matrix of characters (see Figure 1).The user's task was to focus attention on characters in a word that was prescribed by the investigator (i.e., one character at a time). All rows and columns of this matrix were successively and randomly intensified at a rate of 4 Hz. Two out of 12 intensifications of rows or columns contained the desired character (i.e., one particular row and one particular column). The responses evoked by these infrequent stimuli (i.e., the 2 out of 12 stimuli that did contain the desired character) are different from those evoked by the stimuli that did not contain the desired character and they are similar to the P300responses previously reported[2], [3].

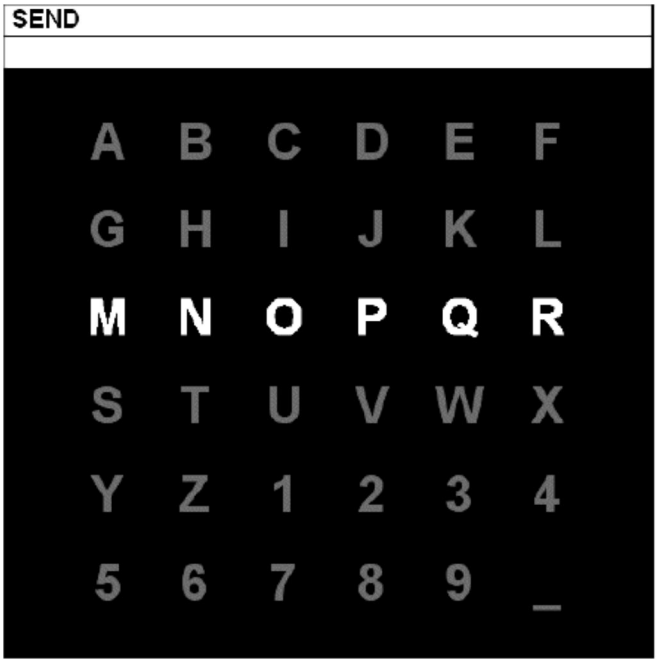

Figure 1: User display for this paradigm

Experimental Protocol

We included in the study a total of eight volunteers, all naïve to BCI training, (3 women; mean age=58 ± 12) with definite, probable, or probable with laboratory support ALS diagnosis (mean ALSFRS-R scores: 32 ± 8 [4]). Scalp EEG signals were recorded (g.MOBILAB, g.tec, Austria) from eight channels according to 10–10 standard (Fz, Cz, Pz, Oz, P3, P4, PO7 and PO8) using active electrodes (g.Ladybird, g.tec, Austria). All channels were referenced to the right earlobe and grounded to the left mastoid. The EEG signal was

digitized at 256 Hz and band-pass filtered between 0.1 and 30 Hz. Participants were required to copy spell seven predefined words of five characters each (runs), by controlling a P300 matrix speller. Rows and columns on the interface were randomly intensified for 125ms, with an inter stimulus interval (ISI) of 125 ms, yielding a 250 ms lag between the appearance of two stimuli (stimulus onset asynchrony, SOA). For each character selection (trial) all rows and columns were intensified 10 times (stimuli repetitions) thus each single item on the interface was intensified 20 times.

Participants were seated facing a 15" computer screen placed at eye level approximately one meter in front of them. The angular distance subtended by the speller was of 15 degrees. A single flash of a letter at the beginning of each trial cued the target to focus. In the first three runs (15 trials in total) EEG data was stored to perform a calibration of the BCI classifier. Thus no feedback was provided to the participant up to this point. A stepwise linear discriminant analysis (SWLDA) was applied to the data from the three calibration runs (i.e., runs 1–3) to determine the classifier weights (i.e., classifier coefficients). These weights were then applied during the subsequent four testing runs (i.e., runs 4–7) when participants were provided with feedback[5].

Table I: Demographic and clinical related data of participants (N=8)

	Age	Sex	ALSfrs-r	Onset
A01	56	M	13	Spinal
A02	59	M	37	Spinal
A03	43	M	33	Spinal
A04	75	F	38	Bulbar
A05	60	F	34	Bulbar
A06	40	M	31	Spinal
A07	61	M	28	Bulbar
A08	72	F	41	Bulbar

Data set

X=[samples X Channels]

Y=[StimType X 1] (1 = NonTarget stimulus, 2 = Target Stimulus)

Y_stim= [StimClass X 1] intensified stimulus classes (Figure 2)

Trial=[Trials X 1] trial start in samples

Classes = textual description of conditions related to Y

Classes_stim = textual description of conditions related to Y_stim

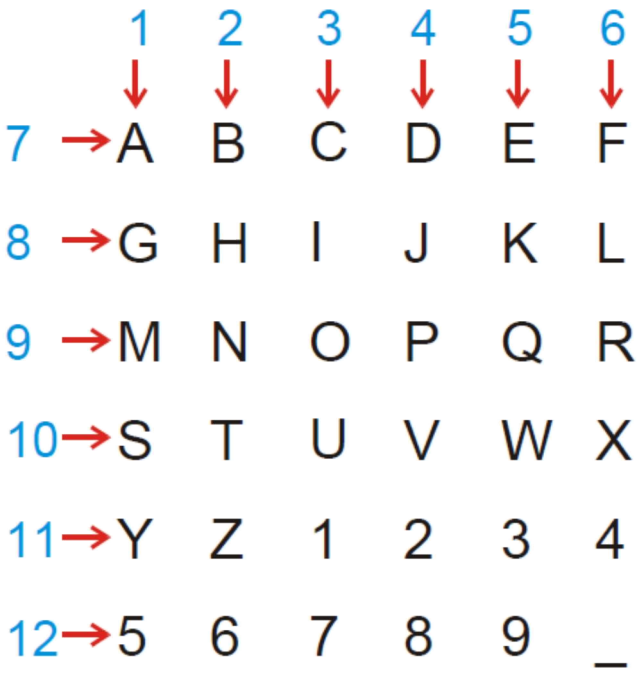

Figure 2: this figure illustrates the assignment of the variable Y_stim to different row/column intensifications

References

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