

P300 Latency Jitter More Likely for People with ALS

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Introduction: Although brain-computer interfaces (BCIs) have been useful for people with amyotrophic lateral sclerosis (ALS), they do not reliably interpret the brain signals of everyone with ALS [1,2]. The reasons for these difficulties remain unknown. P300 BCI [3] configuration is based on the average amplitude, latency, and shape of the subject's P300. Current BCI classifiers assume that the P300 response occurs exactly at the average latency used in the configuration. However, even under tightly controlled conditions, within-subject variations in latency (latency jitter) still occur [4]. We found that BCI accuracy is highly correlated ($r = .744$, $p < .0001$) with latency jitter and that large latency jitter interfere with BCI accuracy [5]. Further, Arico, et al. [6] found decreased BCI performance and increased latency jitter when BCI subjects used covert attention instead of overt attention to operate a Geospell BCI. Thus, understanding for which subjects latency jitter occurs is important.

Material, Methods and Results: Data is from 22 subjects (10 with ALS and 12 age-matched controls). Each subject typed 9 sentences (3 sentences on each of 3 days) [2]. Latency jitter was estimated with our classifier based latency estimation (CBLE) method [5]. Latency jitter differed between sentences and the aforementioned correlation between accuracy and latency jitter holds for all subjects (Fig. 1, left). Sentences were divided into bins by amount of latency jitter and sentence accuracies in each bin were averaged separately for the ALS and age-matched groups. Average accuracy declines with increased latency jitter without relation to ALS (Fig. 1, middle). However, sentences with the highest latency jitter were more common for the ALS group (Fig. 1, right).

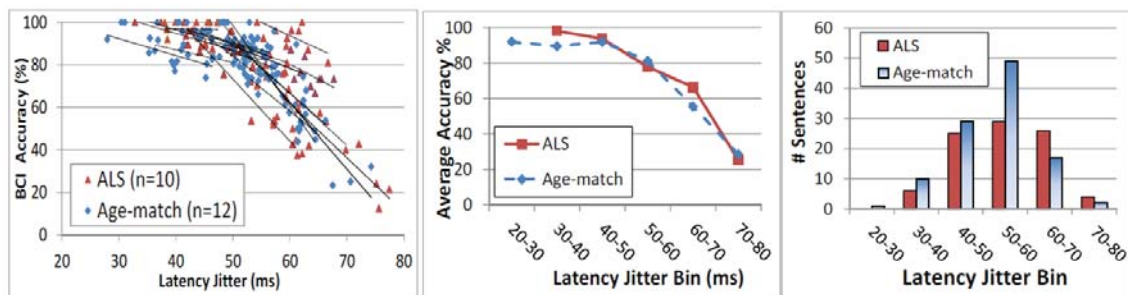


Fig. 1: Relationship between latency jitter and BCI accuracy for individual sentences with regression lines by subject (left), average accuracy by latency jitter bins (middle), and distribution of latency jitter for subjects with ALS and age-matched controls (right).

Discussion: Our ALS group showed higher incidence of latency jitter than age-matched controls despite a relatively minor level of physical impairment. This raises the concern that with increased impairment, the need to use covert attention for BCI operation would further increase the amount of latency jitter and could make a BCI unusable. While the cause for increased latency jitter in the ALS group is not yet known, it is known that latency jitter is greater with impaired attention [4], which is the most common cognitive symptom of ALS [7].

Significance: The high occurrence of latency jitter among people with ALS and its detrimental effect on BCI performance make development of P300 detection methods that are robust to latency jitter a top priority.

Acknowledgements: This study was carried out with support from NIH Grant #R21HD054697 and NIDRR Grant #H133G090005. The views presented here are those of the authors, not of the funding agencies.

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