

Aim: Evaluate the reliability of EEG-based markers of cognition to facilitate research into cognitive changes over time in ALS

Background

- EEG is safe, well-tolerated, and cost-effective: well-suited to longitudinal cognitive research
- Preliminary work for this study was presented at the International Symposium on ALS/MND 2020. This update includes:
 - 4 new subjects
 - Quantitative results

Methods

Healthy volunteers	Age	Sex	Time of sessions
n=10	25.9 ± 2.54 years	50% Female 50% Male	50% AM 50% PM

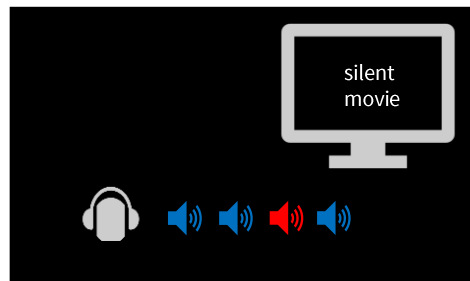


Fig 1. Auditory frequency oddball paradigm. Participant listens passively to a string of standard and deviant tones while watching a silent movie.

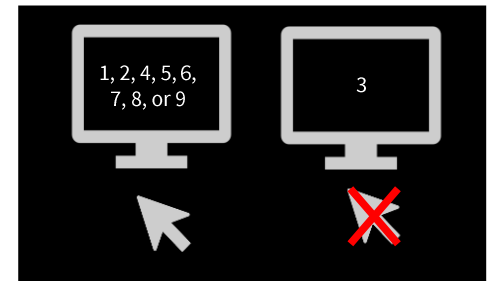


Fig 2. Sustained Attention to Response Task Participant clicks a computer mouse in response to the digits 1, 2, and 4-9, while withholding a response to 3.

- **Repeated EEG visits:** two consecutive days, same time of day
- 5 features identified from **MMN** (auditory oddball task) and **P300** (SART) components:
 - Amplitude and latency of the peak, average amplitude and latency of the component, area under the component
 - **Intraclass correlation coefficient** (two-way, random effects, absolute agreement model)¹ calculated for each feature between days at Fz, Cz, and Pz

Results

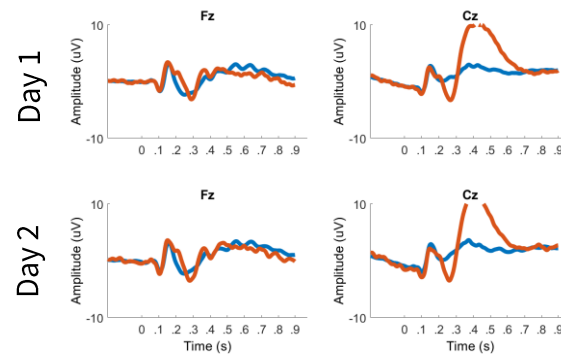
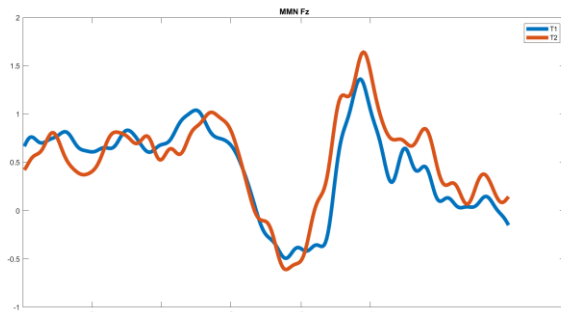


Figure 3. Group average MMN and SART responses MMN responses are shown at the Fz electrode. SART (P300) responses are shown at electrodes Fz and Cz.

Table 1. Intraclass Correlation Coefficients of MMN and P300 component features. Intraclass correlation coefficients (ICC) of amplitude and latency of the peak, mean amplitude and latency, and area under the component for MMN and P300 components across two days, listed with lower bound (LB), upper bound (UB), and coefficient of variation (CoV) at frontocentral (Fz), central (Cz), and parietocentral (Pz) electrodes. Common ranges for ICC interpretation are: <0.5- poor; 0.5-0.75- fair; 0.75-0.90- good; >.90- excellent. Negative ICC values reflect greater variation among subjects than between days.

MMN	Fz				Cz				Pz			
	ICC	LB	UB	CoV	ICC	LB	UB	CoV	ICC	LB	UB	CoV
Amplitude of peak	0.781	0.174	0.945	-0.363	0.815	0.315	0.953	-0.684	0.265	-2.922	0.828	-0.738
Latency of peak	0.537	-0.449	0.876	0.164	0.252	-2.934	0.824	0.356	-0.905	-25.413	0.598	0.460
Mean amplitude	0.664	-0.396	0.917	-0.874	0.532	-0.737	0.881	-1.356	-0.633	-13.364	0.643	1.554
Mean latency	0.793	-0.130	0.954	0.120	0.382	-2.072	0.854	0.238	-0.482	-3.451	0.804	0.190
Area under component	0.493	-0.699	0.867	-0.602	0.685	-0.111	0.919	-0.771	-0.673	-14.194	0.635	-1.085
P300	Fz				Cz				Pz			
	ICC	LB	UB	CoV	ICC	LB	UB	CoV	ICC	LB	UB	CoV
Amplitude of peak	0.828	0.309	0.957	1.004	0.943	0.772	0.986	0.433	0.975	0.867	0.994	0.510
Latency of peak	0.907	0.649	0.977	0.160	0.416	-1.908	0.862	0.100	0.703	-0.252	0.927	0.100
Mean amplitude	0.935	0.739	0.984	1.079	0.939	0.749	0.985	0.509	0.939	0.758	0.985	0.678
Mean latency	-0.004	-2.508	0.741	2.860	-0.243	-3.892	0.690	0.520	0.353	-1.181	0.831	0.758
Area under component	0.898	0.610	0.974	0.574	0.939	0.749	0.985	0.181	0.971	0.889	0.993	0.114

Discussion

- Many of the selected biomarkers show moderate or greater reliability (ICC>0.5) and several show excellent reliability (ICC>0.9).
- Reliability of these methods varies greatly depending on waveform features and electrodes of interest, highlighting the importance of choosing appropriate biomarkers during study design.
- **Good test-retest reliability justifies the use of cognitive EEG biomarkers for the longitudinal study of cognition in ALS, which will aid the development of cognitive treatments and supports for those living with ALS**