

Effects of Deep Brain Stimulation on Mismatch Negativity in Parkinson's Disease

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DEEP brain stimulation (DBS) through an electrode implanted in the subthalamic nucleus (STN) is often associated with significant improvement of motor complications in patients with treatment-resistant Parkinson's disease (PD), yet its effects on attentive information processing remain obscure. Auditory mismatch negativity (MMN) is an event-related potential (ERP) component that is elicited by any discernible deviant sound in a sequence of repetitive acoustic stimuli irrespective of intentional attention, and thus, signifies automatic stimulus discrimination in the pre-attentive processes. In the present study electroencephalogram (EEG) signals were recorded for PD patients without the surgery (DBS Naive; age: 55.7±8.9; gender: 7M/2F; disease duration: 11.0±3.4) and with the electric stimulation turned on (DBS On, 3.5±1.5 months after surgery; age: 60.1±6.7; gender: 9M/5F; disease duration: 9.5±3.8) in a 3-stimulus oddball paradigm. MMN generated by both rare and novel stimuli were found diminished in amplitude and delayed in latency for patients with DBS, suggesting a possible inhibitory action of STN stimulation on involuntary shifts to changes in the environment.

Paradigm: 3-Stimulus Auditory Oddball

Stimuli: 70% standard, 15% deviant and 15% novel tones

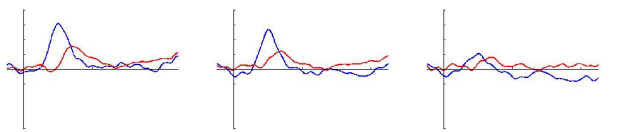
Task: Watching a relaxing silent movie and ignoring the auditory stimuli

Stimulus Duration and Inter-Stimulus Interval: 125+475 ms

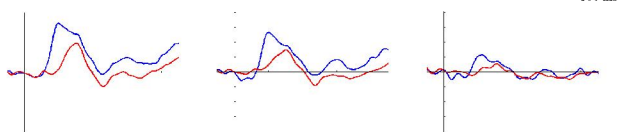


Mismatch Negativity: A negativity displacement in particular at the frontocentral and central scalp electrodes in the difference wave by subtracting the ERP to standard stimuli from that to deviant/novel stimuli ^[1]

Deviant – Standard (D-S)



Novel – Standard (N-S)



Fz

Cz

Pz

Electrode	DBS Naive —		DBS ON —	
	Amplitude (µV)	Latency (ms)	Amplitude (µV)	Latency (ms)
	D-S/N-S	D-S/N-S	D-S/N-S	D-S/N-S
Fz	-6.05/-6.59	101/100	-2.99/-3.92	143/152
Cz	-5.26/-5.17	102/101	-2.39/-2.87	139/152
Pz	-2.05/-2.21	101/111	-1.57/-1.04	139.154

Amplitude: A significant main effect for Group (DBS Naive v.s. DBS ON) at Fz and Cz; None for Type (D-S v.s. N-S); Only a significant interaction at Cz

Latency: A significant main effect for Group at Fz and Cz; None for Type or interaction

Conclusion

The results indicate that STN-DBS might impair PD patients' ability to selectively attend and respond to rare auditory stimuli. The STN and therefore the basal ganglia probably contribute to the generation of MMN.

REFERENCES

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- [2] K. S. Brønnick, H. Nordby, J. P. Larsen and D. Aarsland, "Disturbance of automatic auditory change detection in dementia associated with Parkinson's disease: A mismatch negativity study", *Neurobiol Aging*, vol. 31, pp. 104-113, Apr 2008.

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