

# Effects of Vagal Nerve Stimulation Frequency on Cognitive Function in Refractory Epilepsy Patients

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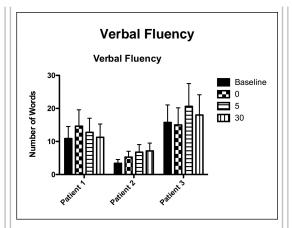
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### Introduction

Epilepsy often leads to persistent cognitive deficits. Spatial memory deficits have been correlated with hippocampal dysfunction and reduced hippocampal theta oscillations. Increases in theta power have been associated with encoding of episodic memory in humans. In the following study, we assessed the effects of vagal nerve theta and gamma stimulation on cognition, including attention, processing speed, spatial working memory and memory retrieval.

### **Methods**

Three patients with medically refractory epilepsy and a previously implanted vagal nerve stimulator underwent cognitive testing at different frequency settings in a randomized order (0 Hz, 5 Hz and 30 Hz). Baseline cognitive testing included performing the Stroop task, N-Back 1 and 2 tasks and a verbal fluency test at the patient's baseline gamma frequency setting. Three days later, the patient repeated the same tasks at three different frequencies (0 Hz, 5Hz and 30 Hz). Reaction time and accuracy were analyzed for the Stroop tasks and Nback tasks. Vocabulary size was analyzed for the verbal fluency task.



## **Results**

In one patient, theta frequency (5 Hz) vagal nerve stimulation resulted in significantly faster reaction times on the congruent and incongruent Stroop tasks as well as the N-Back 1 and N-Back 2 tasks relative to no stimulation and gamma stimulation (30 Hz, p<0.05). In the other two patients, there was no significant change in reaction time for the Stroop tasks or N-back tasks. Additionally, there was no difference in verbal fluency vocabulary size or accuracy in the Stroop or N-back tasks in any of the stimulation paradigms.

#### **Conclusions**

Preliminary results from this trial suggest that vagal nerve theta stimulation may improve cognition in select patients. Further studies are necessary to delineate the effects of vagal nerve theta stimulation on cognition and determine which patients may benefit from theta frequency stimulation.

## **Learning Objectives**

- 1.Short-term vagal nerve theta stimulation does not worsen accuracy or reaction time on cognitive tasks, such as attention, processing speed, spatial working memory and memory retrieval.
- 2.Short-term vagal nerve gamma stimulation does not worsen accuracy or reaction time on cognitive tasks, such as attention, processing speed, spatial working memory and memory retrieval.
- 3.In certain patients, vagal nerve theta stimulation may improve reaction time on cognitive tasks, such as attention, processing speed, spatial working memory and memory retrieval.

