



# Effect of rTMS on Inhibitory Control in Depression: Go/NoGo Commission Error Improvements

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## BACKGROUND

Research has found depression to cause dysfunction in cognition as well as emotional and physical disturbances (Drevets & Furey, 2009).

Low neuronal density has been found in suicidal individuals specifically in the dorsal prefrontal cortex and ventral prefrontal cortex. The ventral prefrontal cortex has also been linked to cognitive inhibition (Boldrini & Mann, 2015).

Furthermore, individuals with depression allocate most of their limited neuronal resources in processing emotional information thus significantly reducing neuronal power for effortful cognitive tasks (Gotlib & Joormann, 2010).

rTMS is a proven, non-invasive treatment for ameliorating depression symptoms in MDD patients but more information is needed on the effects of rTMS on cognitive deficits (Brunelin et al., 2007).

Objective: The current study investigated whether rTMS treatment improved inhibitory control for 18 patients diagnosed with Major Depressive Disorder (MDD) using a Go/NoGo task.

## METHODS

### Participants

- N= 18, M= 8, Age= 21-67 years old
- Primary Diagnosis: Major Depressive Disorder

### TMS Treatment

- TMS Treatment occurred 5 times a week for six to eight weeks.
- 5 patients received unilateral TMS treatment on the left dorsolateral prefrontal cortex (DLPFC) for 30 minutes.
- 13 patients received bilateral DLPFC TMS treatment for 1 hr. each day.
- Standard unilateral and bilateral TMS treatment protocol was used.
- Participants completed the PHQ9 depression scale before starting treatment, during each week of treatment, and at the end of treatment.
- The EEG/ Cognitive Assessment was given to patients within a week before the patient started their round of TMS treatment and within 2 weeks after completing their treatment course.
- The EEG/ Cognitive assessment consisted of 3 parts:
  - Baseline EEG data collected with eyes open
  - Baseline EEG data collected with eyes closed
  - Task EEG & performance data collected during Go/NoGo reaction time assessment.

### Task

The Go/NoGo task is commonly used to assess response inhibition and attention in a population, and paired with electrophysiological measures can yield cognitive processing information (Bokura et al., 2001; Figure 1).

EEG was acquired before and after rTMS therapy while patients completed a Go/NoGo task. Patients were required to respond to target stimuli (large blue circle) and withhold a response to non-target stimuli (small blue circle, non-speech auditory sound, and a checkerboard).



Stimulus Type	Stimulus	Stimulus Description	Type of Response
Go		Large Blue Circle-Target Item	Respond
No-Go		Small Blue Circle	Withhold Response
No-Go		Checkerboard	Withhold Response
No-Go		Non-speech Auditory Stimulus	Withhold Response

Figure 1. Image of EEG & Go/NoGo Assessment adapted from Evoke Neuroscience Inc. 2016.

## RESULTS

### TMS Treatment Results

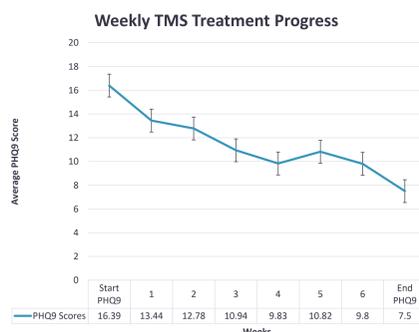


Figure 2.

TMS Treatment Response Rate

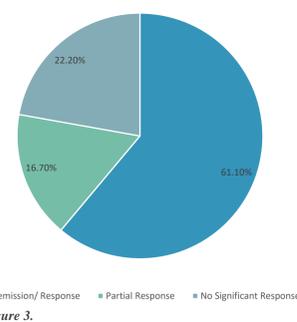


Figure 3.

On average, the patients diagnosed with MDD show a 61.1% improvement of depression symptoms after rTMS therapy.

Specifically, the patients show an average decrease from their initial PHQ9 score of approximately 8.89 points on the PHQ9 after rTMS therapy.

### Go/NoGo Performance Results

Paired Sample T-Test Model Summary at Pre-Testing and Post-Testing

Measures	Mean (SD)		t	df	p
	Pre	Post			
Commission Errors	0.998 (1.19)	0.41 (0.33)	2.32	17	0.03*

Figure 4. \*p ≤ .05

A paired-samples t-test was conducted to compare commission errors (CE) on the Go/NoGo task before and after rTMS treatment. There was a significant difference between CE scores before rTMS treatment (M= 0.998, SD=1.19) and after rTMS treatment (M=0.41, SD=0.33, n= 18) (t[17]= 2.32, p = 0.03).

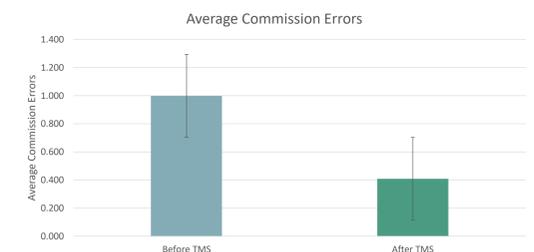


Figure 5.

## IMPLICATIONS

The findings suggests that patients with MDD made fewer errors when trying to discriminate between target and non-target stimuli in the Go/NoGo task after rTMS treatment, implying possible increase in inhibitory control, improved visual discrimination, and overall improvements in attention-based tasks.

Furthermore, increase in inhibitory control in depressed individuals may lead to restoration of function and serotonergic input in the ventral prefrontal cortex (VPFC) region of the brain, therefore, decreasing suicidal tendencies.

## ACKNOWLEDGMENTS

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