The pathophysiology of neurodegenerative disorders is linked to neurophysiological changes (See Figure 1). Microstate time series can provide insight into the neural activity of the resting brain. EEG microstate topographies, called "microstates", are topographies of electric potentials recorded across the scalp in a multichannel recording. These different topographies are found by sliding a template of the brain over the scalp record, looking for the best match. Microstate topographies change according to behavioral states, personality types, and neuropsychiatric disorders. Studies suggest that microstate time series can provide insight into the neural activity of the resting brain. EEG microstate analysis has been proposed as a powerful, inexpensive, and potentially clinically feasible neurophysiological method to examine and evaluate the global functional states of the brain in health and disease. The resting-state EEG recording is a powerful method to compare microstates in the same subject at different times. This analysis may be a powerful tool for determining neurophysiological disturbances in neurodegenerative diseases and monitoring the effects of novel neuromodulation methods, such as rTMS.

In an EEG-fMRI study on Dementia with Lewy bodies patients, Schumacher et al. found that functional connectivity in the thalamocortical and thalamo-striatal circuits was significantly correlated with dopaminergic markers in the striatum. The authors concluded that changes in microstate D, which is related to dopaminergic markers in the striatum, may be an indicator of dopaminergic deficiency in certain brain regions in schizophrenia, and another study in PD, a disease affecting dopamine, concluded that microstate D could be an indicator of dopaminergic deficiency. Changes in microstate D, which we also found in our study, may be associated with motor impairment and dopamine deficiency in PD. Increasing the probability of transition from Microstate D to Salience network Microstate C might indicate that a TMS session is reflecting the recovery of microstate D.

Methods: The study included right-handed 8 patients (1 female, 7 males). The motor symptoms were evaluated with the Unified Parkinson's Disease Rating Scale (UPDRS). Ten sessions of rTMS with 5 Hz frequency were applied to the left pre-SMA region over two weeks. The resting-state EEG was recorded on eyes closed condition with BrainAmp 32 channel DC system. The resting-state EEG recordings and clinical assessments were performed once before the TMS sessions and repeated one week after the last session. The microstates analyses were performed using Microstates analysis tool into MATLAB for EEGLAB (http://www.thomasoescio.com/download/EEGLAB_Microstates). For statistical analysis, JAMOVI was used. For all tests, the significance value was accepted as p<0.05.

Discussion and Conclusion
This study highlights that PD has different microstate parameters that may be specific to movement disorders, rTMS treatment in pre-SMA region has a great potential to interfere with the functional state of the brain. Microstate analysis can be a potential tool for determining neurophysiological disturbances in neurodegenerative diseases and monitoring the effects of novel neuromodulation methods, such as rTMS.

References

Table 1: Demographic data of the studied groups and sequential distribution. For statistical analysis, paired student's t-test was used. HC: healthy controls.