Cognitive Functional Connectivity Analysis of Early MS Patients Using Graph Theory

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ABSTRACT

Alternations in connectivity are the result of specific of pathology of multiple sclerosis (MS) that can lead to physical and cognitive dysfunction. The deficits in MS were reported in many various cognitive domains like working memory, attention, speed of information processing and executive functions. The aim of this study is assessment of connectivity differences in brain using fMRI data under the determined cognitive task between MS patients in the early stages and healthy controls.

Paced Auditory Serial Addition Task (PASAT) in Persian version was administered to analyze the functional networks constructed using Graph theoretical and connectivity measure with linear correlation in patients with CIS and RRMS and healthy subjects. During the task, a random series of single numbers was presented in an auditory way, and the subjects were required to add the two last numbers immediately and reported the result by pressing the response box keys in comparing with target number. After data collecting and preprocessing, the averaged fMRI time series were extracted for 116 nodes that selected based on AAL atlas. The correlation matrices of between each two time series were computed. Then the resultant correlation matrices are thresholded to yield the binary matrices by windows thresholding method. The most commonly network parameters were calculated and compared to differentiation.

Graph analysis suggests that some measures such as modularity could be consider as a reliable indicator related to cognitive deficits in earliest stage of MS patients. These results show how cognitive functional connectivity can globally effect by structural damage.
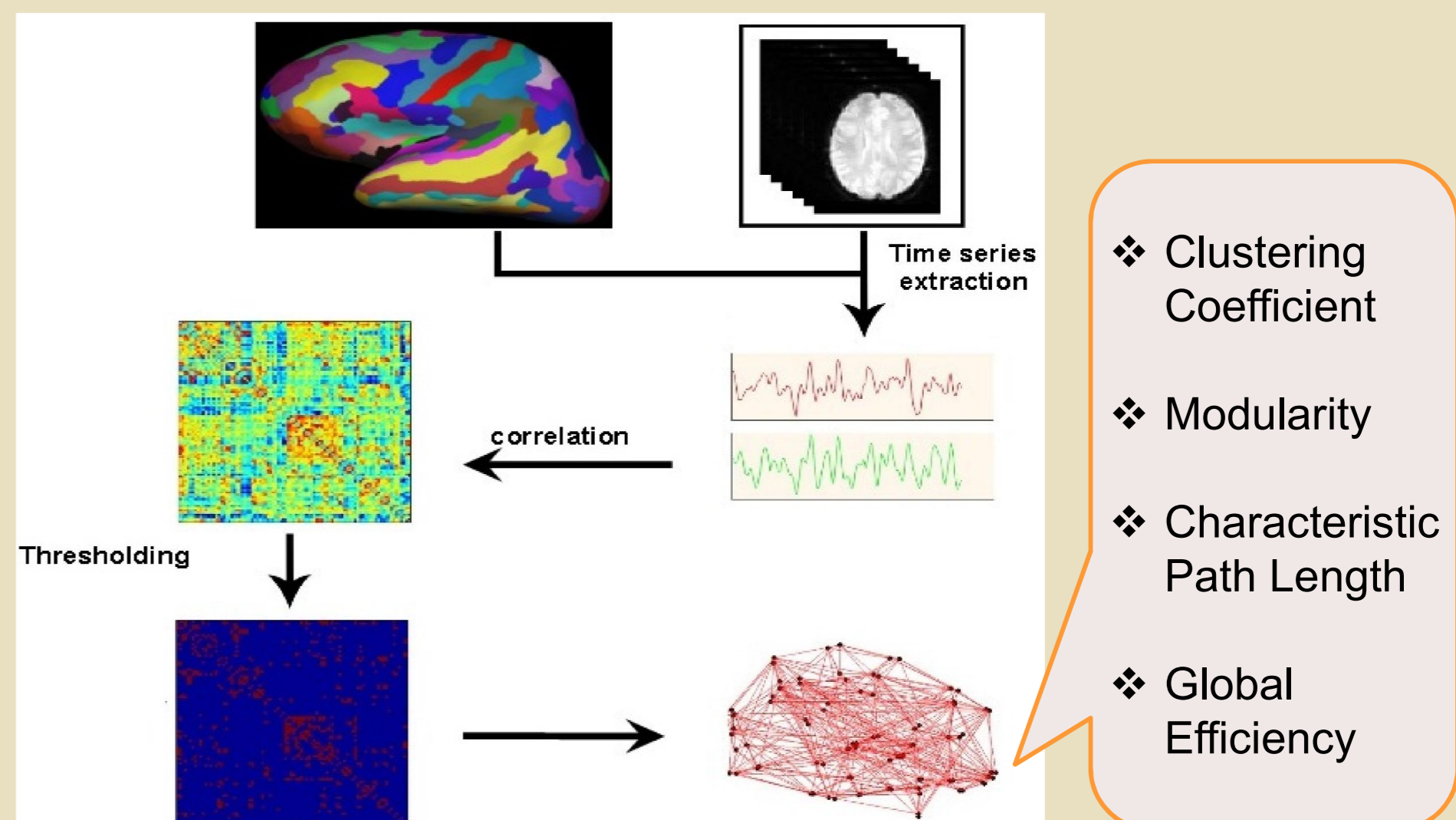
OBJECTIVES

To investigate of changes in graph measures of cognitive functional network in early MS patients

MATERIALS & METHODS

Subjects	CIS and RRMS	Healthy Control
Gender, F/M	6/1	8/4
Handedness	Right-handed	Right-handed
Age range (years) (median)	$20 < 27 - 44 \leq 45$ (35.28)	23 - 40 (30.58)
Disease duration (months) (median)	8 - 96 (3 years)	-
EDSS score	≤ 3	-

Paced Auditory Serial Addition Task (PASAT)
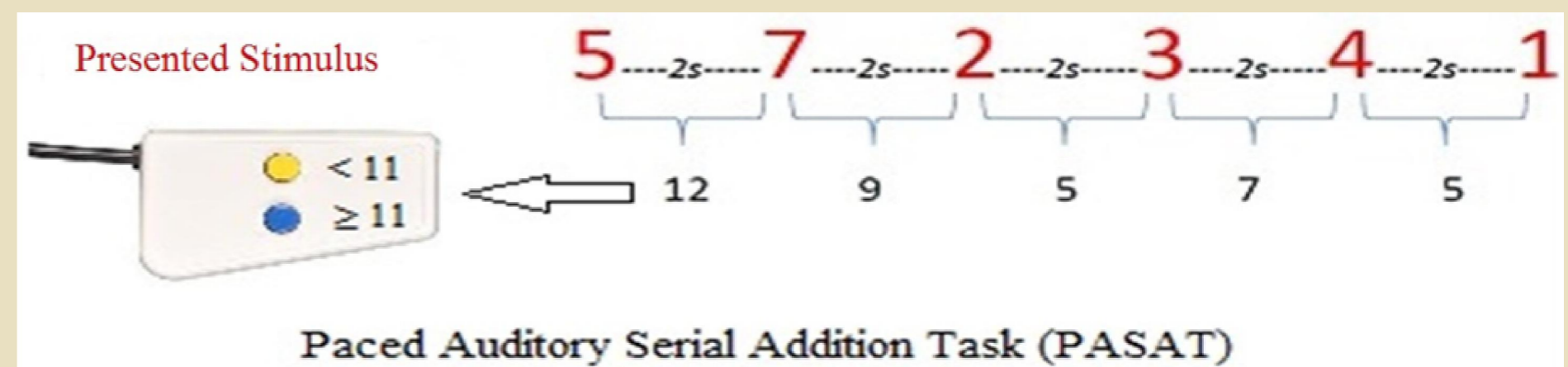
> **Functional MR images:** 3.0 Tesla Siemense scanner
>
> EPI sequence, TR = 2 s, TE = 30 ms, voxel size = $3 \times 3 \times 4$ mm^3
>
> **Structural images:** high resolution 3D T1-weighted MPRAGE sequence

- ❖ Clustering Coefficient
- ❖ Modularity
- ❖ Characteristic Path Length
- ❖ Global Efficiency

CONCLUIONS

- Since neural disconnections in MS seem to result in cognitive decline, we expect differences in the network features that can possibly help to further understanding about early cognitive disorders during disease progression.

- The significant changes in modularity as a measure of functional segregation support this hypothesis that modularity can utilize as a cognitive impairments representation.

RESULTS