# Delayed conscious access related to associative white matter fiber tracts injury in patients with early Relapsing Remitting Multiple Sclerosis

**F. Reuter[1], B. Audoin[1], A. Delcul[2], S. Confort-Gouny[1], J-P. Ranjeva[1], P. J. Cozzone[1], S. Dehaene[2], and J. Pelletier[1]**

[1]Centre de Résonance Magnétique Biologique et Médicale (CRMBM), CNRS UMR 6612, Faculté de Médecine de Marseille, Université de la Méditerranée, Marseille, France, [2]SHFJ, CEA, Orsay, France

## Objective

In the first stage of visual perception, the visual stimulus is processed by a series of brain areas activated in a bottom-up manner. In a second stage, top-down feedback from higher areas to lower-level sensory regions establishes a self-amplified reverberant neuronal assembly which connects together distant brain areas, and is associated with conscious reportability (Dehaene et al, 2004). During visual backward masking task, a stimulus can fail to reach consciousness if the mask replaces the stimulus before this recurrent activity has become stable (Delcul et al, 2006). We infer that in patients with early multiple sclerosis, where diffuse myelin injury has been previously demonstrated (Audoin et al, 2005), breakdown of large-scale cortical integrative processes may induce backward masking deficit that corresponds to a deficit in the late stages of conscious perception, whereas early bottom-up subliminal processing is preserved.

## Method

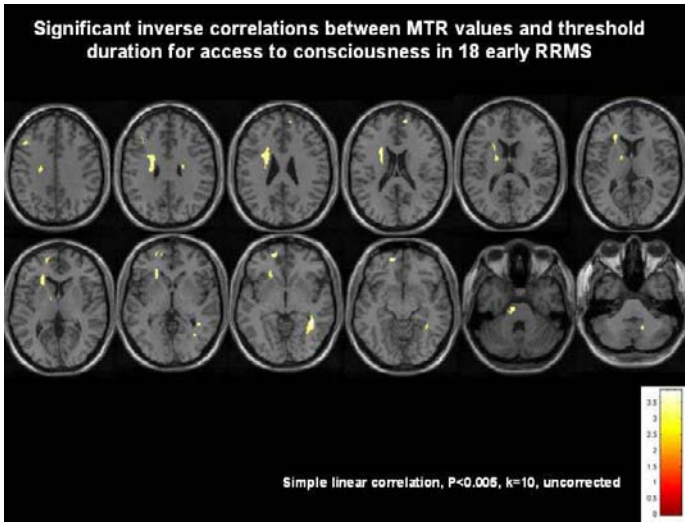
We performed a backward masking study in 18 patients with early MS and 18 healthy controls. We used Arabic digits as stimuli and varied quasi-continuously the interval with a subsequent mask to progressively "unmask" the stimuli. This manipulation allowed us to study the subliminal priming effect caused by these variably masked numbers. We also quantified their degree of visibility to evaluate the threshold duration for access to consciousness. In addition, Magnetization Transfer Ratio (MTR) imaging of the brain was carried out in patients. Statistical analysis of white matter MTR maps was performed using a voxel by voxel analysis (SPM2, linear correlation $p<0.005$, $k=10$; verified using spearman rank test on cluster means).

## Results

The threshold delay between digit and mask necessary for the conscious perception of the masked stimulus was longer in patients compared to control subjects ($p<0.0254$). Subliminal priming of masked numbers was identical in patients compared to controls ($p=0.47$). In patients, the threshold duration for access to consciousness was inversely correlated with regional MTR values in the bilateral superior prefrontal WM, the right dorsolateral prefrontal, the bilateral occipito-frontal fasciculi, the left inferior frontal fasciculus, the left optica radiata, the pons and the left cerebellum.

## Conclusion

In early MS, breakdown of long distance associative fiber tracts may constitute the anatomical substrate of delayed access to consciousness.




## References

Delcul, A., Dehaene, S., & Leboyer, M. (2006). Preserved subliminal processing and impaired conscious access in Schizophrenia. *Archives of general psychiatry, in press*.

Dehaene, S., & Changeux, J. P. (2004). Neural mechanisms for access to consciousness. In M. Gazzaniga (Ed.), *the cognitive neurosciences* (3rd ed., pp. 1145-1157). New York.

Audoin, B., Au Duong, M. V., Ranjeva, J. P., Ibarrola, D., Malikova, I., Confort-Gouny, S., et al. (2005). Magnetic resonance study of the influence of tissue damage and cortical reorganization on PASAT performance at the earliest stage of multiple sclerosis. *Hum Brain Mapp, 24*(3), 216-228.