

BRAIN ACTIVATION ASSOCIATED WITH SUBLIMINAL READING STIMULI IN DYSLEXICS AND NORMAL READERS – AN FMRI STUDY

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Background: Compatibility effect (CE), is a modulation of the motor response time to a target stimulus by a preceding prime stimulus that is either compatible or incompatible with the target stimulus. Using masked prime tasks it was shown that sensory information that has not been consciously perceived can nevertheless prime a subsequent motor response (1). Previous studies used right/left pointing arrows as both the prime and the target stimuli. They found that when the target is presented immediately after the prime, increased response times are observed for incompatible trials, and shorter response times for compatible trials [the positive compatibility effect (PCE)]. However, when the interval between prime and target is increased (>80 ms) the effect is reversed [the negative compatibility effect (NCE)].

This research uses a similar motor task with masked word prime stimuli in order to check if the same results will be obtained for masked word instead of arrow sign. In addition, a group of dyslexic subjects were included in the study, expecting them to be unaffected by masked word prime due to their inability to attain effortless, fast and accurate word identification.

- Aims:** 1. Behavioral: to investigate CE with a modified paradigm including masked word instead of an arrow sign.
 2. fMRI: to identify the brain activity associated with this task.
 3. To compare the behavioral and brain activity of dyslexics and normal readers.

Methods: *Participants:* 6 dyslexic subjects and 10 normal readers participated in 20 fMRI sessions combined with behavioral measurements acquired during fMRI scanning.

Task: Participants were instructed to respond as fast and accurately as possible with a left/right button-press to a left/right-pointing arrow target, respectively. The target was preceded by masked prime stimuli, which were the words left/ right. The prime's direction was either the same or opposite directions as the target's (compatible and incompatible trials), respectively. In a control experiment the prime words were irrelevant to the task.

fMRI measurement: T2* weighted BOLD contrast (TR/TE 3000/35, FA 90°, SW 3 mm, 0.4 mm gap, FOV 22 cm, matrix 64X64 resulting in 3.4X 3.4 mm² in plane resolution) images were acquired using 3T MRI (GE EXCITE 3 HD) and 8-channels head coil. fMRI data were analyzed using SPM2 with first level and second level (group) analysis. **Behavioral results** were acquired during fMRI scanning.

Results: *Behavioral results:* Surprisingly, CE was found only for the dyslexic group. The data replicate the classic masked priming effect - PCE when the prime-target interval is short, and the reverse, NCE when the interval is long (fig 1). No significant CE was found for the normal readers groups and for both groups in the control experiment (irrelevant masked prime words).

fMRI Results: In general the masked prime word stimuli initiated activity in frontal regions of motor decisions and language areas including Broca's and Wernicke's areas, in the left hemisphere (fig 2., green blobs). This activity is typical for reading processes.

For the dyslexic group, findings indicate a stronger activity in visual and language regions equivalents in the right hemisphere, which is not typical for regular reading processes (fig. 2 red blobs). These findings may suggest that CE found for dyslexic subjects is related to processing of subliminal sensory input in the language areas equivalents in the right hemisphere.

Discussion: The current finding of CE induced by a brief masked word prime in the dyslexics extends our previous report (2) of the improved reading ability of dyslexics at high reading rates. Right hemisphere involvement in language processing of dyslexics was suggested as a compensatory mechanism in previous papers (e.g. 3).

- Conclusions:** 1. Word perception exists without awareness.
 2. Behavioral and brain activity results indicated that CE and the perception and processing of a subliminally word stimulus in the right hemisphere occurred only in the dyslexic subjects.

- References:** 1. A.R.Aron, F.Schlaghecken, P.C.Fletcher, et. al., Brain 126, No. 3, 713-723, 2003.
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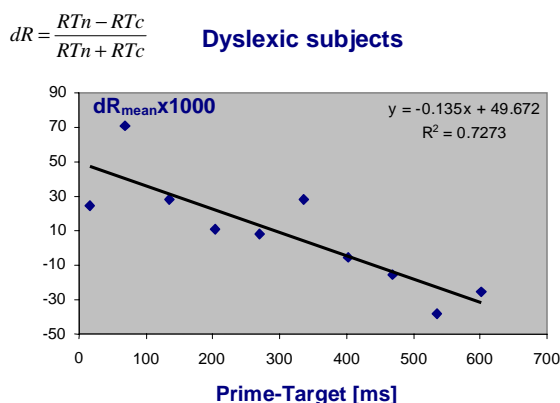


Fig. 1: CE in dyslexic subjects.
 RTc, RTn – compatible and non-compatible response times.

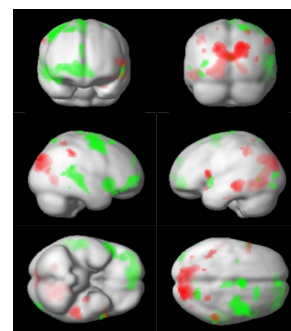


Fig. 2: fMRI Results.
 Green – Overall activation associated with the tasks.
 Red – Dyslexics > Normal readers