

ABNORMAL FUNCTIONING OF THE LEFT TEMPORAL LOBE IN LANGUAGE-IMPAIRED CHILDREN

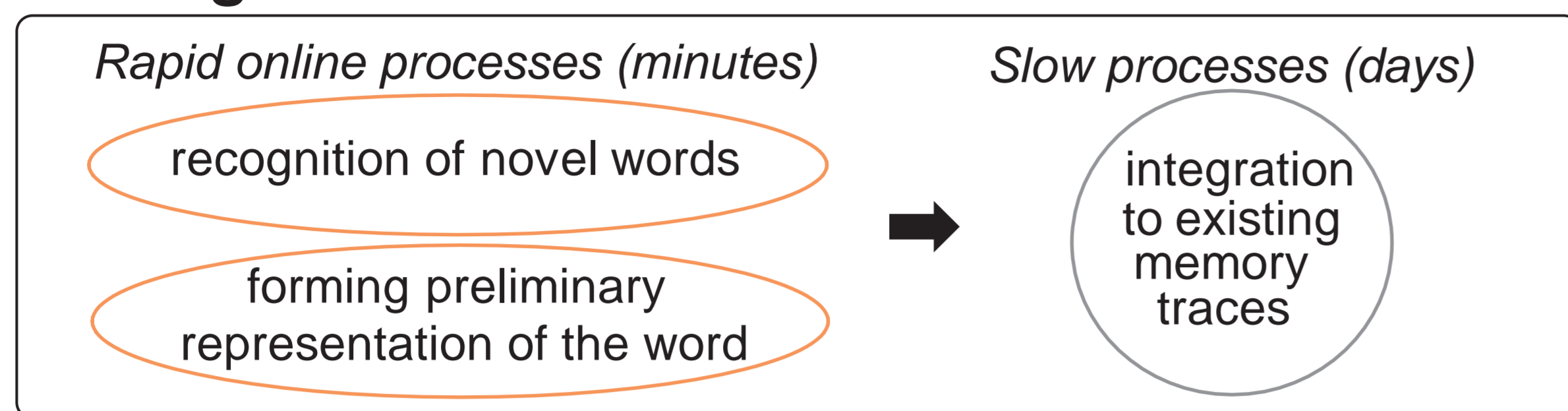
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INTRODUCTION

Specific language impairment (SLI)

pervasive impairments in speech perception; limited vocabulary and poor verbal short-term memory (1,2)

Learning new words



Rapid processes involved in word learning were followed in SLI and non-impaired children in the left and right hemisphere using magnetoencephalography (MEG)

METHODS

Subjects

Children (mean age 9 yrs 7 months; range 106 – 127 months) from 'Etiology of dysphasia, symptoms and prognosis' -project

- 10 with no history of language impairment
- 11 children with a diagnosed SLI

COGNITIVE PROFILE OF THE TWO SUBJECT GROUPS

Tests	Controls	SLIs	significant P
Vocabulary (a)	26.0 (7.1)	17.8 (10.3)	C > SLI
Block design (a)	43.5 (6.7)	44.8 (11.1)	
Digit span score (a)	7.0 (1.2)	5.9 (1.0)	C > SLI
Pseudoword repetition (b)	12.5 (0.8)	10.2 (2.3)	C > SLI
Sentence repetition (b)	26.6 (1.8)	22.9 (4.0)	C > SLI
Phonological processing (b)	31.9 (3.3)	27.7 (2.2)	C > SLI
Sentence reading (c)	13.2 (3.1)	10.8 (4.1)	
Reading speed (/min)	83.1 (35.5)	63.4 (30.5)	
Naming speed (ms)	46.6 (9.8)	48.4 (7.9)	

(a) WISC-III (Wechsler, 1991), (b) NEPSY (Korkman et al., 1998)
 (c) ALLU (Elementary School Reading Test, Lindeman et al., 1998)
 standard deviations in parentheses, ■ Control children > SLIs

Stimuli, experimental setup and subjects

- spoken real words (150 items) and pseudowords (100 items)
- duration 550 ms (7-8 letters), presented every 2.5 seconds
- 75 real words repeated immediately after the first presentation
- total length of the experiment 8 + 8 minutes

"listen to the stimuli and respond to proper names by button press" (probability 6%)

306-channel Elekta Neuromag with continuous head position tracking and movement compensation (3)



EVOKED RESPONSES - CONTROL CHILDREN

Adults: N100 response followed by a longer-lasting N400 response (4,5)
Children: N100, N250 and a delayed N400 response (maximum ~ 600 ms)
N400 activation: attenuated by the immediate repetition of spoken words

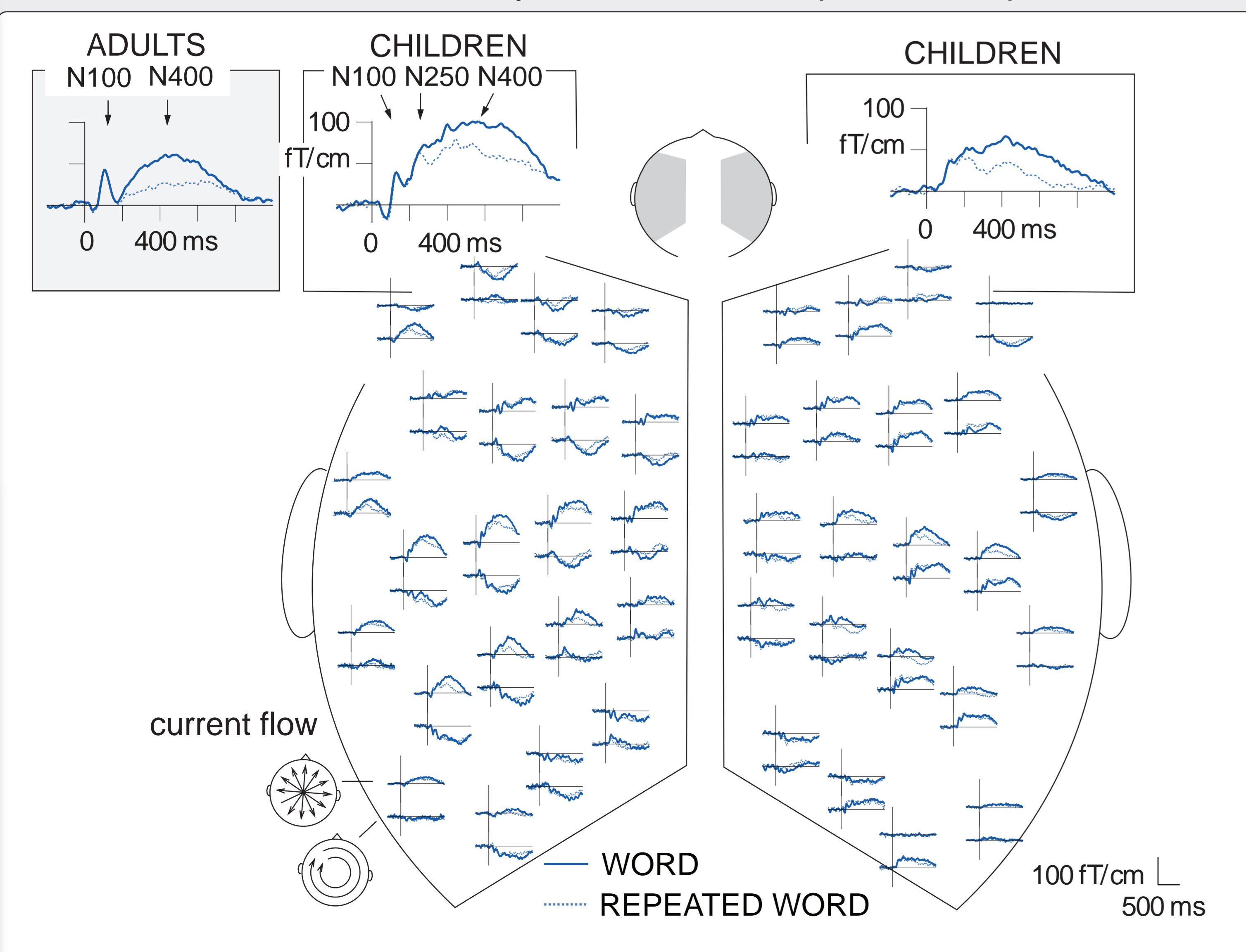


Fig 1. Mean evoked responses recorded by planar gradiometer MEG sensors and calculated across 10 control children to spoken words presented for the first time and to their immediate repetitions. The responses are displayed for the 22 channel pairs centered above the temporal areas that show the maximum signal.

MINIMUM CURRENT ESTIMATES - CONTROL CHILDREN

Activation centers around the bilateral superior temporal cortices during the N100, N250 and N400 responses.

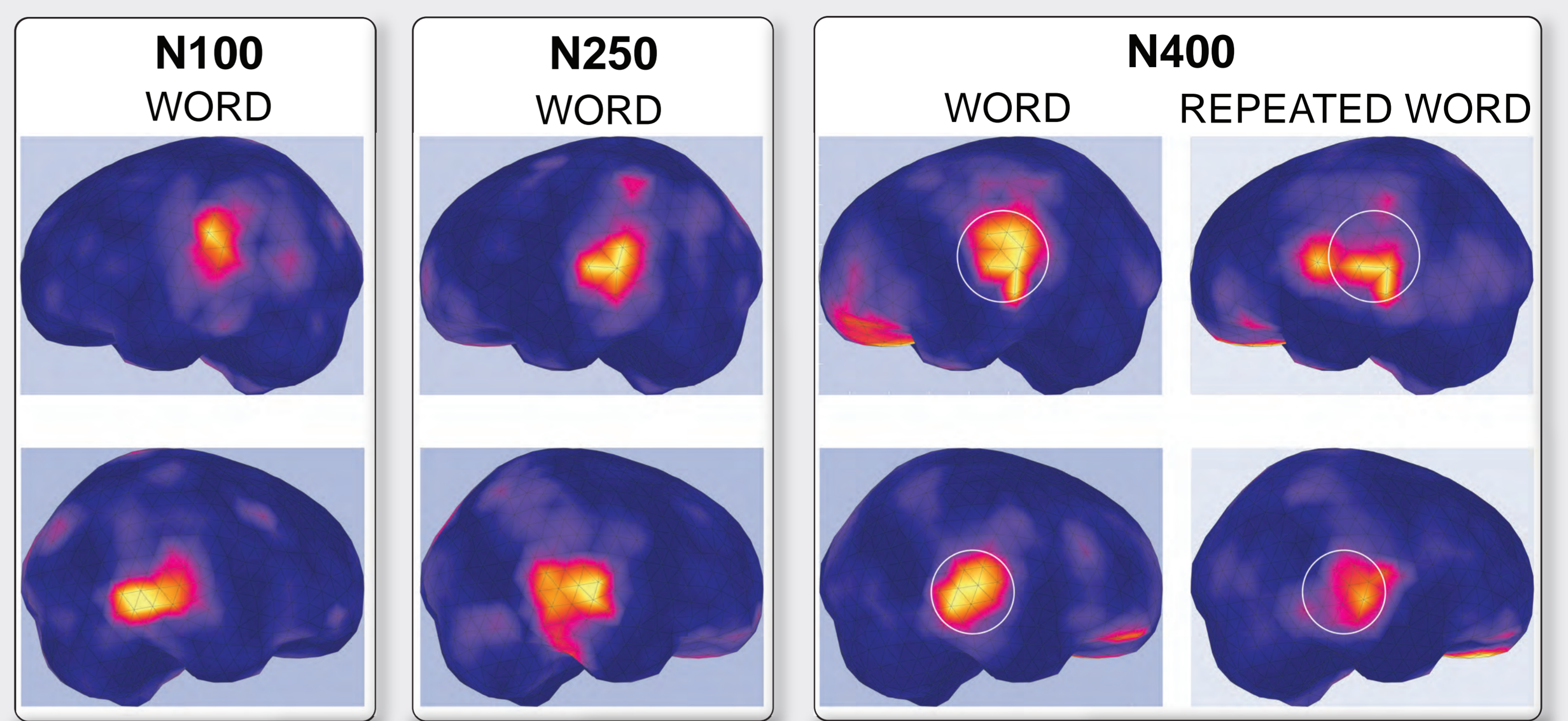


Fig. 2. MCEs (6) for spoken words during the N100, N250 and N400 responses. The estimates were calculated for each child and then averaged across all control children using a default brain model. Activation is integrated over 120-140 ms (N100), 230-270 ms (N250) and 400-600 ms (N400).

CURRENT DIPOLES - SLI AND CONTROL CHILDREN

The bilateral N400 responses modeled as equivalent current dipoles (7)

Representations - Activation to new vs. repeated words

- Onset phase of the N400 reflects activation of lexico-semantic representations (4,5)
- SLI children: the repetition effect (index of short-term maintenance of activation) 400-600 ms after word onset was nonexistent in the left hemisphere (in control children $p < 0.04$).

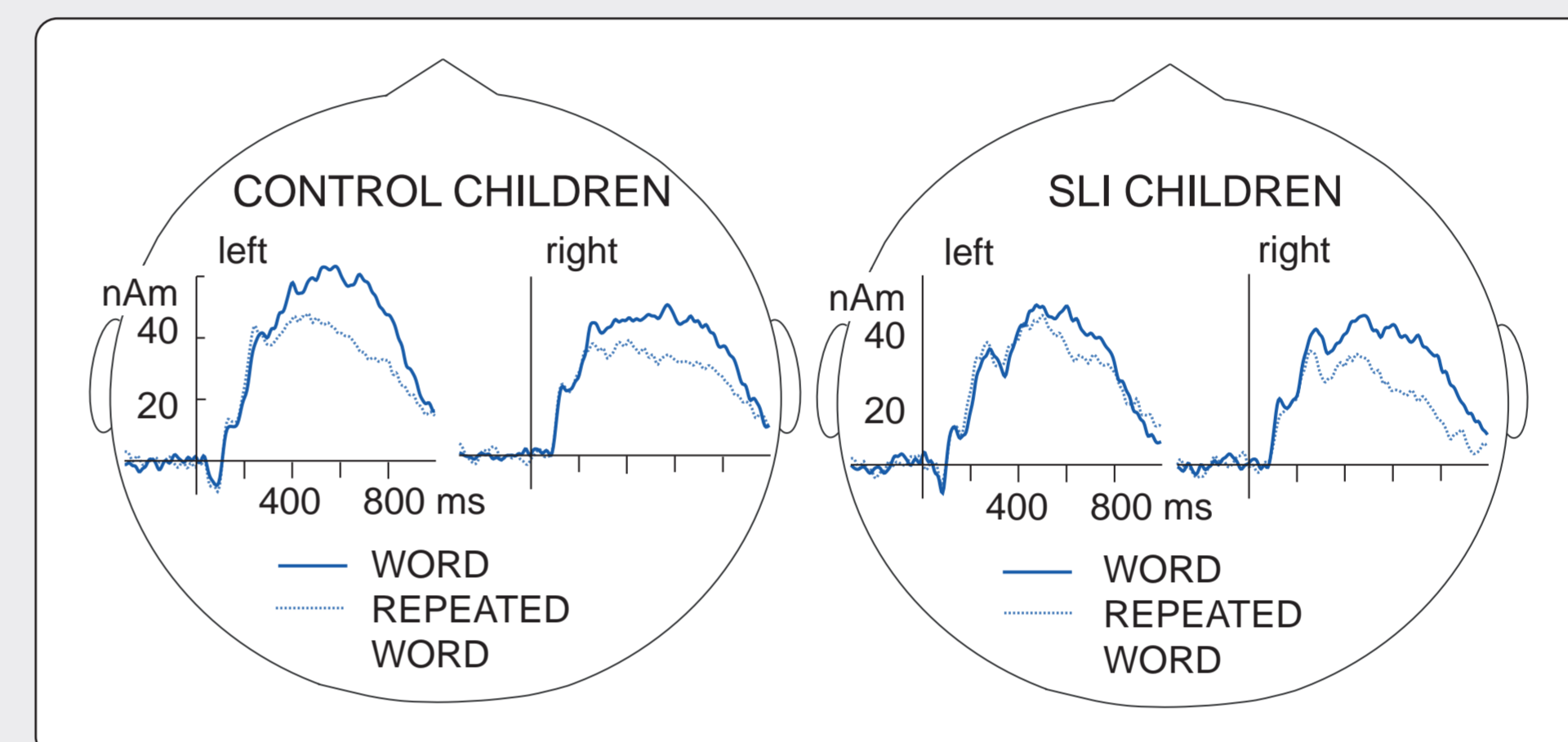


Fig. 3. The mean time course of activation in the left and right superior temporal cortex in control and SLI children for words and repeated words.

Recognition - Activation to words vs. pseudowords:

- SLI children: the lexicality effect (index of continued recruitment of lexico-semantic candidates for pseudowords) 600-800 ms after word onset in the left hemisphere was missing (in control children $p < 0.01$).

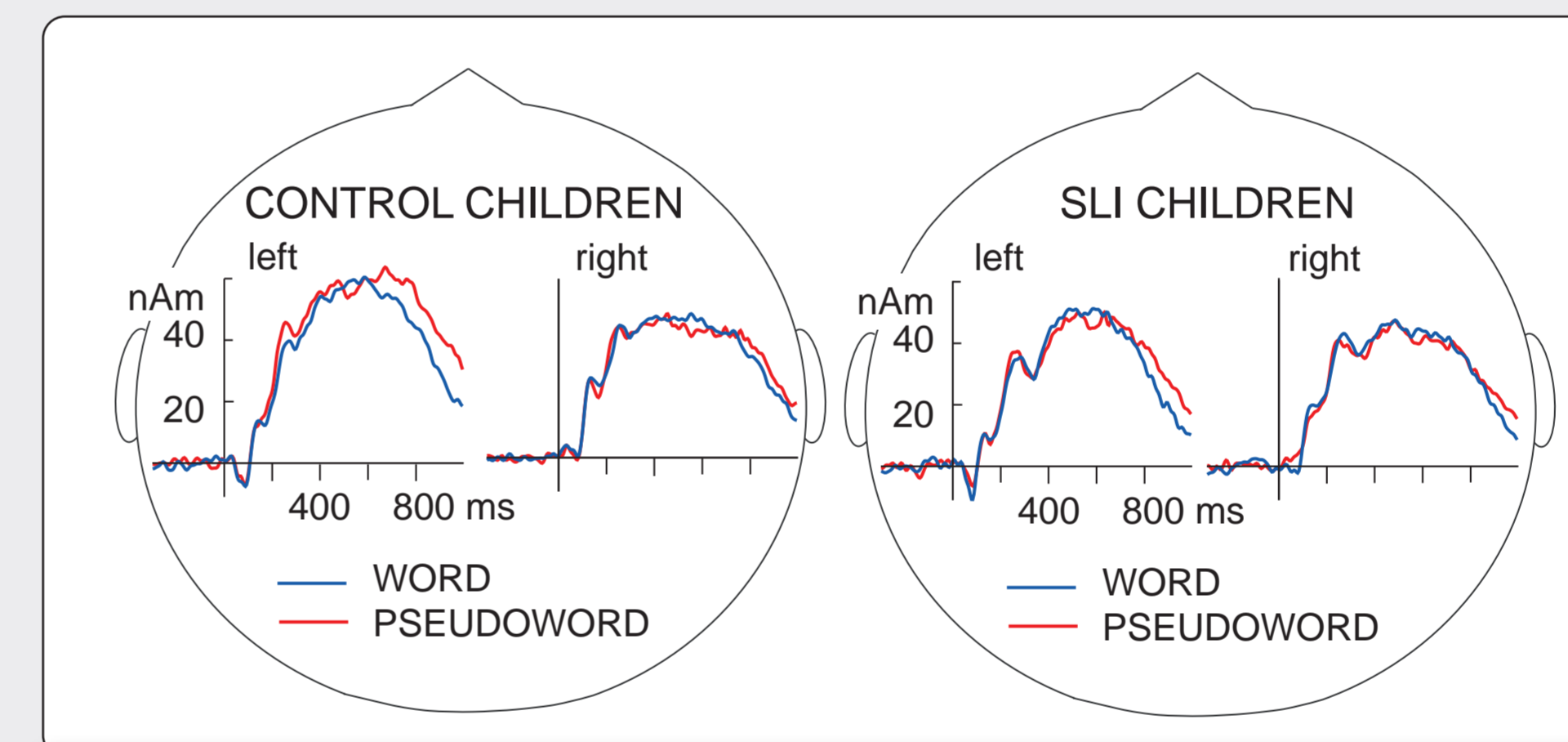


Fig. 4. The mean time course of activation in the left and right superior temporal cortex in control and SLI children for words and pseudowords.

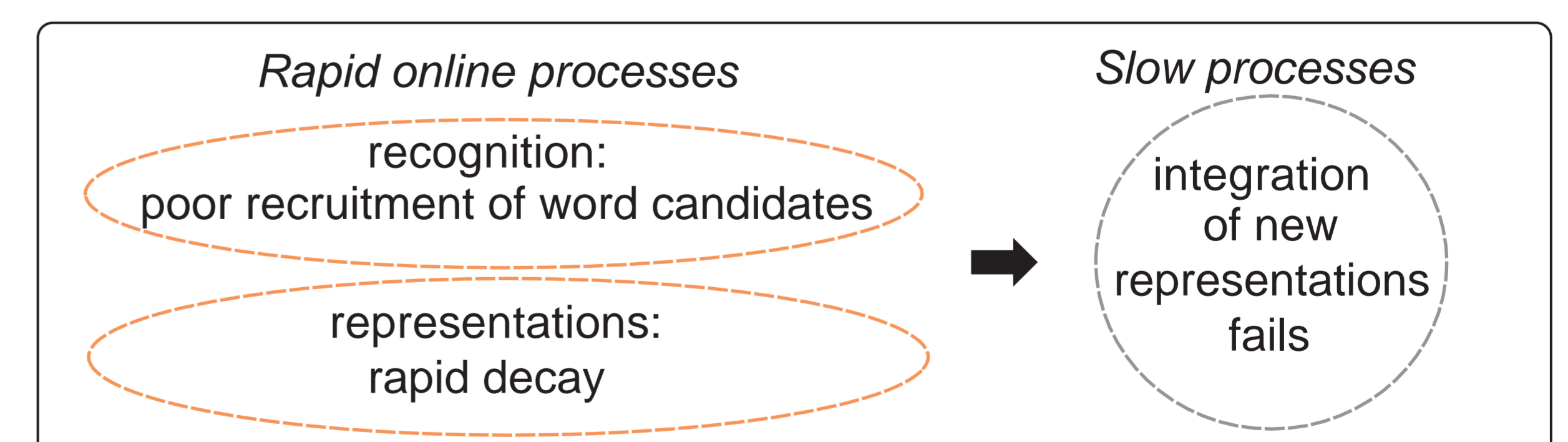
CONCLUSIONS

School-aged non-impaired children

- N400 response is modulated by word repetition (first vs. immediate second presentation) and lexicality (words vs. pseudowords)
- N400 response and stimulus-induced modulations are about 200 ms delayed in children as compared with adults → cortical responses are considerably immature at the age of 10 yrs

Language-impaired children

no repetition or lexicality effects in the left hemisphere



Abnormal functioning of the left language-dominant hemisphere is particularly evident in SLI children

The unusually rapid decay of speech-evoked activation in the left superior temporal lobe in SLI children is likely to contribute to their impaired vocabulary growth

References:

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- (7) Hämäläinen et al. (1993) Rev Mod Phys, 65, 413–497.