Neurophysiological alterations during phoneme and word processing in the acute stage of aphasia

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BACKGROUND

Possible to investigate phonological input processes using event-related potentials (ERPs)

Mismatch Negativity (MMN) and P300 reflect phoneme discrimination → pre-attentive and attentive deviance detection in oddball task (interspersing frequent stimuli with rare, infrequent stimuli)

Possible to investigate single-word processing using ERPs

N400 for word recognition/comprehension → N400 to pseudowords (PW) larger than N400 to real words (RW) = ‘pseudoword effect’

Only a few studies have used ERPs in acute aphasic patients [1,2] !!!

→ NONTHELESS ERPs = valuable complement in the clinical evaluation of acute aphasic patients → when behavioural assessment is difficult or impossible!

→ Before clinical use, the following research questions first need to be answered:

1) Difference between place, manner and voicing during pre-attentive and attentive auditory phoneme discrimination?

2) What is the effect when more attention is required? Is the attentive task appropriate for clinical use?

3) Can acute aphasic patients discriminate between real words and pseudowords?

MATERIALS AND METHOD

Patient group

10 patients: 5 men/5 women
Mean age: 69.4 jaar (+/- 3.46)
< 2 weeks post-stroke = acute stage

Norm group

44 subjects: 20 men/24 women
Equivalent mean age (p < .05)

Behavioural testing

AAT (only patients)
PALPA (subtests phonological input)

Neurophysiological testing

Electroencephalogram (EEG) recorded through 23 electrodes
interventional 10-20 system

RESULTS

Phoneme discrimination

Patient group

Place (Manner, Voicing)
aphasia = norm
aphasia < norm
aphasia > norm

MMN
P300
aphasia = norm
aphasia < norm
aphasia > norm

NMN: more right lateralized instead of left lateralized = compensation mechanism [4]

Within the aphasic patients

MMN: place > voicing; place > manner; voicing = manner

P300: place > voicing; place = manner; voicing = manner

Word recognition

Aphasic patients

→ intact pseudoword effect = pseudowords > real words (N100, P200, N400)

→ P200: PW aphasic patients > PW norm group

BUT timing differences!!

Aphasic patients are slower than the norm group during processing of pseudowords (N100, P200 and N400) and real words [P200]!!

Phoneme discrimination

Place of articulation less subject to neuronal loss? → more spared than manner and voicing

More spared than manner and voicing

What is the effect when

More spared than manner and voicing

Discussion and conclusion

Phoneme discrimination

Place of articulation less subject to neuronal loss?

More spared than manner and voicing

Better imprinted because of larger spectral differences and/or additional auditory-motor interface [5]?

Effect attention!!

Pre-attentive = only voicing diminished compared to norm

Attentional = all 3 distinctive features diminished compared to norm

Neuronal resources for attention allocation supress neuronal activation dedicated to deviance detection?

Word recognition

Intact pseudoword effect in aphasic patients

Detection of irregular phonological structure and difference in lexical status

But more cognitive effort/less inhibition during processing of lexical properties (P200 ↑)

Less efficient information transfer (delay compared to the norm group) does not have a negative effect on lexical processing ↔ disturbed semantic integration [6]

Conclusion

The paradigms seem to be sensitive for clinical, neurophysiological evaluation of phoneme discrimination and word recognition in acute aphasia

Howerer

Be critical when using the attentive task (P300 potential) because of other influential cognitive factors!

References


