Phonological impairment as a decay-based impairment : New evidence from a single case study

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Introduction

In interactive models of receptive language processing such as those by Dell (1986) and Martin and Saffran (1992) (Figure 1), spreading of activation between language levels is determined by 2 properties:

- Decay rate of phonological, lexical and semantic activations

  During speech comprehension, a decay impairment leads to a reduced impact of phonological representations, activated first and thereby suffering to a greater extent from the severe decay rate, as opposed to semantic representations.

- Connection strength between phonological, lexical and semantic levels of representation

  During speech comprehension, a reduced connection strength leads to an increased impact of phonological variables, and a reduced impact of lexical and semantic variables.

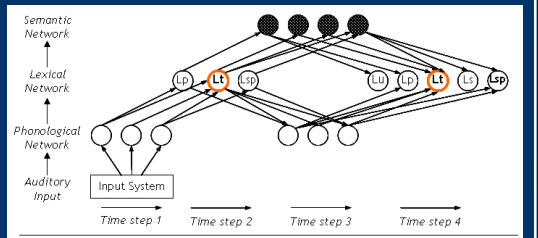

Figure 1. Interactive spreading activation models of Martin & Saffran (1992).

Lp: phonological nodes/ Lt: lexical node/ Lsp: semantic and phonological nodes/ Lu: unrelated lexical nodes

These two processing impairments can parsimoniously explain the co-occurrence of a number of language processing impairments in aphasic patients while classic box-and-arrow-type models of language processing often need to posit the existence of multiple deficits. However, neuropsychological evidence supporting interactive accounts of language processing deficits is currently limited to a small number of cases.

Aim

Present **a single case study** providing further new support for the existence of decay rate impairments as an underlying cause of receptive language impairment.

Method

Participants

MF (aged 52) is an aphasic patient with a left hemisphere ischemic lesion and has subtle speech comprehension impairments.
The control group is composed of 15 normally developing adults (mean age : 55 years).

Tasks

Auditory lexical decision with phonologically and semantically related primes*: if decay impairment, reduced phonological priming effect*

Judgement of synonyms for high and low imageability word pairs
Single word repetition for high or low imageability words
} *if decay impairment, better performance for high imageability words*

Disyllabic nonword repetition *: if decay impairment, reduced performance*

Minimal pair discrimination with or without delay between syllables *: if decay impairment, greater difficulties for syllables with delay*

Results

	MF	Control ranger (N=15)	
Auditory lexical decision			
Size of phonological priming effect	*23 ms**	*104-282 ms*	→ *Reduced phonological priming effect*
Size of semantic priming effect	*88 ms*	*79-124 ms*	→ *Normal semantic priming*
Judgement of synonyms			
Size of imageability effect	*373 ms*	*301-425 ms*	→ *Normal imageability effect*
Single word repetition			
High imageability (accuracy)	*98%*	*98.8-100 %*	→ *Mild impairment for low imageability word*
Low imageability (accuracy)	*94%*	*98.8-100 %*	
Single nonword repetition			
Accuracy	*62%**	*92.6-97.6 %*	→ *Severe impairment*
Minimal pair discrimination (without delay)			
Consonant oppositions	*92.8%*	*85.7-100 %*	
Vowel oppositions	*96.4%*	*92.8-100 %*	
Minimal pair discrimination (with delay)			
Consonant oppositions	*85.7%**	*89.2-100 %*	→ *Impaired for syllables with delay*
Vowel oppositions	*78.5%**	*92.8-100%*	

** indicates performance significantly different from controls according to the modified t-test by Crawford & Garthwaite, 2005*

Discussion - Conclusion

The interpretation of MF's language processing deficits differs according to theoretical approaches:

- According to classic box-and-arrow models : ***multiple*** deficits have to be posited at the level of speech perception (auditory analysis system), phonological processing (acoustico-to-phonological conversion), lexical-semantic access (auditory input lexicon and semantic system) and short-term memory.

- But according to the interactive account of Martin and Saffran (1992) : a ***single*** decay rate impairment (as expressed by a reduced impact of phonological variables as opposed to semantic variables) explains all aphasic symptoms.

MF illustrates the conceptual **parsimony** of computational accounts of language processing and their **usefulness** for the assessment of aphasia.

References

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