A theoretically motivated approach of receptive language assessment based on an interactive spreading activation account of language processing

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Introduction

In interactive models of receptive language processing such as 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

  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

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

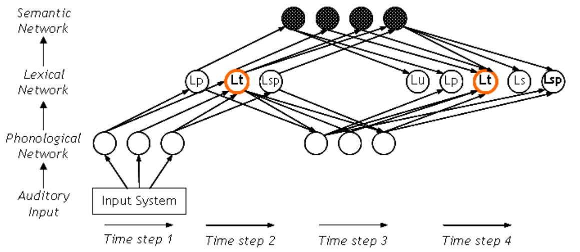

Figure 1. Interactive spreading activation models of Martin & Saffran (1992).

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 where classic box-and-arrow-type models of language processing need to posit the existence of multiple deficits.

Aim

Illustrate the parsimony of interactive models of language processing via the case study of patient MF, presenting a constellation of aphasic symptoms that can be explained as resulting from an abnormally increased decay rate of language activation.

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

Minimal pair discrimination *with natural and temporally slowed stimuli* : ***if decay impairment, greater difficulties for slowed stimuli***

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

Results

	MF	Control group
Minimal pair discrimination		
Consonant oppositions	99 %	96,9 % - 100 %
Vowel oppositions	91,8 %	91,3 % - 100 %
Minimal pair discrimination (Temporally slowed stimuli)		
Consonant oppositions	64,3 % *	79,7 % - 92,8 %
Vowel oppositions	78,6 % *	82,9 % - 91,1 %
Auditory lexical decision		
Size of phonological priming effect	23 ms *	104 ms - 283 ms
Size of semantic priming effect	88 ms	79 ms - 124 ms
Judgement of synonyms		
Size of imageability effect	374 ms	301 ms - 425 ms
Single word repetition		
High imageability (accuracy)	98%	98,8 % - 100 %
Low imageability (accuracy)	94%	98,8 % - 100 %
Single nonword repetition		
Accuracy	62% *	92,3 % - 97,6 %

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

MF's performances

Minimal pair discrimination
- *Impaired for temporally slowed stimuli*

Auditory lexical decision
- *Reduced phonological priming effect*
- *Normal semantic priming*

Judgement of synonyms
- *Normal imageability effect*

Single word repetition
- *Mild impairment for low imageability word*

Single nonword repetition
- *Severe impairment*

Discussion - Conclusion

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

- According to interactive models : a *single* decay rate impairment (as expressed by a reduced impact of phonological variables as opposed to semantic variables) explains all aphasic symptoms.
- 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 to semantic system) and short-term memory.

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

References

Dell, G.S. (1986). A spreading-activation theory of retrieval in sentence production. *Psychological Review*, *93*(3), 283-321.
Martin, N., & Saffran, E. M. (1992). A computational account of deep dysphasia: Evidence from a single case study. *Brain and Language*, *43*(2), 240-274.

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