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Procedia Social and Behavioral Sciences 23 (2011) 125–126

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**Procedia**  
Social and Behavioral Sciences

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Academy of Aphasia 2011

## Quantitative Analysis of Connected Speech in Aphasia: Insights from Greek-speaking Patients with Fluent and Non-fluent Types of Aphasia

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### Introduction

During the last decade an increasing number of studies focused on aphasia in Greek-speaking patients. These studies used mainly structured tasks that explored the availability of specific linguistic constructions. The objective of the present study was to investigate the pattern of language deficits of Greek-speaking patients with fluent and non-fluent types of aphasia using quantitative analysis of connected speech.

### Methods

*Participants.* Participants included 12 patients with aphasia (four with fluent type, and eight with non-fluent type) and seven non-impaired speakers matched for sex, age and education with the patients.

*Materials & Procedure.* Participants described the Cookie Theft picture. Speech samples were audio recorded, transcribed, and treated following the Quantitative Production Analysis protocol (Saffran, Berndt & Schwartz, 1989), which was modified for analysing the Greek speech samples.

### Results

The results are summarized in Table 1. Mann-Whitney U test (2-tailed exact significance) was used in all comparisons. Compared to controls, all patients produced shorter utterances [fluent patients vs. controls:  $U=3$ ,  $p=0.042$ , non-fluent patients vs. controls:  $U=0$ ,  $p<0.001$ ] with mainly nouns and verbs, as revealed by their reduced elaboration index [fluent patients vs. controls:  $U=1$ ,  $p=0.012$ , non-fluent patients vs. controls:  $U=0$ ,  $p<0.001$ ]. Not only non-fluent patients but also patients with fluent aphasia produced more ungrammatical (with morphosyntactic errors) sentences than controls [fluent patients vs. controls:  $U=0$ ,  $p=0.006$ , non-fluent vs. controls:  $U=5.5$ ,  $p=0.006$ ]. Patients with non-fluent aphasia performed worse than controls in four lexical selection measures [closed class words:  $U=0.5$ ,  $p<0.001$ , nouns:  $U=5.5$ ,  $p=0.007$ , prepositions:  $U=2$ ,  $p=0.001$ , adverbs:  $U=3.5$ ,  $p=0.002$ ]. Verb production, however, was not impaired. The use of embedded sentences was limited [ $U=2$ ,  $p=0.001$ ]. In contrast, patients with fluent aphasia did not perform significantly differently from controls on lexical selection measures. Even noun production, which is said to be impaired in fluent aphasia, was close to normal. We explored noun-verb dissociation by comparing fluent aphasic patients with non-fluent

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patients. Patients with non-fluent aphasia produced more nouns than patients with fluent aphasia [ $U=2$ ,  $p=0.018$ ], however, the difference in verb production was not significant. To investigate access to the left periphery of the sentence, known to be impaired in aphasia, we compared the two aphasic groups' production of embedding sentences. Patients with fluent aphasia produced more embedding sentences than non-fluent patients [ $U=3.5$ ,  $p=0.034$ ].

**Table 1: Mean levels of performance (SD) of patients with fluent aphasia, patients with non-fluent aphasia, and controls per quantitative measures.**

Categories of quantitative measures (Gordon, 2006)	Patients with fluent aphasia	Patients with non-fluent aphasia	Controls
<b>Lexical Selection</b>			
Proportion of closed class words	0.55 (0.09)	0.42 (0.06)	0.54 (0.02)
Proportion of nouns	0.19 (0.06)	0.36 (0.12)	0.25 (0.03)
Proportion of adjectives	0.02 (0.01)	0.02 (0.03)	0.02 (0.01)
Proportion of prepositions	0.04 (0.03)	0.01 (0.02)	0.07 (0.02)
Proportion of adverbs	0.07 (0.02)	0.04 (0.02)	0.09 (0.04)
Proportion of pronouns	0.10 (0.03)	0.05 (0.04)	0.06 (0.02)
Proportion of verbs	0.25 (0.05)	0.21 (0.08)	0.20 (0.02)
<b>Sentence Productivity</b>			
MLU	4.46 (0.79)	3.33 (0.72)	5.98 (1.21)
Elaboration index*	1.22 (0.44)	0.77 (0.26)	2.66 (0.64)
Embedding index	0.29 (0.13)	0.08 (0.09)	0.46 (0.31)
<b>Discourse Productivity</b>			
Number of narrative words	128.75 (51.56)	44.63 (35.51)	127.86 (27.45)
<b>Grammatical Accuracy</b>			
Proportion of sentences	0.82 (0.07)	0.62 (0.23)	0.77 (0.10)
Proportion of utterances without verbs	0.17 (0.07)	0.28 (0.15)	0.22 (0.09)
Proportion of single-word utterances	0.01 (0.02)	0.10 (0.20)	0.01 (0.02)
Proportion of well-formed sentences	0.67 (0.14)	0.61 (0.30)	0.95 (0.05)
Auxiliary complexity	0.16 (0.14)	0.24 (0.25)	0.30 (0.25)

\*Level of elaboration within subject-NPs and VPs.

## Conclusions

The noun-verb dissociation between the two aphasic groups is not supported by the findings. Both aphasic groups produced sentences with no elaboration and few embeddings. Patients with fluent aphasia produced more embeddings than non-fluent patients. The quantitative analysis highlighted some hitherto (largely) unexplored areas of language deficits of Greek-speaking patients with aphasia, such as impaired morphosyntax in fluent aphasia and impaired preposition production in non-fluent aphasia. In order to reassess our conception of language deficits in aphasia, these impairments need to be described and interpreted.

## References

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