Which Word Planning Processes Require Attention: Evidence from Dual-Task Interference in Aphasics Speakers

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Introduction
In everyday life, utterance production is affected under dual-task condition (speaking while cooking or hearing the radio), and this seems to be all the most the case in case of impaired language. It has actually been recognized that utterance planning is not entirely automatic and some processes need attention. Dual-task paradigm have been used to test attentional requirement in word production (Ferreira & Pashler, 2002). Studies showed that conceptualization and lexical selection are under attentional demand (Roelofs & Piai, 2011), and recently, studies carried out with healthy (Cook and Meyer, 2008; Fargier & Laganaro, 2019) and aphasics speakers (Laganaro, Bonnans, & Fargier, 2019) have shown that post-lexical processes (phonological and phonetic encoding) also need some amount of attentional demand. More specifically, an increase of phonological errors has been reported in aphasic participants in a dual-task condition with concurrent auditory stimuli appearing at SOA of +300 ms (Laganaro et al, 2019), whereas lexical errors were not affected by the same dual-task. In the study presented here, we aim at investigating whether other word planning processes (other types of errors) are affected by a concurrent dual-task if auditory stimuli are presented at different SoAs.

Methods
Twenty-one participants suffering from aphasia following a left hemispheric stroke (mean age: 59.52) took part to the study as well as a group of 26 control subjects (mean age: 56.17) with no history of neurological impairment.

Participants underwent a picture naming task and an auditory (syllable) detection task in isolation (single-task condition) and under dual-task conditions. Under dual-task condition, the auditory stimuli (four different CV syllables) appeared at three SOAs, (+150 ms, +300 ms or +450 ms) corresponding to the time-window associated with lexical, phonological and phonetic encoding in Indefrey (2011). Under dual-task condition, the participants were instructed to name the pictures as fast and accurately as possible, while pressing a key when they heard the syllable /fo/ (associated with filler pictures, discarded from the analyses).

Results

Under dual-task condition, both control and aphasic participants were interfered at each SOA relative to single task on production latencies. In the control group, there was no difference in accuracy in dual-task condition relative to single task. Analyses by type of error were

performed in brain-damaged participant. The rate of lexical errors (semantic paraphasias, unrelated lexical errors verbal perseveration) was not significantly different between the single and dual task conditions. An increase of phonological errors (phonological paraphasias, neologism) was found at late SOAs (+300 and +450 ms) and an increase of non-responses (omissions errors) at SOA+150 ms (see Figure 1).
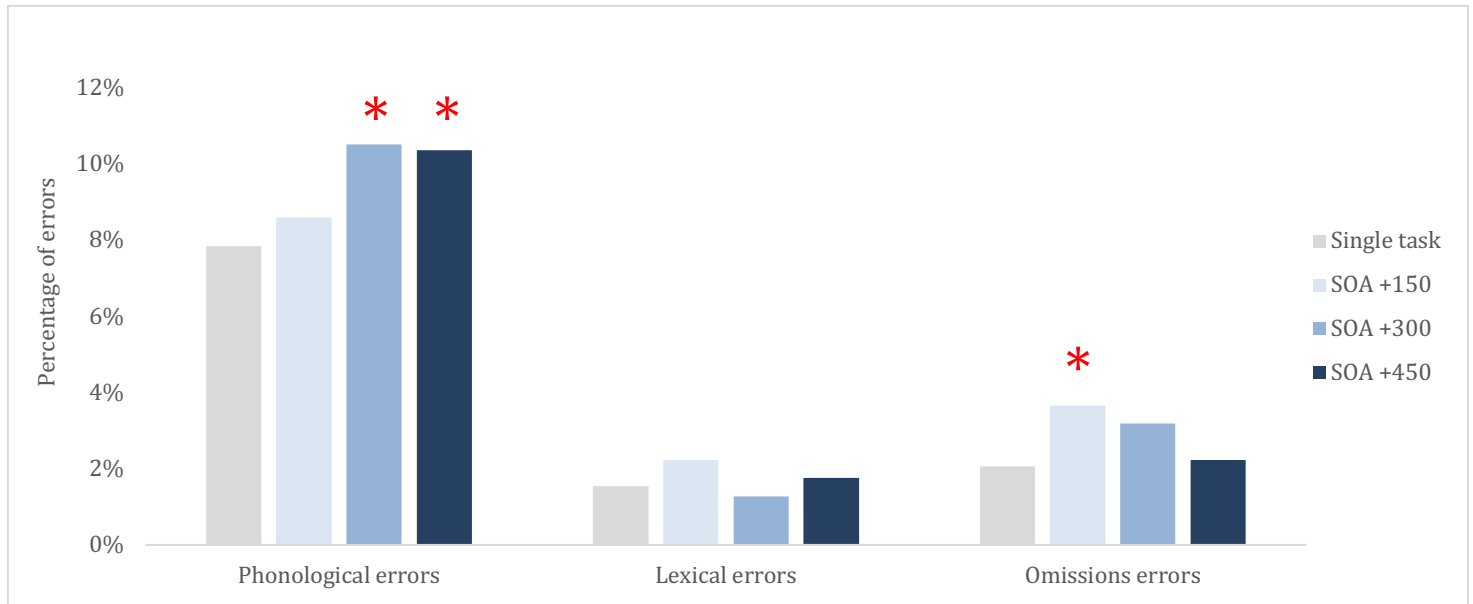

Figure 1. Rate of errors per error type in aphasics speakers at each SOA

Conclusions

The results confirm that the observation by Laganaro et al. (2019) that only phonological errors increased under dual-task condition was related to the specific SOA used in that study. The increase of omissions errors and phonological errors at specific SOAs associated respectively to underlying lexical (SOA150 ms) and post-lexical (300 and 450 ms) encoding processes confirm that attentional resources are involved at all encoding processes leading respectively to an increase of omission errors and of phonological errors.

References

Cook, A. E., & Meyer, A. S. (2008). Capacity demands of phoneme selection in word production: New evidence from dual-task experiments. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *34*(4), 886-899.

Fargier, R. & Laganaro, M. (2019). Interference in speaking while hearing and vice versa. *Scientific Reports 9(1), 5375.*

Ferreira, V. S., & Pashler, H. (2002). Central bottleneck influences on the processing stages of word production. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *28*(6), 1187-1199.

Indefrey, P. (2011). The Spatial and Temporal Signatures of Word Production Components: a Critical Update. *Frontiers in Psychology, 2*. https://doi.org/10.3389/fpsyg.2011.00255.

Laganaro, M, Bonnans, C. & Fargier, R. (2019). Word form encoding is under attentional demand: evidence from dual-task interference in aphasia. *Cognitive Neuropsychology*.

Roelofs, A., & Piai, V. (2011). Attention Demands of Spoken Word Planning: A Review. *Frontiers in Psychology*, *2*.