Motor Speech Planning Versus Programming in Apraxia of Speech

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Introduction

There has been a long debate in the literature about speech production models for several years. Some authors propose a one-step model between phonological encoding and articulation (e.g. “phonetic encoding” in Levelt., 1989) while others include two processes allowing the transformation of a linguistic code into a motor program, (Guenther, 2016; Van der Merwe, 2020) sometimes called “motor speech planning” and “motor speech programming”. The latter models are based on observations of the pathology. Indeed, a broad consensus has emerged in the literature that apraxia of speech (AoS) involves impaired ability to retrieve and/or assemble the different elements of the phonetic plans (Blumstein, 1990; Code, 1998; Varley & Whiteside, 2001; Ziegler, 2008, 2009), and the impairment has been located in the *motor speech planning* processing stage. A different locus has been attributed to dysarthria, which underlying impairment has been located in the *motor speech programming* processing stage. There is however very limited empirical evidence in favor of two distinct processing stages transforming a linguistic (phonological) code into articulation.
In the present study, we sought to target (a) motor speech planning, via the comparison between the production of legal and illegal CCV clusters and (b) motor speech programming, via the manipulation of uttering conditions. These two manipulations will be crossed with two groups of participants with different types of motor speech disorders, AoS and who are expected to present an opposite pattern of performance.

Methods

Participants : 4 participants suffering from AoS following a left hemisphere stroke ; 4 participants suffering from hypokinetic dysarthria (Parkinson’s disease – PD)

Material and procedure : stimuli consist of bisyllabic pseudo-words matched on first phoneme and second syllable and varying on the first syllable structure and legality (CV, legal CCV and illegal CCV). A delayed production task was used to separate linguistic from motor speech encoding. The participant had to produce the target stimuli as fast and accurately as possible under two uttering conditions: *normally or whispering*.

Results

Accuracy was coded by two independent raters (inter-rater agreement between .926 and .829, almost perfect agreement (Kappa statistics, Landis & Koch, 1977)).
The accuracy was fitted with mixed models (Baayen, Davidson, & Bates, 2008) with the R-software (R-project, R-development core team 2005). Results showed an effect of uttering conditions with decreased performance in the “whispering” condition compared to normal speech only in the PD group and an effect of CV structure in both groups with an interaction showing larger effect in AoS (see figure 1).

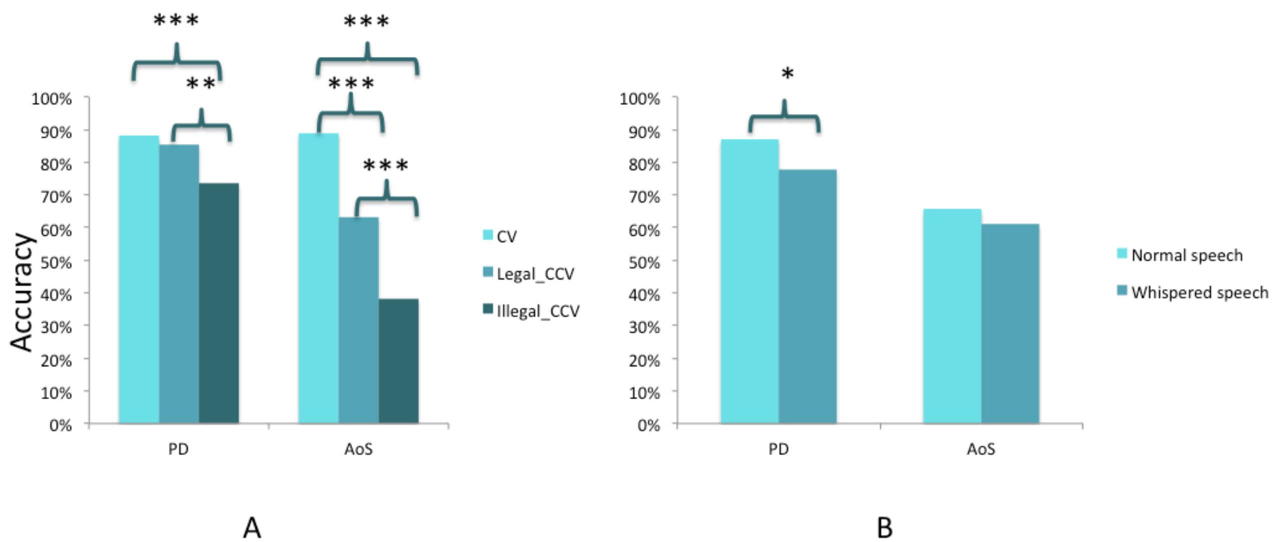

Figure 1. Mean accuracy by group, by structure (A) and by condition (B).

Conclusions

Our preliminary results on 8 participants indicate the expected opposite pattern in participants with AoS and dysarthria: uttering condition, which is supposed to be parametrized at motor programming only affected performance in participants with dysarthria while clusters and in particular illegal CC affected much more performances in AoS. These results bring further support to models of speech production that propose two processing stage of speech.

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