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Dynamic aphasia: the relation between executive functions and language deficits

Introduction. Dynamic aphasia (DA) is a language disorder characterized by severely reduced spontaneous speech, whereas naming, comprehension and repetition remain largely intact. Evidence suggests high heterogeneity in the neuropsychological profiles of DA patients with regard to language specificity of the deficits underlying spontaneous speech reduction. For example, patient CH's fluency deficit manifested exclusively in the verbal domain, as demonstrated by his normal performance on a variety of non-verbal fluency tests (Robinson et al., 2005). In the same vein, patient ROH's inability to produce a verbal plan stood in marked contrast to his intact non-verbal planning abilities (Costello & Warrington, 1989). On the other hand, some patients demonstrated fluency deficits in both verbal and non-verbal domains (Robinson et al., 2015). Finally, non-verbal inhibition deficits are frequently observed in DA patients (Robinson et al., 2015). The occurrence of executive functions (EF) deficits in generation of ideas (as measured by fluency tests), planning and inhibition in the context of well-preserved fundamental linguistic processes suggests that DA could arise from a general executive dysfunction affecting language production (Ardila, 2010).

Robinson and colleagues (2015) incorporated the above-mentioned evidence into a unified account that distinguishes between language-specific (LS) and domain-general (DG) DA forms. The former has been proposed to arise from a failure in high-level verbal response selection (Robinson et al., 2005). The authors argued that an additional load is imposed on the conceptual preparation stage of language processing when the patient has to choose amongst a number of competing verbal responses activated by a stimulus in a discourse generation task, which precludes spontaneous speech production (Robinson et al., 2005). DG form is conceptualized as an impairment in 'fluent sequencing of novel thoughts' (Robinson et al., 2015), characterized by a lack of novel words and sentences and a tendency to perseverate at the discourse level, in contrast to normal performance in sentence level generation tests. Importantly, previous research is based exclusively on single-case investigations in patients with various etiologies. Moreover, the possibility for direct comparison between reported patients is limited due to variable testing protocols. Therefore, the mechanisms of the two DA forms yet need further clarification.

Aims and hypotheses. The present study addresses the executive functions mechanisms underlying spontaneous speech reduction in a group of patients with stroke-induced DA. We hypothesize that both forms of DA are driven by selective executive functions impairment. Following Robinson et al. (2005), we expect that pathologically increased inhibition between the many verbal concepts leads to an inability to preferentially activate one concept over the others, thus precluding spontaneous speech generation. Secondly, discourse-level perseverations observed in DG form could either reflect a failure in generating an initial plan or arise at a later language processing stage due to an inability to switch from one element

of a plan to another. An exploratory analysis will be performed to clarify the contributions of planning and switching deficits to the 'fluent sequencing of novel thought' syndrome.

Method. DA patients will be recruited in the Center for Speech Pathology and Neurorehabilitation, Moscow. The patients will undergo comprehensive language assessment using the Russian Aphasia Test (Ivanova et al., 2016). Additional narrative samples will be collected during the interview. Several Quantitative Production Analysis measures (Berndt et al., 2000) and novelty measures (Robinson et al., 2015) will be derived from the speech samples for statistical analysis.

The executive functions deficits will be consistently investigated with a newly devised testing battery. First of all, verbal and design fluency tests will be administered to identify which modalities are encompassed by the patients' generation deficits. Secondly, verbal selection deficit will be investigated in a sentence completion test under two conditions (high vs. low predictability sentences; Burgess & Shallice, 1996). In the third part, patients' inhibitory function will be assessed in both verbal and non-verbal modalities using the sentence completion test (unrelated condition; Ibid.) and the Flanker test, respectively. In the fourth part, written word, sentence and picture arrangement tests (Bormann et al., 2008) will measure the patients' ability to generate and implement verbal and non-verbal plans. The patients' switching ability will be assessed using Luria's go-no go rhythm tapping task.

Conclusions. The current study addresses the relation between executive functions and language deficits in DA. We extend the scope of previous research by performing the analysis in a group of etiologically homogeneous patients with stroke-induced DA and performing consistent EF testing. Expected results have potential implications for tailoring speech therapy methods for patients with different DA forms.

References

1. Ardila, A. (2010). A proposed reinterpretation and reclassification of aphasic syndromes. *Aphasiology*, *24*(3), 363–394.
2. Berndt, R. S., Wayland, S., Rochon, E., Saffran, E., & Schwartz, M. (2000). Quantitative production analysis: A training manual for the analysis of aphasic sentence production. *Hove, U.K.: Psychology Press.*
3. Bormann, T., Wallesch, C.-W., & Blanken, G. (2008). Verbal planning in a case of "Dynamic Aphasia": an impairment at the level of macroplanning. *Neurocase*, *14*(5), 431–450.
4. Burgess, P. W., & Shallice, T. (1996). Response suppression, initiation and strategy use following frontal lobe lesions. *Neuropsychologia*, *34*(4), 263–272.
5. Costello, A. L., & Warrington, E. K. (1989). Dynamic aphasia: the selective impairment of verbal planning. *Cortex; a Journal Devoted to the Study of the Nervous System and Behavior*, *25*(1), 103–114.
6. Ivanova, M. V., Dragoy, O. V., Akinina, J. S., Soloukhina, O. A., Iskra, E. V., Khudyakova, M. V. & Akhutina, T. V. (2016). AutoRAT at your fingertips: Introducing the new Russian Aphasia Test on a tablet. *Frontiers in Psychology Conference Abstract: 54th Annual Academy of Aphasia Meeting*.
7. Robinson, G., Shallice, T., & Cipolotti, L. (2005). A failure of high level verbal response selection in progressive dynamic aphasia. *Cognitive Neuropsychology*, *22*(6), 661–694.
8. Robinson, G., Spooner, D., & J Harrison, W. (2015). Frontal dynamic aphasia in progressive supranuclear palsy: Distinguishing between generation and fluent sequencing of novel thoughts. *Neuropsychologia* (Vol. 77).