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What drives task performance in fluency tasks in people who had COVID-19?

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Introduction

People who had COVID-19 may have persistent symptoms after recovery (e.g., difficulty breathing, fatigue; Carfi et al., 2020). Also, they may score below the norm on tasks assessing attention, memory, executive functions, and language (Kumar et al., 2021). Fluency tasks have shown to be affected in some individuals with COVID-19 (Almeria et al., 2020). However, the specific factors driving the such performance – as measured by the total number of correct words – are still under scrutiny. The aim of this work is then to understand (1) whether people who had COVID-19 are more impaired in animal or letter fluency relative to a normative sample; and (2) whether their performance can be explained with demographic factors, common COVID-19 symptoms, and word properties of fluency tasks. This work derives from the need to look beyond the total number of correct items in tasks that assess language (e.g., Shallice, 1988; Whitworth et al., 2014; cf. Cutler, 1981). This approach – which includes looking at the characteristics of the words produced in fluency tasks (e.g., frequency, age of acquisition, concreteness) – has shown to be relevant to classify and to describe the language impairments of people with neurodegeneration (Rofes et al., 2019, 2020).

Methods

Eighty-four Spanish-speaking people who had COVID-19 responded to a 60 second animal fluency task and to a letter (“P”) fluency task, 10-35 days after hospital discharge or self-quarantining. We obtained demographic factors (i.e., age, sex/gender, education in years), common symptoms (i.e., anosmia, anxiety score, breathing difficulty, coughing, days of hospitalization, D-dimer, depression score, dermatological alterations, diarrhea, dysgeusia, fatigue, ferritin, fever, handedness, headache, myalgia, subjective complaints), and calculated eight word properties for each correct word (i.e., age of acquisition, concreteness, familiarity, word length, frequency, imageability, orthographic similarity, and phonological similarity). The normative sample consisted of 179 healthy adults aged 18 to 49 (Casals-Coll et al., 2013) and 346 healthy adults aged 50-94 (Peña-Casanova et al., 2009). We used a Chi-square test to address Aim 1, and Random forests and Conditional inference trees to address Aim 2.

Results

People who had COVID-19 were not more impaired in any of the fluency tasks relative to the normative sample (see Table 1). Age of Acquisition and Frequency were most important to predict correct words in animal fluency. Concreteness and depression scores

were most important to predict the total word count in letter fluency. No other measure (i.e., demographic, linguistic, symptom/factor) showed as important (see Figure 1).

Conclusion

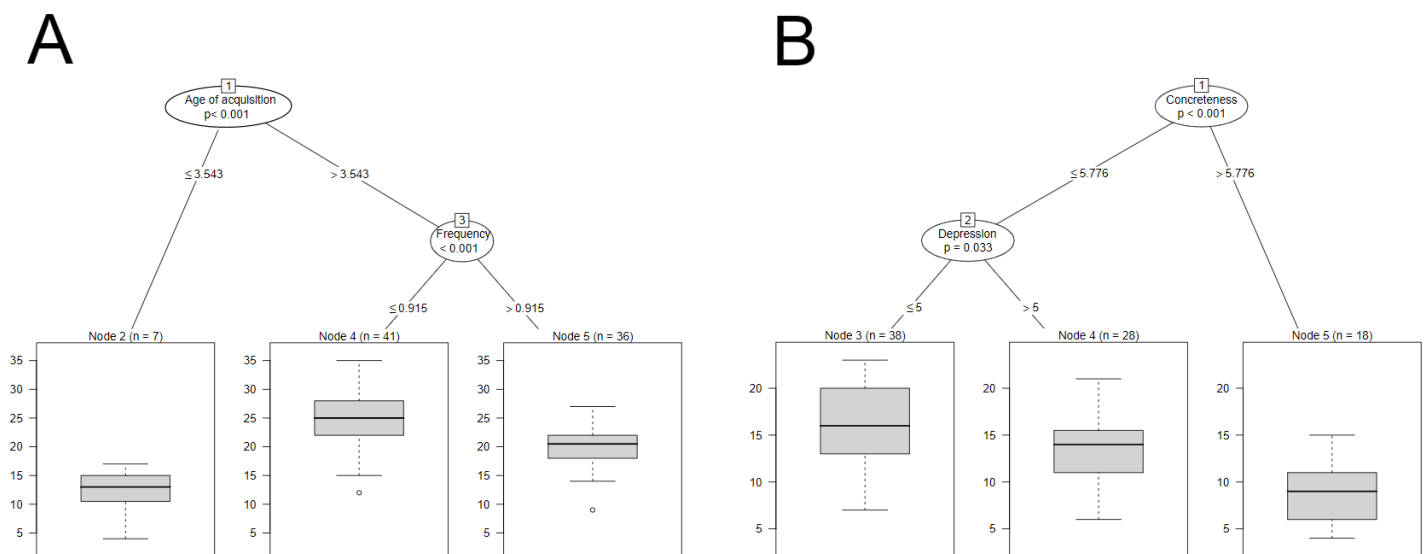
People who had COVID-19 were not more impaired in fluency tasks than healthy participants. Word properties described in studies of fluency and other tasks were relevant to explain animal fluency. Concreteness and depression relevance to letter fluency were not expected and may be specific to people who had COVID-19. The results await replication in a bigger sample including fluency measures of executive functions and correlations with other test scores.

Table 1 Fluency tasks: people impaired, correct words, and word properties

	Animal fluency	Letter fluency ("P")
People impaired	5/84 (5.9%)	8/84 (9.5%)
Correct words	22(6), 4-35	14(5), 4-23
Age of acquisition	4.1(0.4), 3.1-5.1	4.6(0.7), 2.9-6.4
Concreteness	6.1(0.1), 5.8-6.2	5.5(0.4), 4.3-6.2
Familiarity	5.7(0.2), 5.4-6.3	5.9(0.3), 5.1-6.7
Word length	6(0.5), 4.5-7.4	5.9(0.7), 4.5-8
Frequency	0.9(0.1), 0.4-1.7	0.8(0.4), 0.1-1.4
Imageability	6.3(0.1), 5.9-6.6	5.8(0.4), 4.5-6.6
Orthographic similarity	6.9(2.2), 3.3-16	9.3(4), 1.3-20.3
Phonological similarity	15.6(4.5), 7-34.3	17.8(7.6), 2.7-41.3

We indicated mean (standard deviation) and range; or the total number of people, percentage.

Figure 1. Conditional inference trees for animal fluency (A) and letter fluency (B)



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