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Introduction

We used the Morphosyntactic Generation Task (MorGen) (Stockbridge, Matchin, et al., 2021; Stockbridge, Walker, et al., 2021), to assess the lesion correlates of different aspects of phrasal production in people with chronic aphasia. The MorGen is designed to elicit two-word noun phrases involving different modifiers: numeral quantifiers (one vs. two), color adjectives (red vs. blue), size adjectives (big vs. small) and inflectional morphology (plural -s vs. null inflection, possessive -s; Figure 1). Here we report lesion-symptom mapping analyses in chronic post-stroke aphasia, in order to ascertain whether impaired production of features are associated with distinct lesion correlates. Prior work in progressive aphasia found that size features were not a strong basis of impairment regardless of variant (Stockbridge, Matchin, et al., 2021), so only plural and possessive inflectional marking, color, and number were examined.

Methods

Twenty-six people with chronic post-stroke aphasia were assessed on the MorGen. The MorGen presents two simultaneous images in each trial, which contrast based on one feature (number, color, size, possession). Subjects are asked to describe the target image using two words. We assessed inflectional morphology by averaging across performance on plural and possessive -s and assessed color and number separately.

Subjects' lesions were manually drawn on their MRI scans and subsequently warped to MNI space (Fridriksson et al., 2018). We tested three regions of interest (ROIs): posterior temporal lobe (JHU atlas, posterior STG and MTG), Broca's area (JHU atlas, pars opercularis and pars triangularis), and anterior arcuate fasciculus (Catani atlas, overlap with posterior temporal lobe ROI removed). We calculated the percent damage to each ROI for each subject and then performed regression analyses in NiiStat (https://www.nitrc.org/projects/niistat/) to assess the relationship between performance on each measure and damage to each ROI.

Results

Performance on the three measures of interest dissociated from each other. Performance deficits were associated with the following lesion correlates ($p < 0.05$). Color adjectives: damage to arcuate fasciculus ($Z = -2.33$) and posterior temporal lobe ($Z = -2.30$). Numeral quantifiers: damage to Broca's area ($Z = -2.00$). Inflectional morphology: damage to arcuate fasciculus ($Z = -2.81$) and Broca's area ($Z = -1.77$).

Conclusions

Color adjective deficits involved posterior regions, similar to those described previously for deficits on picture naming tasks with noun targets (Baldo et al., 2013; DeLeon et al., 2007; Fridriksson et al., 2018). Deficits in inflectional morphology were primarily associated with damage to arcuate fasciculus and, to a lesser extent, Broca's area. This is consistent with the need to coordinate posterior temporal and inferior frontal regions with each other to select the correct inflectional form given the structural context (Matchin & Hickok, 2020). Finally, deficits on numeral quantifiers primarily implicated damage to Broca's area, which is consistent with a role for this region in retrieving functional elements. In sum, production of different morphemes requires overlapping but distinct brain systems.

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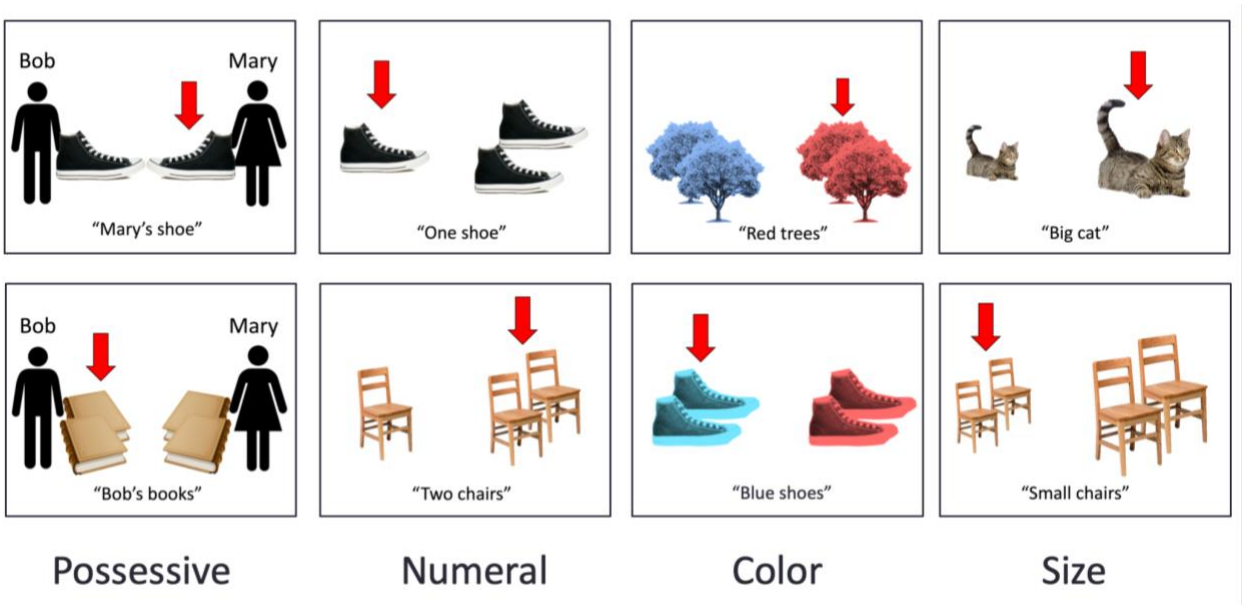

Figure 1. Example stimuli from the MorGen task. Target responses are shown in quotations. The arrow indicates the target image to be described on that trial, using exactly two words.