Supplemental Material S1. Demarcation of vocalic and consonantal boundaries for calculating the normalized Pairwise Variability Index–Vowels (nPVI-V).

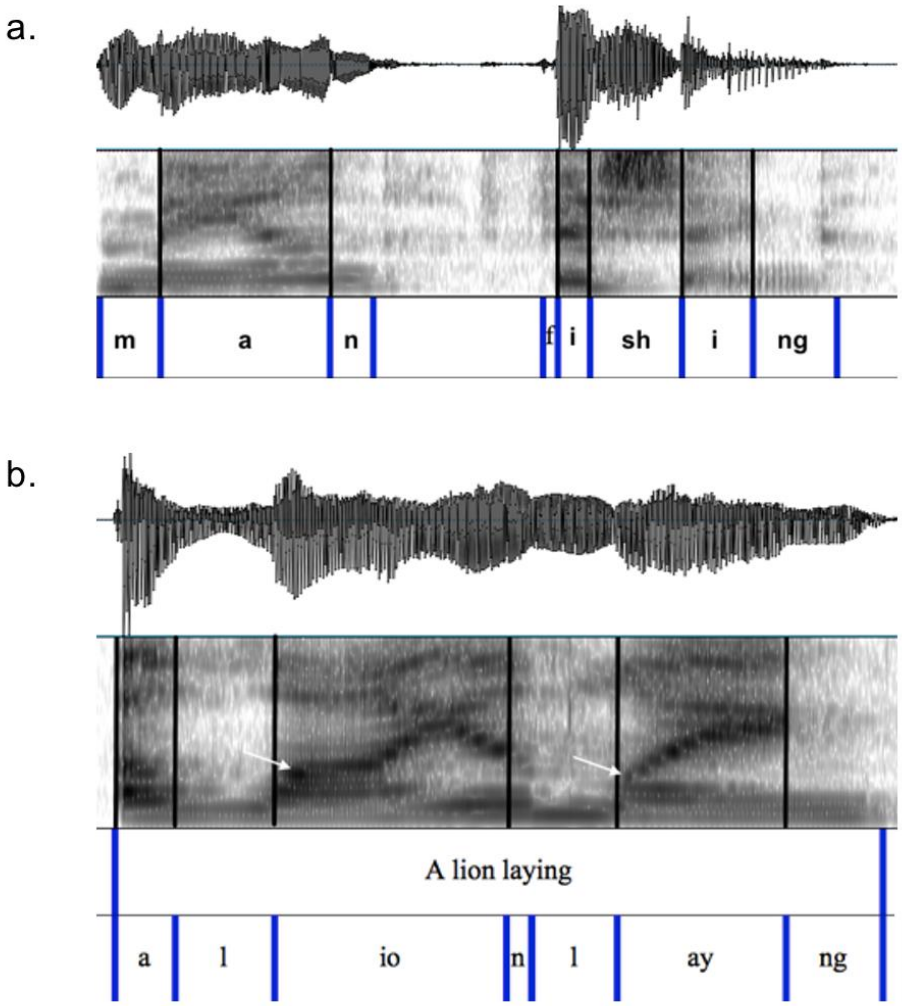
The following sections detail specific criteria for vowel boundaries, consonant boundaries, and pauses to calculate the nPVI-V coefficient.

Vowel boundaries. Vowels were identified based on visible formant structure. Vowel onset boundaries were placed at the onset of visible voicing, corresponding to the onset of the second formant (Ordin & Polyanskaya, 2015). Vowel offset boundaries were identified by termination of the formant structure or abrupt change in amplitude that preceded the onset of a consonant. Devoiced vowels, while infrequent, were not included in the vowel segments, but instead, with the adjoining consonant interval (Liss et al., 2009).

Consonant boundaries. Consonant boundaries were identified by the onset of frication (fricative consonants), spectral energy that corresponded to burst release (plosives), nasal formant structure (nasals), and at the first formant for sonorant consonants (/l/, /r/, /w/). In cases where a sonorant preceded or followed a vowel, amplitude of the first formant was used to guide segmentation (Ordin & Polyanskaya, 2015). The end of each consonant boundary was based on termination of frication (fricatives), the first formant structure (sonorants), and, for plosives in the final position, plosive release was captured in consonantal segments provided it was visible on the spectrogram (Ordin & Polyanskaya, 2015). Plosives that occurred in the medial position of a word, where a burst release was not visible (as in the production of a "tap," e.g., /bʌɾə˞/ for *butter*), were identified by the segment of reduced spectral energy (White & Mattys, 2007). This was the same procedure for unreleased plosives in the final position. In cases where a plosive in the medial position could be identified by a stop gap, the period of silence preceding the plosive was not included in the plosive boundary; accordingly, if periods of silence preceded the onset of other consonantal segments, these silences were not included in the consonantal interval so as not to skew the duration of plosive segments (White & Mattys, 2007).

Pauses. Periods of silence were not included in consonantal or vocalic intervals. Pauses between words and phrases were not included in the calculation of PVI (Grabe & Low, 2002; Thomas & Carter, 2006; White & Mattys, 2007). Grabe and Low (2002) advocated for the omission of pauses from the calculation of the PVI coefficient to reduce bias that can be introduced when this measure is computed across word and phrase boundaries. Pertinent to the current study sample, utterance boundaries can be especially challenging to determine in speakers with aphasia, as pauses can occur due to linguistic and/or motor speech production difficulties. Therefore, to reduce subjectivity in the segmentation process, consonant and vowel intervals were segmented only when visible on the spectrogram, according to the above-stated criteria. Utterances in which extraneous background noise impeded accurate reading of the spectrogram were excluded from PVI calculation. An example Praat annotation for a speaker with apraxia of speech is presented in Figure S1.

Figure S1. Example spectrogram indicating consonant and vowel boundaries (panel a) and an example spectrogram from a speaker with apraxia of speech (AOS; panel b). Vowel boundaries are emphasized by thick vertical lines in the spectrogram. Panel b depicts how formant structure was used to identify vowels at liquid–vowel boundaries (i.e., emergence of second formant frequency, indicated by white arrows).



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