An Acoustic Typology of Apraxic Speech – Toward Reliable Diagnosis

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Abstract
Differential diagnosis of apraxia of speech (AOS) is complicated by frequently co-occurring speech and language disorders. Auditory-perceptual measures may not adequately differentiate between disorders. This study adapted an acoustic analysis protocol developed for Parkinson’s disease (PD). Preliminary results are positive, showing differences between individuals with AOS, PD, and healthy controls (HC).

Index Terms: apraxia of speech, acoustic analysis

1. Introduction
Apraxia of speech (AOS) is a disorder of speech motor programming characterized by increased durations of speech sounds and transitions between sounds, syllables and words, speech sound distortions, and mis-assignment of stress [1]. Currently, diagnosis is based on auditory-perceptual judgments which are vulnerable to bias [2] and may not be discriminative. There is no systematic objective diagnostic protocol. Rosen et al. [3] developed a speech analysis tool for individuals with dysarthria from PD that measures intensity, duration, and frequency in the acoustic speech signal. We adapt this tool for AOS using PRAAT [4] to objectively profile the timing and spatial distortions. Our primary research question asks whether this protocol differentiates speech of individuals with AOS from HC and individuals with PD.

2. Methods

2.1. Participants
Preliminary data from two males with AOS are presented alongside published data from 20 individuals with PD and 20 age and gender matched HC [4]. AOS diagnosis was based on McNeil et al. [1] with consensus between KJB and DAR.

2.2. Data collection and analysis
Analyses were completed on conversational speech recorded at 48kHz with 5cm mouth-to-microphone distance. Each sample was parsed into tone groups, defined as “a set of words bound by an intonation contour” [3]. PD and HC subjects had 15 tone groups each, AOS1 had 40 and AOS2 48. Tone groups were analyzed for percent pause time, intensity variation, and spectral range as indices of acoustic distinctiveness [3] using custom-written software (AJ).

3. Results and Discussion
Preliminary results are presented in Figure 1. Data suggest that AOS1 and AOS2 have increased pause time, intensity variation, and spectral range compared to HC while individuals with PD show reduction in these measures. These findings are consistent with predictions based on previous studies of perceptual and acoustic characteristics of apraxic and parkinsonian speech [1,3].

![Figure 1: Mean (±1SD) percent pause time, intensity variation, and spectral range for AOS1, AOS2, nd PD and HC groups.](image)

4. Conclusions
Preliminary findings suggest that this analysis protocol will differentiate individuals with AOS from HC and PD. Advantages include objectivity, speed and ease of use, and ecological validity with use of conversational speech.

5. References