

# Disordered voice quality

Thea Knowles

UB Praat Scripting Workshop

April 28, 2021

# Voice quality in dysarthria/dysphonia

- Voice quality (& other metrics of phonatory abnormalities) can play a role in differential diagnosis (classification)
- Can tell us about neuropathology and vocal physiology
- May impact functional communication (intelligibility, acceptability, etc)
- Perceptual rating tools
  - GRBAS (Grade, Roughness, Breathiness, Asthenia [weakness], Strain): 4 point scale
  - Consensus Auditory Perceptual Evaluation of Voice (CAPE-V): Visual analog scale

## Perceptual terms often used to describe abnormal voice quality

- **Rough**
- **Harsh voice:** voice is harsh, rough, and raspy
- **Hoarse (wet) voice:** There is wet, “liquid sounding” hoarseness
- **Breathy voice:** voice is breathy, weak, and thin
  - May indicate “air wastage”, indicating hypoadduction
- **Strained-strangled voice:** Voice sounds strained or strangled (an apparent effortful squeezing of voice through the glottis)
  - May indicate excessive VF closure, or hyperadduction

# Differential diagnosis

- Can often help in diagnosis of underlying etiology of neurological impairments
  - “strained-strangled” voice quality → more likely to be spastic dysarthria secondary to upper motor neuron lesions
  - “breathiness”/“aphonia”/“hoarseness” → more likely to be hypokinetic dysarthria (basal ganglia dysfunction) or flaccid dysarthria (lower motor neuron damage; uni- or bilateral vagus nerve damage), but unlikely to be upper motor neurons

# Classifying phonatory function of dysarthria

Ramig 1995; Ramig & Scherer, 1992

- **Hypoadduction:** reduced or weak VF closure
  - Breathy, hoarse (reduced loudness)
  - Lower motor neuron, Parkinson's, some traumatic brain injuries
- **Hyperadduction:** tightly (excessively) closed VFs
  - Harsh, strained-strangled (abnormal loudness, including excessive)
- **Phonatory instability:** fluctuations in VF closure
  - Rough/hoarse voice, glottal fry, (pitch breaks)
  - May be short term (cycle-by-cycle) or long term (>1 cycle)
- Mixed phonatory impairment: Combination of above

# Acoustic findings of voice quality in PD

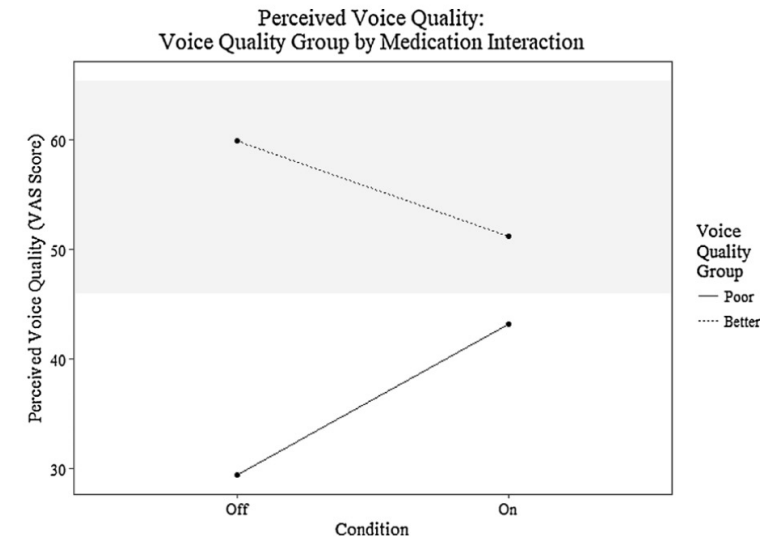
*Correspond with hypoadduction*

- High jitter, high shimmer → possibly reduced neuromuscular control of laryngeal abduction or adduction
  - Abnormal shimmer (amplitude fluctuations) correlated with perceptual measures of breathiness
    - Vocal fold bowing in PD → increased airflow turbulence and intensity variations
- Abnormal HNR
- Lower CPP
- Lower L/H ratios

# PD treatment effects on voice quality

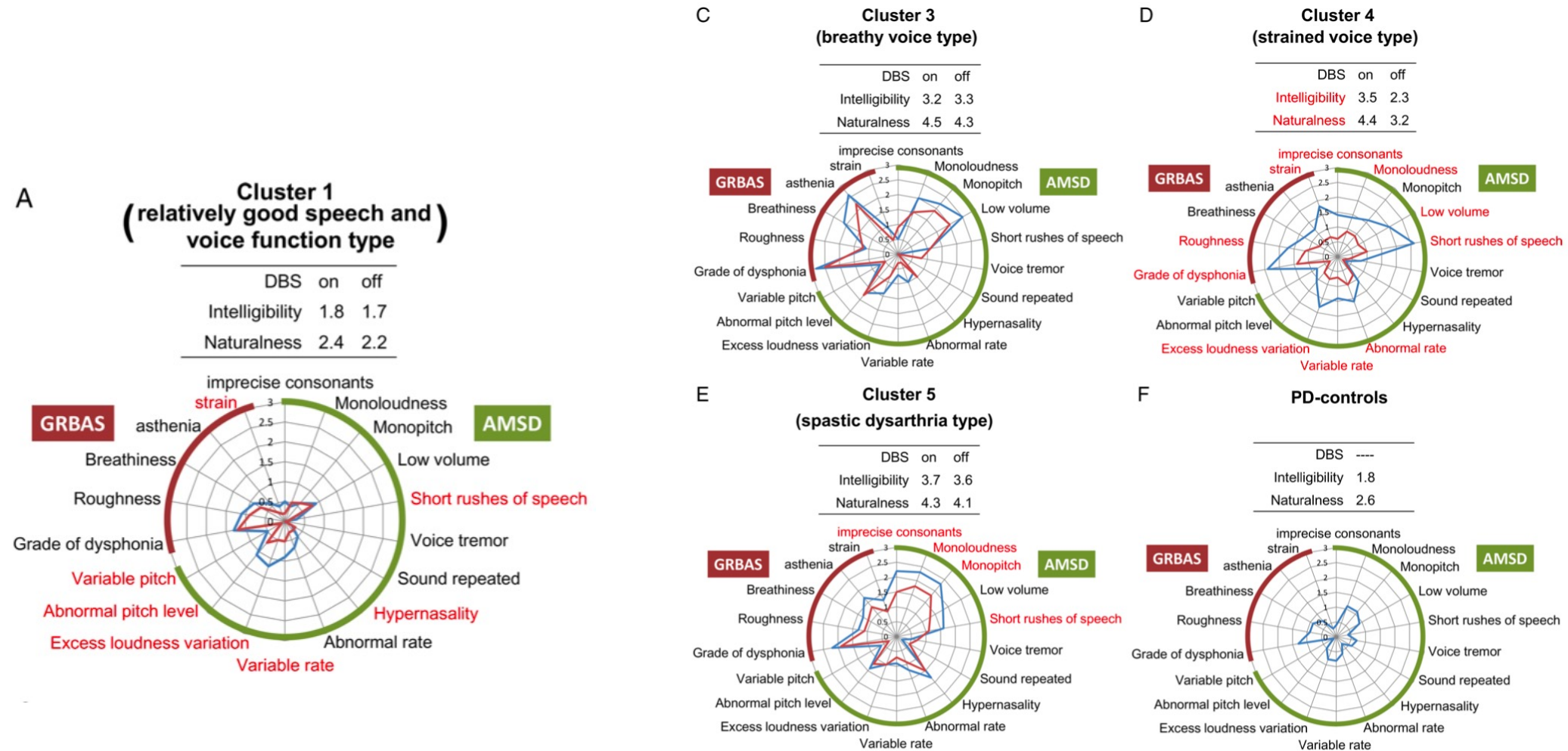
Inconsistent findings, but generally...

- Pharmaceutical: Levodopa
  - Improvements in jitter, shimmer, HNR
  - Direction of change dependent on baseline:
    - more severe → improve, less severe → worsen
- Surgical: Deep brain stimulation
  - Worsening in jitter, shimmer, HNR compared to pre-surgery
  - Improvements when stimulation ON compared to OFF



Cushnie-Sparrow et al., 2018

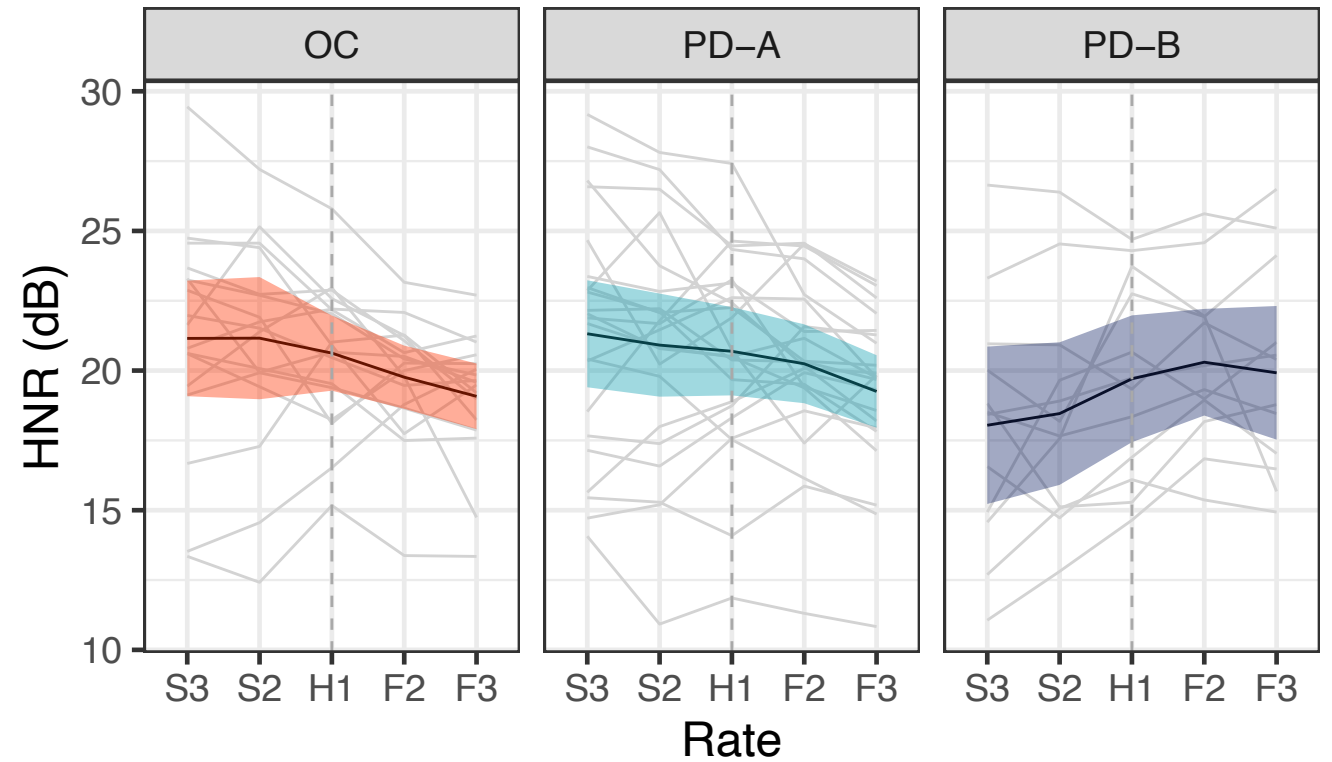
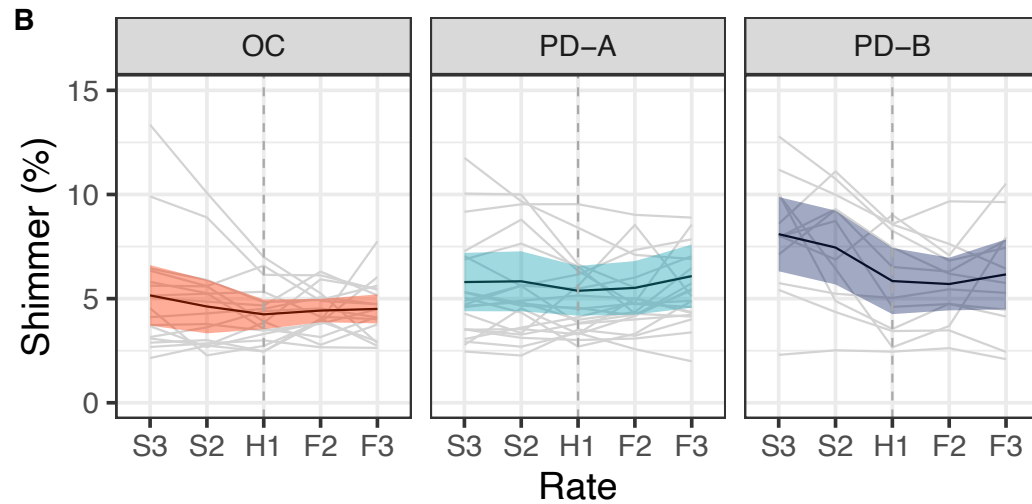
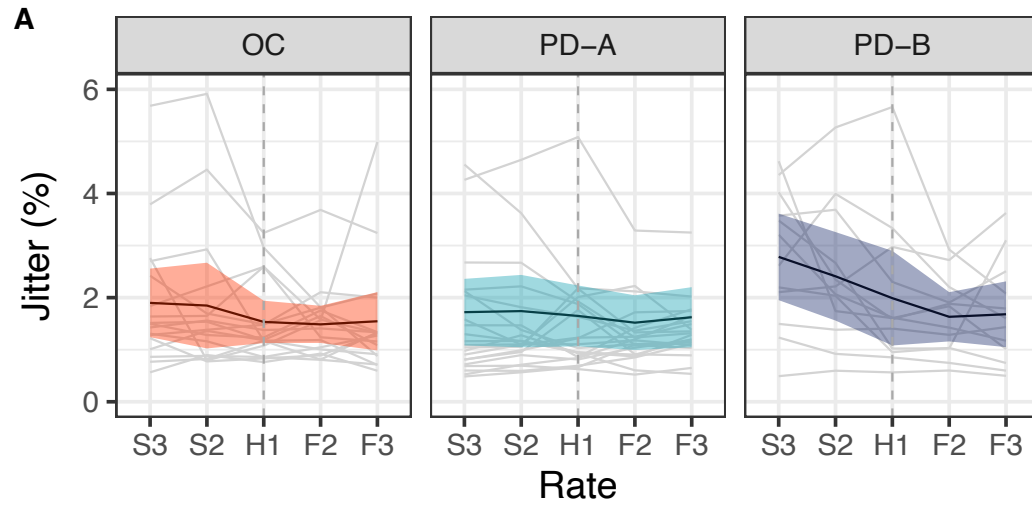
# Deep brain stimulation



Tsuboi et al., 2015

**Figure 1** Spider diagrams of speech and voice variables in the five clusters and PD-Controls. Higher scores indicate worse condition. Cluster 1 (A); cluster 2 (B); cluster 3 (C); cluster 4 (D); cluster 5 (E); and PD-Med (F) are shown. With regard to the five clusters, spider diagrams of speech and voice disorders in the on and off stimulation conditions are indicated in blue and red, respectively. The overall grades of severity (intelligibility and naturalness) are shown above each spider diagram. The variables that changed significantly after stopping stimulation are marked in red.

# Modified speech rate

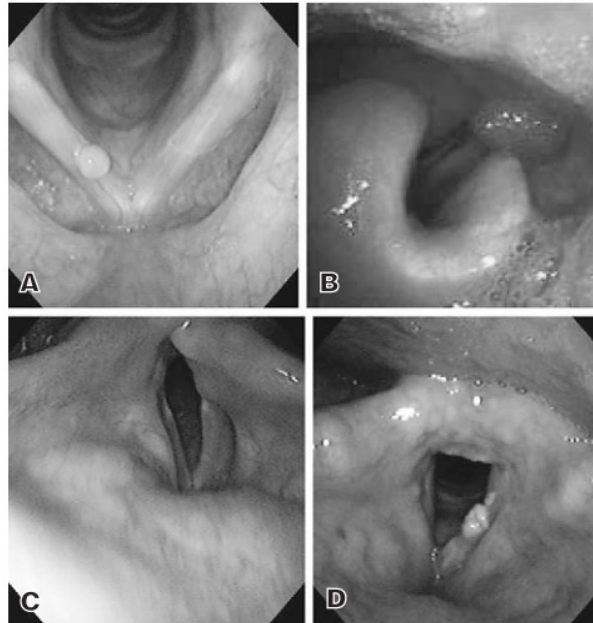




# Duffy clips

Label & clip	Description
Harsh voice (Sample 17, 96)	Voice is harsh, rough, and raspy.
Hoarse (wet) voice (Samples 1–4, 15, 82, 88, 97)	There is wet, “liquid-sounding” hoarseness.
Breathy voice, or breathiness (continuous) (Samples 1–4, 14, 15, 16, 82, 88)	Voice is continuously breathy.
Breathy voice, or breathiness (transient) (Sample 18, 22)	Breathiness is transient or intermittent.
Strained (strained-strangled) voice (Samples 5, 6, 8–10, 17, 21, 45, 84, 86, 89, 94, 96, 98, 102)	Voice quality sounds strained or strangled (an apparently effortful squeezing of voice through glottis).

# Some causes of dysphonia (damage to VF)



**Fig. 1 Main conditions which cause voice disorder**

A: Right vocal cord polyp

B: Acute epiglottitis

C: Left recurrent nerve paralysis

D: Laryngeal cancer of the left glottis

[Extracted and modified from the Japan Society of Logopedics and Phoniatics (editor).']

**Figure 4:** Differences in voice quality and duration of the voiceless section by condition and experiment showing an increase in glottal opening under prominence and when there was a contrast with a minimal pair (Experiment 2).

