Defining and Measuring Voice Quality

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Voice Quality is Hard to Measure

• Complex
• Unstable
The Definitional Dilemma

• Voice is hard to define
• Voice quality is also hard to define
The ANSI Definition

“…that attribute of auditory sensation in terms of which a listener can judge that two sounds similarly presented and having the same loudness and pitch are dissimilar.”
The ANSI Definition

• Often maligned
  – A negative definition
  – Defines quality in the context of one specific task; hard to operationalize or generalize to other tasks
  – Implies quality is independent of frequency and amplitude
Virtues of the ANSI Definition

• Treats sound quality as the result of a perceptual process
• Highlights importance of signals and listeners in determining quality
Why Include the Listener?

• Just as loudness and pitch do not exist without the listener, vocal quality is an acoustic-PERCEPTUAL phenomenon.
How Listeners Introduce Variability

- Listeners may pay attention to different acoustic aspects of signals, even in the same task
- Importance of a given cue may depend on context or task demands
- Different listeners may use different cues
- Definitions of quality that focus on production or acoustics cannot account for such effects
So: How Should We Measure Quality?

• Create lists of terms to describe listeners’ auditory impressions
## Venerable and Modern Labels for Voice Quality

<table>
<thead>
<tr>
<th><strong>Julius Pollux</strong></th>
<th><strong>Moore, 1964</strong></th>
<th><strong>Gelfer, 1988</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear</td>
<td>Clear, light, white</td>
<td>Clear</td>
</tr>
<tr>
<td>Deep</td>
<td>Deep</td>
<td>Resonant, low</td>
</tr>
<tr>
<td>Brilliant</td>
<td>Bright, brilliant</td>
<td>Bright, vibrant</td>
</tr>
<tr>
<td>Small, feeble, faint</td>
<td>Breathy, whispery</td>
<td>Breathy, soft, babyish, weak</td>
</tr>
<tr>
<td>Thin</td>
<td>Thin, pinched, shallow,</td>
<td>Thin</td>
</tr>
<tr>
<td>Hollow, indistinct</td>
<td>Hollow, covered</td>
<td>Muffled</td>
</tr>
</tbody>
</table>
## More Labels for Voice Quality

<table>
<thead>
<tr>
<th></th>
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<th><strong>Gelfer, 1988</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Brassy</td>
<td></td>
<td>Buzzy, clangy, metallic</td>
<td>Metallic</td>
</tr>
<tr>
<td>Harsh</td>
<td></td>
<td>Harsh, strident,</td>
<td>Harsh, gravelly</td>
</tr>
<tr>
<td>Shrill, sharp</td>
<td></td>
<td>Shrill, sharp, piercing, cutting, pointed</td>
<td>Shrill, sharp</td>
</tr>
<tr>
<td>Smooth</td>
<td></td>
<td>Smooth, velvety</td>
<td>Smooth</td>
</tr>
<tr>
<td>Dull</td>
<td></td>
<td>Dull, heavy, dead</td>
<td>Dull, heavy, thick</td>
</tr>
</tbody>
</table>
Well-known Problems with Rating Scale Approaches

• Atheoretical approach
• Which scales to include?
• Poor reliability and questionable validity
• Redundancies and ambiguities
  – MDS and factor analytic studies have not resolved this problem
Vagaries of Scale Definition

Breathiness = dry, hard, excited, pointed, cold, choked, rough, cloudy, sharp, poor, bad? (Isshiki et al.)

Or:

Breathiness = breathy, wheezing, lack of timbre, moments of aphonia, husky, not creaky? (Hammarberg et al.)
What to Do?

• Voice Profile Analysis
  – Consistent from phonetic theory
  – Specifies how scales are related to each other
  – Specifies where information about quality might be, but does not model listeners’ behavior
What to Do?

- Acoustic assessment protocols
  - e.g., Dysphonia severity index, Hoarseness diagram
  - Depend on inconsistent correlations with perceptual measures for validity as measures of quality
What to Do?

• Method-of-adjustment task using speech synthesis
  – Does not depend on selection/definition of labels for quality dimensions
  – Helps listeners focus attention and avoids reliance on internal standards
  – Demonstrates causation between acoustic attributes and perceived quality
  – Follows directly from ANSI definition of quality
Strengths/Limitations

- Reliability
- Directly links perception to acoustics
- Technically difficult at present
Conclusion

• When we cannot measure, our knowledge is meager and unsatisfactory.
  – Attributed to Lord Kelvin

• If it exists, it exists in amounts, and if it exists, it can be measured.
  – Lord Thorndyke
Acknowledgment

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