

# ACOUSTIC CORRELATES OF PERCEIVED CREAKY VOICE IN A CONTROLLED SAMPLE OF AMERICAN ENGLISH

SAMEER UD DOWLA KHAN (REED COLLEGE)

KARA BECKER (REED COLLEGE)

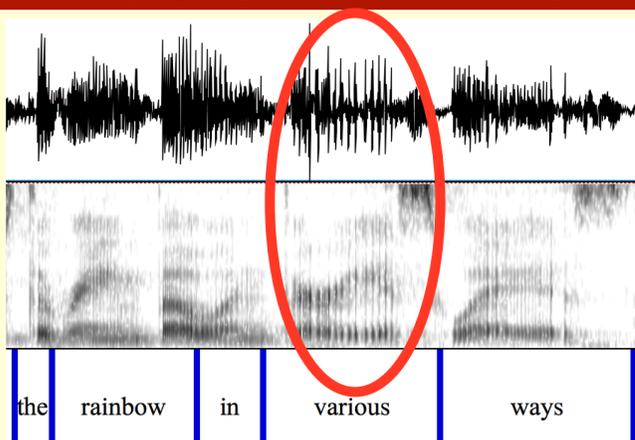
LAL ZIMMAN (UC SANTA BARBARA)

90<sup>TH</sup> MEETING OF THE LINGUISTICS SOCIETY OF AMERICA

## BACKGROUND

- **Creaky voice** is typically described as:
  - Low, irregular pitch (f0)
  - Multiple pulsing
  - Added noise
- Two ways to identify it:

## 1. AUD/VISUAL IMPRESSION



## 2. ACOUSTIC CORRELATES

- **Pitch**
  - Low f0: English (G&K2015), Black Miao (K2014)
  - High f0 (tense): Chong (DC2009), Black Miao (K2014)
- **Spectral amplitudes**
  - Low H1c: White Hmong (E2012)
  - High H2c: Chanthaburi Khmer (W&J2003)
  - Low H1c-A1c: Mazatec (G&K2010), Yi (K2011), Khmer (W&K2003)
  - Low H1c-A2c: Mazatec (G&K2010)
  - Low H1c-A3c: Santa Ana del Valle Zapotec (E2010)
  - Low H1c-H2c: Mazatec, Chong (DC2009), Yi (K2011), English, Zapotec (E2010)
- **Periodicity**
  - Low harm.-to-noise ratio (HNR): English (G&K2015)
  - Low cepstral peak prom. (CPP): English (P&a2015), Mazatec (G&K2010), Yi (K2011)
- **Multiple pulsing**
  - High subharm.-to-harm. ratio (SHR): English (P&a2015)

## QUESTIONS

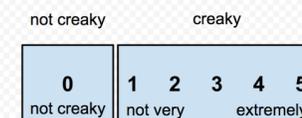
- How best to identify creaky voice in American English?
- **Auditorily**: are native listeners **reliable raters** of creaky voice?
- **Acoustically**: what acoustic features **correlate** with relative ratings of creak?

## METHODS

- **Talker group**
  - 5 speakers of Am. English
- **All transgender men**
  - Participants in /s/ study (Z2015)
  - Demographic associated with higher use of creak (Z2012, Z2013)
- **5 tokens per speaker of IP-final word "bows"**
  - Extracted from Rainbow Passage
  - Pitch range 40-220Hz
  - Scaled to 70dB intensity
- **Listener group**
  - 14 linguistics majors (9F, 5M)
- **Pre-test**
  - Unambiguously creaky and modal recordings of 6th talker used to test for familiarity with phonetic terms
  - Disqualified a 15th listener
- **Setup**
  - Lab of Linguistics (LoL) at Reed
  - Run in SuperLab w/ headphones

You may repeat a sound as many times as you like.  
To repeat: press the spacebar and follow the instructions on the next screen.

When you're ready, please indicate how creaky the sound was by pressing the number key that corresponds to your rating on the scale below. (0, 1, 2, 3, 4, 5)



## RESULTS: RATINGS

- Listeners generally used the full scale: 0-5
- 3 listeners used only 1-5, i.e. everything had creak
- Mean rating = 1.44, SD = 1.83
- **Ratings across listeners are reliable**
- **Intra-class correlation = 0.615**

Listener	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Max	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Mean	2.12	2.68	1.64	1.56	1.64	2.04	1.88	2.20	3.56	2.72	2.92	2.64	3.04	2.32
Min	0	0	0	0	0	0	0	0	1	1	0	0	1	0
SD	1.96	1.95	2.03	1.58	1.50	2.11	1.83	1.83	1.19	1.31	1.66	2.00	1.72	1.89

## RESULTS: ACOUSTIC CORRELATES

- Each token's vowel was subjected to automated acoustic measurements in **VoiceSauce** (S2010)
- **Correlations** made between mean ratings and acoustic measurements
  - Bonferroni-corrected alpha = .003
- As expected, higher creak ratings were **strongly correlated with lower f0**
- However, creakier ratings were **not significantly correlated with spectral amplitude measures**
- Non-significant trend in **unexpected direction**
- Higher creak ratings were **strongly correlated with lower periodicity**, as expected
- Unexpectedly, higher creak ratings had a non-significant correlation with **weaker cues to multiple pulsing**

Measure	Expected	Observed	Pearson	p-value
f0	lower	lower	-.91	< .001*
H1c	lower	lower	-.02	.914
H2c	higher	lower	-.20	.376
H1c-H2c	lower	higher	.21	.342
H1c-A1c	lower	higher	.50	.018
H1c-A2c	lower	higher	.51	.016
H1c-A3c	lower	higher	.52	.014
HNR-05	lower	lower	-.75	< .001*
HNR-15	lower	lower	-.71	< .001*
HNR-25	lower	lower	-.77	< .001*
CPP	lower	lower	-.54	.009
SHR	higher	lower	-.54	.009

## DISCUSSION

- **Why does our creaky voice have breathy-like qualities in the steeper spectral slope?**
- **Typology of non-prototypical creak** (K&a2015):
  - Vocal fry: regular f0
  - Multiply pulsed voice: multiple f0's
  - Tense/pressed voice: mid/high, regular f0
  - Aperiodic voice: no perceived pitch
  - **Slifka voice: steeper spectral slope**
- Slifka voice is described as having (S2000, S2007):
  - Low, irregular f0 (alternating with regular f0)
  - Spreading glottis, high airflow
  - Rising airflow as subglottal pressure falls
- **How common is Slifka voice?**
- BU news corpus (n=4) and lab study (G&K2015):
  - Low f0, low HNR
  - High SHR
  - **Variable spectral slope: steeper for men?**
- Interviews of Central Californians (C&P2015):
  - Women produce shallower spectral slope in creak
  - **Men produce steeper spectral slope in creak**
- **Is Slifka voice more common among men?**
- Ongoing work: looking across 8 gender+sex identities to explore creak further (B&a2015)

## CONCLUSIONS

- Creak was **reliably rated by listeners**
- Ratings were correlated with:
  - **Low pitch\*** (low f0)
  - **Low periodicity\*** (low HNR-05, HNR-15, HNR-25)
  - **Steeper spectral slope** (high H1c-A1c, etc.)
  - **Less audible multiple pulsing** (low SHR)
- This type of creak most closely resembles **Slifka voice** (a.k.a. non-constricted creak)
- Aligns with very recent work suggesting that this **may be more common among men**

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