Reverberation increases perceptual calibration to reliable spectral peaks in speech

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• Sensory systems are highly sensitive to stable aspects of the environment.

• Signal properties are less informative when they are reliable (stable or recurring across time)
  • Adaptation, habituation, attenuation, calibration, …

• Signal properties are more informative when they change
  • More useful for perception
Perceptual Calibration

“Please say what vowel this is” before /i/-/u/ target

Common $F_2$ peak $=$ decrease reliance on $F_2$, increase reliance on tilt

Methods

• 20 native English speakers with normal hearing

• Precursor: “Please say what vowel this is”
  • 100-Hz bandpass filter centered at vowel F₂, gain = +20 dB

• Vowels: synthesized 5-by-5 matrix varying from /i/ to /u/
  • Varied in F₂ and tilt, all other stimulus parameters matched
Alexander & Kluender (2010)
Results: Experiment 1

1. Vowels in isolation
   - Calculate logistic regression on responses
   - Standardized regression coefficients = perceptual weights
Results: Experiment 1

2. Vowels following precursors that share F₂ peak
   - Calculate logistic regression on these responses
Perceptual calibration = changes in weights across sessions

- Reliable cue ($F_2$) $\rightarrow$ decrease weight
- Changing cue (tilt) $\rightarrow$ increase weight
Reverberation

- In speech, energy in a spectral peak waxes and wanes across time; here this peak is made reliable.

- Reverberation smears spectral peaks across time, which would increase their presence throughout the precursor.

- Perceptual calibration is predicted to increase in highly reverberant listening conditions ($T_{60} = 2.97$ seconds).
Results: Experiment 2

1. Vowels in isolation, reverberation
Results: Experiment 2

2. Vowels following precursors that share $F_2$ peak, reverberation
Results: Experiment 2

Perceptual calibration = changes in weights across sessions
- Reliable cue ($F_2$) $\rightarrow$ decrease weight
- Changing cue (tilt) $\rightarrow$ increase weight
• Greater perceptual calibration for reverberant speech ($p$’s < .001)
• But, different starting points for listener groups ($F_2: p < .02$)
Methods

- 22 new listeners
  - n=11: Dry 1\textsuperscript{st}, Reverberant 2\textsuperscript{nd}
  - n=11: Reverberant 1\textsuperscript{st}, Dry 2\textsuperscript{nd}
- Same stimuli as previous experiments
Results: Experiment 3

Perceptual Calibration (Weight Change)

Dry 1st
- F2
- Tilt

Reverberant 2nd
- F2
- Tilt

Reverberant 1st
- F2
- Tilt

Dry 2nd
- F2
- Tilt

Spectral Cue
Conclusions

- Perceptual calibration increases in highly reverberant listening conditions.

- Experience with reverberation extinguished calibration in non-reverberant listening conditions.