The role of speech-specific signal characteristics in vowel normalization

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Introduction

• Listeners interpret vowels relative to the vowel space of a speaker
• Sounds from a [i] to [e] continuum (a first formant (F1) vowel contrast) are interpreted relative to a speakers’ F1 range
• Vowel normalization might be due to a general-purpose acoustic mechanism, which compensates for long-term spectra

If vowel normalization is the result of an acoustic mechanism, it should also apply to nonspeech sounds

Experiment 1: speech

• Listeners categorized [pɪt] to [pɛt] targets presented after a precursor with a high F1

⇒ More /i/ responses to targets presented after a precursor with a high F1

Experiment 2: nonspeech

• Experiment 1 materials manipulated to become uninterpretable, but to retain their acoustic complexity
• A training procedure familiarized participants with the nonspeech sounds

⇒ No normalization despite a similar long-term average relation between precursor and target.

Experiment 3: fewer manipulations

A) Materials only spectrally rotated
B) Materials manipulated in all ways except spectral rotation

Experiment 3A: Only spectral rotation

⇒ Normalization re-occurred.

Exp. 3B All but spectral rotation

⇒ Weak normalization, which was not replicated on a second occasion.

Experiment 4: Perceived “speechyness”

• Although Experiment 3a gave the largest effect (of the nonspeech materials), its precursor was rated as least speech-like.

⇒ Amount of normalization is not predicted by perceived “speechyness”

Additional experiments:

Nonspeech carriers:
A) With pitch movement: No normalization
B) Reintroducing breaks: No normalization

Nonspeech targets:
A) Imposing pitch movement: No normalization
B) Reversing the targets: No normalization

Repeating 3a&b with attention to carriers:
Introducing an attentional task did not increase the effect (in fact, the small normalization of Exp. 3B vanished, while that of 3A remained)

Conclusions

• Perceived resemblance to speech does not explain the results
• Only nonspeech with enough acoustic resemblance to speech results in normalization
• It appears that vowel normalization is not due to a general acoustic process
• Vowel normalization might be a result of learning about covariations in natural speech