Acoustic Correlates of English Clear Speech Produced by Native Korean Speakers

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RESEARCH BACKGROUND

- People can adjust their speech to be clearer than usual when there is an obstacle in communication (e.g. when a listener is hearing-impaired)
- Clear speech is acoustically distinguishable from conversational due to slower speaking rate, longer vowel duration, higher pitch, wider pitch range, vowel space expansion, and longer VOT for voiceless stops (Picheny et al., 1986)
- Relatively little is known about clear speech produced by L2 speakers.

RESEARCH QUESTIONS

- Are native Korean speakers of English able to modify their English speech in the same manner as native English speakers do when asked to speak clearly?

METHODOLOGY

Participants

- 14 native Korean speakers residing in the U.S. (10 males; age mean = 29.12; age SD = 3.32)
- 9 native Midwestern-English speakers (4 males; age mean = 20.89; age SD = 2.09)

Stimuli

- 4 English quadruplets that have corner vowels (e.g. *peat, pat, poot, pot*)
- 6 English pairs that have a voiced and a voiceless alveolar stop (e.g. *tad, dad*)

Statistical Verification

- Linear mixed model with *Subjects* as a random effect and *Speaker Group* (Korean vs. English), *Speaking Mode* (Casual vs. Clear), and *Voicing* (in some models) as fixed effects (+interactions)

Procedure

- Each participant read stimuli, repeating three times, in casual speaking style first and then in clear speaking style with a short break between two styles.

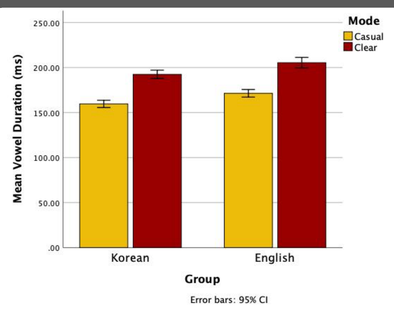
Acoustic Measurements

- Vowel duration
- Mean pitch and pitch range during vowel (pitch normalized to semitones: 12ln(x / individual mean f0)/ln2
- VOT, onset f0 (also normalized to semitones)
- Vowel space measured as area of irregular quadrilateral (based on F1 and F2 at midpoint), Vorperian & Kent (2007): 0.5*[(/i/F2*/æ/F1+/æ/F2*/a/F1+/a/F2*/u/F1+/u/F2*/i/F1)-(/i/F1*/æ/+/æ/F1*/a/F2+/a/F1*/u/F2+/u/F1*/i/F2)]

RESULTS

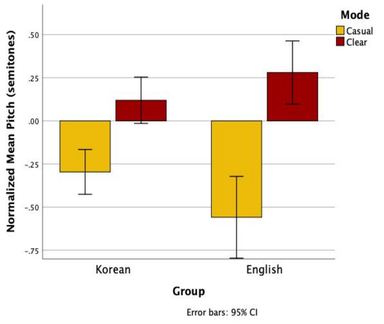
Vowel Duration

- A significant effect of Mode (F(1, 2199) = 184.788, p < .05): clear speech vowels were significantly longer than casual speech vowels.
- A significant effect of Group (F(1, 2199) = 25.435, p < .05): vowels produced by English group were significantly longer than those produced by Koreans
- No significant interaction between Mode and Group (F(1, 2199) = 0.065, p = .798)



Mean Pitch

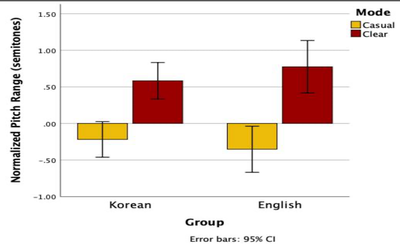
- A significant effect of Mode (F(1, 2199) = 54.409, p < .05): clear speech vowels had significantly higher pitch than casual speech vowels.
- No significant effect of Group (F(1, 2199) = 0.358, p = .549)
- A significant interaction between Mode and Group (F(1, 2199) = 6.211, p < .05): English group produced greater clear speech difference in pitch than Korean group.



RESULTS (Cont'd)

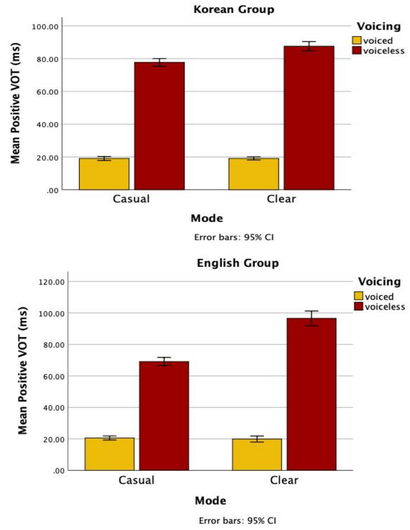
Pitch Range

- A significant effect of Mode (F(1, 2199) = 42.764, p < .05): clear speech vowels had significantly greater pitch range than casual speech vowels.
- No significant effect of Group (F(1, 2199) = 0.037, p = .848)
- No significant interaction between Mode and Group (F(1, 2199) = 1.221, p = .269)



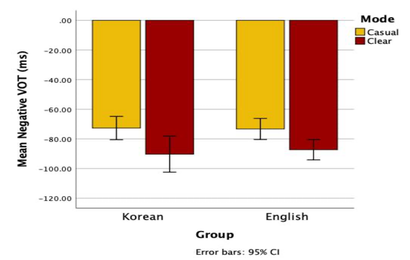
Positive VOT

- A significant effect of Mode (F(1, 1456) = 84.234, p < .05): clear speech vowels showed significantly longer VOT than casual speech ones.
- No significant effect of Group (F(1, 1456) = 0.466, p = .495)
- A significant interaction between Mode and Group (F(1, 1456) = 17.861, p < .05): English group made a significantly greater VOT difference between speaking modes than Korean group.
- A significant interaction between Voicing and Mode (F(1, 1456) = 90.084, p < .05): VOT difference between voiced and voiceless stops was significantly greater in clear speech than in casual speech.
- A significant interaction among Voicing, Mode and Group (F(1, 1456) = 20.869, p < .05): English group made a significantly greater difference between casual and clear speech in terms of VOT difference between voiced and voiceless stops.



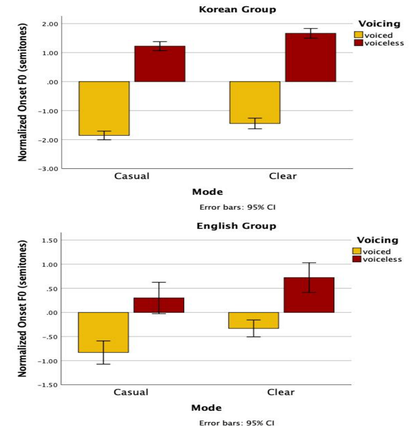
Negative VOT

- A significant effect of Mode (F(1, 187) = 11.743, p < .05): clear speech vowels showed significantly longer negative VOT than casual speech vowels.
- No significant effect of Group (F(1, 187) = 0.067, p = .796)
- No significant interaction between Mode and Group (F(1, 187) = 0.149, p = .700)

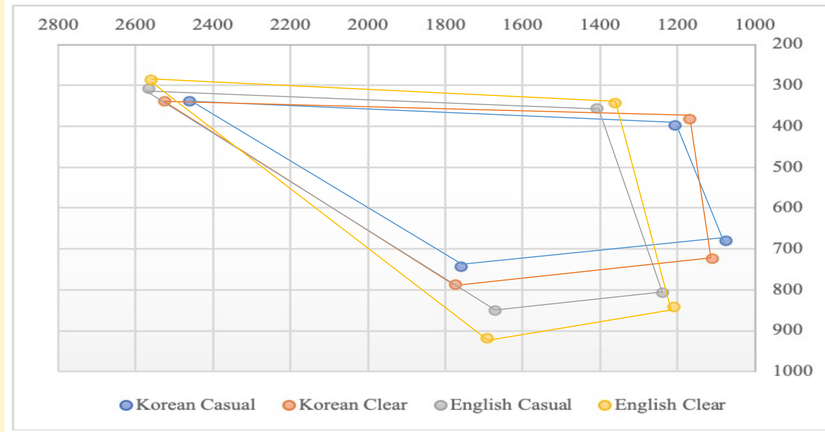


Onset F0

- A significant effect of Mode (F(1, 1643) = 38.113, p < .05): clear speech vowels had significantly higher onset f0 than casual speech vowels.
- No significant effect of Group (F(1, 1643) = 0.811, p = .368)
- No significant interaction between Mode and Group (F(1, 1643) = 0.050, p = .824)
- No significant interaction between Voicing and Mode (F(1, 1643) = 0.024, p = .878)
- No significant interaction among Voicing, Mode and Group (F(1, 1643) = 0.125, p =.724)

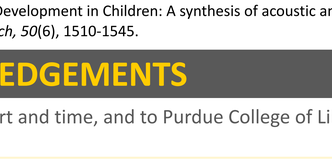


RESULTS (Cont'd)



Vowel Space Expansion

- A significant effect of speaking Mode (F(1, 543) = 20.002, p < .05): vowel space area was significantly expanded in clear speaking style.
- A significant effect of Group (F(1, 543) = 13.114, p < .05)): English group showed significantly larger vowel space than Korean group did.
- No significant interaction between speaking mode and speaker group (F(1, 543) = 0.134, p = .576)



DISCUSSION & CONCLUSION

- For all acoustic parameters, the effect of Speaking Mode was significant.
  - Acoustically distinct clear speech compared to casual one was elicited.
- L2 clear speech was largely acoustically comparable to L1 speech: the interaction between Speaking Mode and Speaker Group was significant only for mean pitch and positive VOT.
  - Native English speakers made a significantly greater pitch difference in clear speaking style.
    - Possibly because L2 speech tends to be relatively monotone compared to L1 speech.
  - English group also made a greater difference in positive VOT for clear speech than Korean group did.
    - F0, not VOT, is a primary correlate of voicing, especially to young Korean speakers (Kang & Guion, 2008), which could explain this pattern.

Future Studies

- What would be the interaction between the effect of lexicon and the effect of speaking mode on vowels?
  - Would a vowel be hyperarticulated more in clear speech if it is found in a word with a minimal lexical counterpart (*feat* vs. *fit*) than otherwise?

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ACKNOWLEDGEMENTS

Many thanks to all participants for their support and time, and to Purdue College of Liberal Arts PROMISE Award for financial support.

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