Vowel duration: phonetics or grammar?

- Vowel is longer before voiced than voiceless consonant in L1
  - English
    - Adult: House (1963), Mack (1982), 150%
    - Children: Ko (2007)
    - Korean, Russian, French: Chen (1970), not to the degree of English.
  - Japanese: Not explored much.
- Does English have a special grammar to elongate the vowel (e.g., Lisker, 1974)?
- Or is it just a general phonetic mechanism (e.g., Lestree, 1970)?

Determining factors

House (1961): Vowel duration study of adult American English speakers
- Investigated average durations of 12 vowels of American English in disyllabic nonsense words
- Target words: unstressed (carrier) syllable [s] + stressed syllable ([CV]C)
  1. C1 and C2 should be the same phoneme (e.g., [lůst], [lův])
  2. 12 vowels [i, e, e, a, u, a, o, o, ò, o, a, ò]
  3. 14 consonants [t, d, s, z, s, t, p, b, k, d, q, g]
- 14 consonants x 12 vowels = 168 words (no repetition)

Three American English male speakers
- Four factors affecting vowel duration in English
  1. Primary influences: part of English phonology, acquired by native speakers
     - Character of context (post-vocalic voicing distinction: voiced/voiceless consonants)
     - Character of vowel (tense/lax vocalic distinction)
  2. Secondary influences: a function of the articulatory process
     - Character of vowel (vowel height: close, mid and open vowels)
     - Character of context (consonant class: stops, affricates, fricatives)
- Claim: Vowel duration in English is affected by both universal and language-specific characteristics of the post-vocalic consonants and the target vowels.

- Investigated the acquisition of vowel duration in children speaking American English
- Especially when and how children acquire vowel durational differences as a function of postvocalic voicing
- Corpus: subset of the Province Corpus (included in the CHILDES database)
- Four children: postvocalic voiced/voiceless-distinction
- Three children: tense/lax vowel distinction
- Age range: 0;11 to 4;0
- Target words
  1. Variants (spontaneous speech corpus)
  2. Minimal or near-minimal pairs of CV (e.g., back-gog, duck-bug)
- Three findings
  1. Vowel duration conditioned by voicing before the age of 2
  2. Tense/lax vowel durational distinction acquired before the age of 2
  3. No developmental trend in the acquisition of the vowel duration conditioned by postvocalic voicing
- Claim: Postvocalic consonant voicing distinction and tense/lax vowel duration are universal, but language-specific characteristics, which conflicts with House (1961).


- Is the vowel duration conditioned by postvocalic consonant voicing universal or language-specific?
- If the vowel duration difference before the postvocalic voiceless/distinction is universal, we would expect that children speaking any language should show the same tendency as in Ko (1997)
- A corpus study of the Japanese-acquiring children was conducted.

Corpus Study: NTT infant database

- Longitudinal data of spontaneous speech at home, subset of the data (3 of 5 speakers) were segmented and labeled.
- All children were born and raised in Tokyo and Kanagawa area.

Subject ID Age range Gender Recorded hours

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<th>Subject ID</th>
<th>Age range</th>
<th>Gender</th>
<th>Recorded hours</th>
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<tr>
<td>3</td>
<td>2-5</td>
<td>M</td>
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Analysis by Target Words

- Postvocalic consonant effect: Vowels before voiced > Vowels before voiceless (Figure 1)
- Consonant class effect: Fricatives > Stops > Glottal stops (Figure 1)
- Effect of vowel height: Low > Med > High (Figure 2)
- Phonological distinction of vowel length: Overlap? More analyses below (Figure 2)

Analysis by Age

- Short vowels: Getting shorter from 30-36 months (Figure 3a)
- Long vowels: Highly variability across all ages (Figure 3b)

Summary

- Both consonant class effect and vowel height effect are observed.
- Short/Long contrast is not stable yet.
- As far voicing dependent durational difference, Universal (Ko, 2007) beats Language specific (House, 1961) hypothesis.
- If so, does that universal property in L1 carry over to L2?

Preliminary Production Experiment in L2 English

- Question: Do L1 Japanese speakers show “universal” vowel duration differences in L2 English?

Methods

- Materials
  1. 16 minimal pairs, ending with a voiced/voiceless consonant, 32 words in total
  2. Taken from an English phonetic textbook for college students (Takebayashi and Saito, 2008)
     - [b] = bead, head, peace, peas, feet, feed
     - [m] = mid, mid, lid, lid, slid, slid, kid, kick, his, his
     - [p] = peek, per, bet, bed, yet, said
     - [b] = batch, bad, cat, card
     - [d] = dad, bud, buzz, buzz, duck, dog, cup, cub
     - [k] = kick, knot, nod, got, god
     - [g] = guard, pudding
     - [p] = proof, prove, leaf, leave, grief, grove
- Participants
  1. 15 students at Daito Bunka University (1 grad, 4 undergrads (sophomores, juniors and seniors))

Procedures

- Pronounced each target word embedded in a carrier sentence, “Say ________.”
- Six times per target word, random presentation controlled by Praat (Boersma and Weenink, 2013)

- Measurements
  1. Exclude voicing words (e.g., “feed” pronounced as [fɛd], “cub” as [kub])
  2. Start and end points of each target vowel were first segmented automatically, and manually corrected by the authors trained as phoneticians.

Analysis by Participants

- Categorized into two groups in terms of English speaking ability
  - Advanced group: SS1, SS7, SS16
  - Basic group: the rest
- Voiceless/voiced postvocalic consonant distinction (Figures 6 & 7)
  1. Group effect (Figure 6)
     - Overall vowel durations: Advanced > Basic
     - Voice-dependent duration difference: Advanced > Basic
     - Almost all participants showed vowel durational difference between voiceless/voiced postvocalic consonant (Figure 7)

Discussion and Conclusion

- The postvocalic voicing effect on vowel duration is universal. A corpus analysis of Japanese infant data supports this view.
- Universal durational differences do carry over to L2.
  - Voicing distinction
  - Consonant class
  - Vowel height
  - Language specific durational difference [all on top of [enhances / enlarges] the universal one.
  - Needs a model for [adding / adjusting] (multiplying) the parameter for the distinction in L2.
  - L1 grammar works together with the development of language proficiency in L2.