Accent-meter/tune alignment in Japanese vocal music

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Pitch accent system

• Where do pitch accent languages belong in the theory of prosodic typology?

• There has been a great deal of controversy over the pitch accent system.

  • Indirect (accentual) approach:
    Accent goes on position X. \(\rightarrow\) Tones go to accent.
    (Goldsmith 1976, Haraguchi 1979, Ladd 1996, Van der Hulst 2011, among others)

  • Direct (tonal) approach:
    Tones go to position X.
Pitch accent in Tokyo Japanese

- Tokyo Japanese has been described as a pitch accent language.

- There have been two different approaches in analyzing Tokyo Japanese: Accentual and tonal analyses.
  - The accentual analysis expects that the position of accent is lexically decided and a falling pitch contour falls on the accented position (McCawley 1968, Goldsmith 1976, Haraguchi 1979, 1988).
    
    ex) ə.me ‘rain’ vs. a.me ‘candy’
  - In the tonal approach, tones are directly assigned to morae (Pulleyblank 1986, Poser 1984, Pierrehumbert & Beckman 1988, Hyman 2006).
    
    ex) A.me ‘rain’ vs. a.ME ‘candy’ (H tone in capital letters)
Research question

- Which approach is a better one for Tokyo Japanese, accentual or tonal?
- Does an accent exist in Tokyo Japanese? Does a position claimed to be accented mark a phonological prominence?
  - If yes, it suggests that the accentual approach is on the right track and a falling pitch is assigned to the accented (and the following) mora.
  - If not, the tonal approach is a better analysis, because there is no accented position to assign a falling pitch. This expects that tones are directly assigned to syllables without the notion of accent.
Text-tune alignment

- One way to answer this question is to see how text aligns with musical meters and notes.
- Previous studies show that in stress languages, such as English, stressed syllables tend to fall on strong beats of the meter (Palmer & Kelly 1992, Halle & Lerdahl 1993, Temperley & Temperley 2013). ex) accent [ˈæk.ʃənt]
- Also, previous studies show that in tonal languages, there is a mapping between tonal transitions and musical note transitions (Wong & Diehl 2002, Wee 2007, Schellenberg 2009). ex) σσ (HL)
Hypotheses

H1) If an accent in Tokyo Japanese is a phonological prominence, we will find that an accented mora is aligned with a strong beat and a falling pitch goes to that mora.

H2) If Tokyo Japanese has a restricted tonal system, we will find that there is a mapping between tonal transitions and musical note transitions, but the position claimed to be accented is not necessarily aligned with a strong beat.
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Warabeuta ‘play songs’

- Warabeuta: A kind of traditional folk songs, mostly sung by children when playing games.
- These songs have been orally transmitted for a long time, and minor variations in lyrics and tunes are common depending on the regions they are sung.
- *Nihonno Warabeuta* ‘Play songs in Japan’ by Obara (1932)
  - 27 songs sung in the Tokyo area are selected.
  - Sample song: *Hiraita hiraita* ‘(A flower has) bloomed, bloomed’
Text annotation

- Every syllable/mora in our data was classified in four ways: its accent type, syllable weight, metrical strength, and musical note transition to the next note.
- Accent categories: ac, uc, af, uf
  - Accentedness: a (accented) or u (unaccented)
  - Word category: c (content) or f (function)
- Syllable weight: h or l
  - Heavy syllables were coded as h and light syllables as l.
  - If two light morae were aligned with the same musical note, they were labeled as h.
Music annotation

- For meter annotation (metrical strength), the method Temperley & Temperley (2013) use is adopted.
  - The tactus level (the quarter-note level in 2/4, 3/4, and 4/4 time signatures): 2
  - One level above the tactus level (the one-measure level in 2/4, 3/4 and the half-measure level in 4/4): 3
  - The one-measure level in 4/4: 4
  - All beats below the tactus: 1

- For musical note transition, we classified the direction of musical note transitions (from the given note to the next one) into three groups: rising, falling, and level (Wong & Diehl 2002, Wee 2007, Ketkaew & Pittayaporn 2014).
Example of the encoding

Figure 1: The first line of “hiraita hiraita” showing the encoding of lyrics, metrical levels, and note transition. Syllable weights are not shown here, because all morae are light, but the first ’rai’.
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Figure 2: Mean metrical strength by accent type. Level 4 is the strongest beat, and Level 1 is the weakest beat of the meter. A paired t-test across songs: $t(26) = 4.3, p = 0.0002$. 
Accent-meter alignment by syllable weight

Figure 3: Mean metrical level by syllable weight. Level 4 is the strongest beat, and Level 1 is the weakest beat of meter.
Accent vs. Syllable weight in meter alignment

To see how accent type and syllable weight affect the musical metrical level, we built a linear mixed-effect model.

|                  | Estimate | St. Error | t-value | Pr(>|t|) |
|------------------|----------|-----------|---------|----------|
| (intercept)      | 2.51     | 0.1       | 25.18   | < 0.001  |
| Weight           | -0.02    | 0.17      | -0.12   | 0.9      |
| Accent           | -0.61    | 0.09      | -6.5    | < 0.001  |
| Weight*Accent    | 0.71     | 0.24      | 2.86    | 0.004    |

Table 1: The output of a linear mixed-effects model. The reference category is accented light syllables.
Accent-tune alignment

Figure 4: Percent of note transitions by accent category
Accent-tune alignment by syllable weight

Figure 5: Percent of note transitions by syllable weight
Figure 6: Falling transition and/or strong metrical level (Level 3, 4) by accent category
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Syllable weight

• One difference between accent-meter alignment and accent-tune alignment in Tokyo Japanese can be found in the role of syllable weight.
  
  • Accent-meter alignment:
    Accented ⟹ strong beats regardless of syllable weight
    Heavy unaccented syllable > light unaccented syllable
  
  • Accent-tune alignment:
    Accented ⟹ falling transition
    Unaccented ≠ falling transition

• In music, a strong beat is needed in every measure. If all syllables in a measure are not prominent (no accent position), heavy syllables are likely to fall on strong beats.
Prominence-meter alignment value

- Stress-meter alignment value in Temperley & Temperley (2013): Difference between stressed and unstressed syllables in metrical strength
  - English: 1.15 (= 3.08 – 1.93)
  - French: 0.77 (= 2.57 – 1.8)
- Accent-meter alignment value in Tokyo Japanese: 0.52 (= 2.5 – 1.98)
- The value for Japanese is much smaller than that of English and slightly smaller than that of French.
- This seems to be because Japanese can employ another way of marking an accent in music: a falling pitch.
Conclusion

• The results of this study show that accented syllables in Japanese are likely to align with a strong beat and/or a falling pitch regardless of syllable weights.
  • Accent in Tokyo Japanese seems to be prominent.
  • A falling pitch goes to an accented position.

• The results support that Tokyo Japanese is a “pitch accent” language. (= Accentual approach)

• Future direction: Adding more songs in other genres
Reference I


Reference II


Thank you!