Boundary-driven Account for Downstep in Japanese

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Summary

- This study verifies the boundary-driven account for downstep in Japanese: downstep is triggered not directly by accents but by phonological boundaries
- Nine native speakers of Tokyo Japanese participated in a production experiment
- A new type of F0 downtrend: *final-accented downstep*.
  - a stair-step-like F0 downtrend caused by final-accented words without particles, with a smaller F0 fall than downstep.
- Our finding indicates that accents do not directly trigger downstep

Backgrounds

- In Tokyo Japanese, words are classified as either accented or unaccented
  - **Unaccented (U)**＝no sharp F0 fall
  - **Accented (A)**＝H*L = F0 fall
- Downstep
  - Pitch range compression triggered by lexical pitch accent [1]
  - If the pitch height of X is AX < UX, then X is downstepped [2,3]
  - The assumption: downstep is triggered only by accented words
- Boundary-driven downstep
  - The insertion of boundaries triggers a step-like F0 downtrend that resembles downstep, even without accents [4]
  - A phonological boundary must be inserted after every accent owing to accent culminativity and anti- lapse constraints [3]
- Research Question: Which account is more accurate: the accent-driven account or the boundary-driven account?

Figure 1: Schematic of downstep

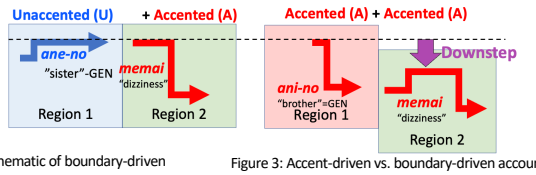


Figure 2: Schematic of boundary-driven downstep

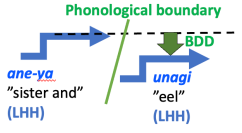
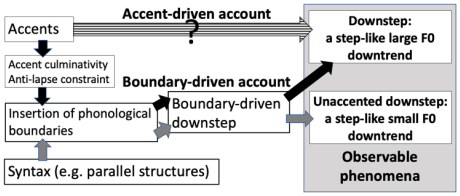


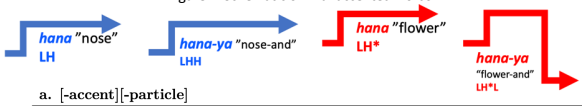
Figure 3: Accent-driven vs. boundary-driven accounts



Method

- Participants: A total of 9 native speakers of Tokyo Japanese
- Procedure: Production experiment
- Measurement:
  - R1Fall: the maximum value of the pitch in N1 minus the minimum value of the pitch of the following conjunction *ya*
  - R1MaxF0: the normalized F0 maximum in Region 1.
  - R2MaxF0: the normalized F0 maximum in Region 2.
- LME [5], backward selection [6]

Figure 4: Schematic of final-accented words



a. [-accent][-particle]

item	hana,	mori,	ue	to-itta	kanji-ga	ka'itearu
gloss	nose,	forest,	top	such as	Chinese.character-NOM	written

'Chinese characters such as "nose," "forest," and "top" are written there.'
鼻・森・上といった漢字が書いてある。

b. [+accent][-particle]

item	hana',	mori,	ue	to-itta	kanji-ga	ka'itearu
gloss	flower,	forest,	top	such as	Chinese.character-NOM	written

'Chinese characters such as "fower," "forest," and "top" are written there.'
花・森・上といった漢字が書いてある。

c. [-accent][+particle]

item	hana-ya	mori-ya	ue	to-itta	kanji-ga	ka'itearu
gloss	nose-and	forest-and	top	such as	Chinese.character-NOM	written

'Chinese characters such as "nose," "forest," and "top" are written there.'
鼻や森や上といった漢字が書いてある。

d. [+accent][+particle]

item	hana'-ya	mori-ya	ue	to-itta	kanji-ga	ka'itearu
gloss	flower-and	forest-and	top	such as	Chinese.character-NOM	written

'Chinese characters such as "fower," "forest," and "top" are written there.'
花や森や上といった漢字が書いてある。

Table 1: Sample stimuli used in experiment: Accented moras are underlined.

Results

- the [+accent/-particle] condition did not show a large F0 downtrend
  - contrary to the prediction from the accent-driven account
- the small step-like downtrend found in the [+accent/particle] level is slightly larger than the downtrend in the [-accent/-particle] level

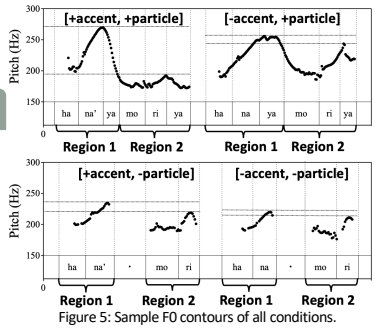


Figure 5: Sample F0 contours of all conditions.

Table 2: Results of mixed-effects models for R1Fall.

Predictor	β	t	p
(Intercept)	3.763	7.993	<.001
Accent	4.372	26.260	<.001

Table 3: Results of mixed-effects models for R1MaxF0.

Condition	Predictor	β	t	p
[-accent, -particle] vs. [+accent, -particle]	(Intercept)	0.858	37.17	<.001
	Accent	0.045	0.90	.372
[-accent, +particle] vs. [+accent, +particle]	(Intercept)	1.083	39.895	<.001
	Accent	0.274	8.547	<.001
[-accent, -particle] vs. [-accent, +particle]	(Intercept)	0.891	39.891	<.001
	Particle	0.110	3.734	<.001
[+accent, -particle] vs. [+accent, +particle]	(Intercept)	1.050	28.992	<.001
	Particle	0.339	6.884	<.001

Table 4: Results of mixed-effects models for R2MaxF0.

Condition	Predictor	β	t	p
[-accent, -particle] vs. [+accent, -particle]	(Intercept)	0.410	11.497	<.001
	Accent	-0.081	-3.947	<.001
[-accent, +particle] vs. [+accent, +particle]	(Intercept)	0.369	12.919	<.001
	Accent	-0.378	-8.199	<.001
[-accent, -particle] vs. [-accent, +particle]	(Intercept)	0.504	18.758	<.001
	Particle	0.108	4.998	<.001
[+accent, -particle] vs. [+accent, +particle]	(Intercept)	0.275	7.570	<.001
	Particle	-0.189	-4.399	<.01

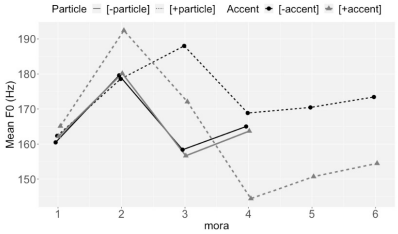


Figure 6: Mean of normalized F0 means per mora for item 1, item 2, and item 3. The [-accent, -particle], [+accent, -particle], [-accent, +particle], and [+accent, +particle] conditions are represented by solid black, solid gray, dashed black, and dashed gray lines, respectively.

Discussions

- Our findings support the boundary-driven account rather than the accent-driven account
- Two facts indicate that there is no downstep in the [+accent, -particle] condition:
  - 1) the [+accent, -particle] condition did not exhibit a large F0 compression for meeting the requirements for a paradigmatic diagnosis
  - 2) the [+accent, -particle] condition had a sufficiently higher F0 peak at Region 2 compared to the [+accent, +particle] condition
- Are the phonological accents in the [+accent, -particle] condition deleted?
  - No, because the Accent factor did create a slightly lower F0 peak at Region 2 in the [+accent, -particle] condition than in the [-accent, -particle] condition.

- Boundary-driven downstep
  - a phonological mechanism that lowers the pitch of subsequent PPhrases when a PPhrase or a PClause directly dominates two or more PPhrases
  - $(_{\text{PPhrase1}}(_{\text{PPhrase2}}X)(_{\text{PPhrase3}}Y)(_{\text{PPhrase4}}Z))$
- Accented downstep
  - a step-like large F0 downtrend after an accented word
  - has traditionally been called downstep
  - one example of the phonetic realization of boundary-driven downstep
- Unaccented downstep
  - a step-like small F0 downtrend after an unaccented word
  - one example of the phonetic realization of boundary-driven downstep

Conclusion

- Our experiment results reveal a step-like F0 downtrend that is smaller than downstep, despite the presence of final accents
- Thus, our study contends that accented downstep in Japanese is caused by boundaries rather than directly by accents

Selected References

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