Investigation of Validity of Paradigmatic Diagnosis for Downstep in Japanese

Kei Furukawa and Satoshi Nakamura

Nara Institute of Science and Technology (NAIST)

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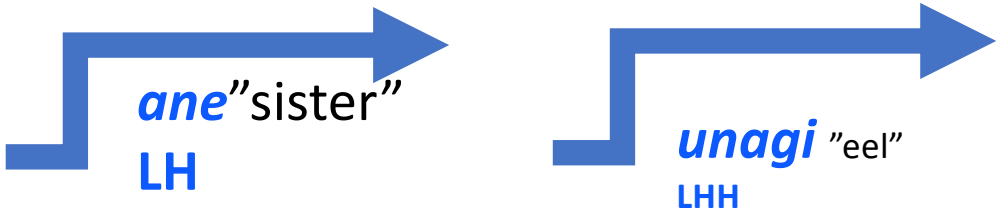
Take-home messages

- (1) Traditional diagnosis of downstep in Japanese has two confounding factors
  - Spill-over effect of accents
  - Phonological phrasing
- (2) This research proposes a new diagnostic approach controlling the two confounding factors.
- (3) This research provides evidence that downstep is caused not by accents but by phonological boundaries.

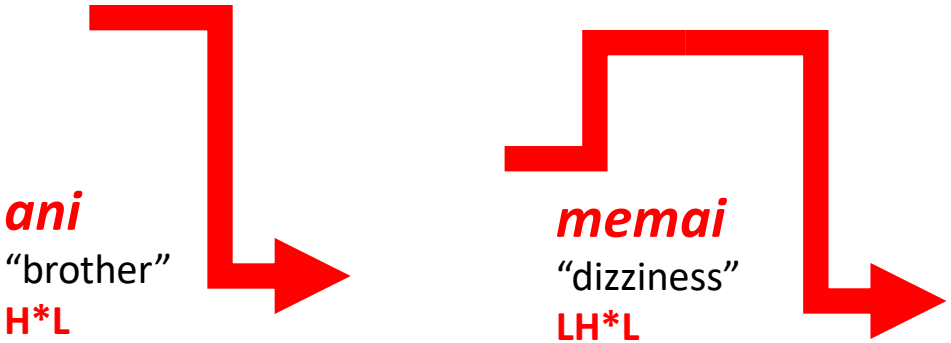
Accented vs. unaccented words

Unaccented (U) = no sharp F0 fall

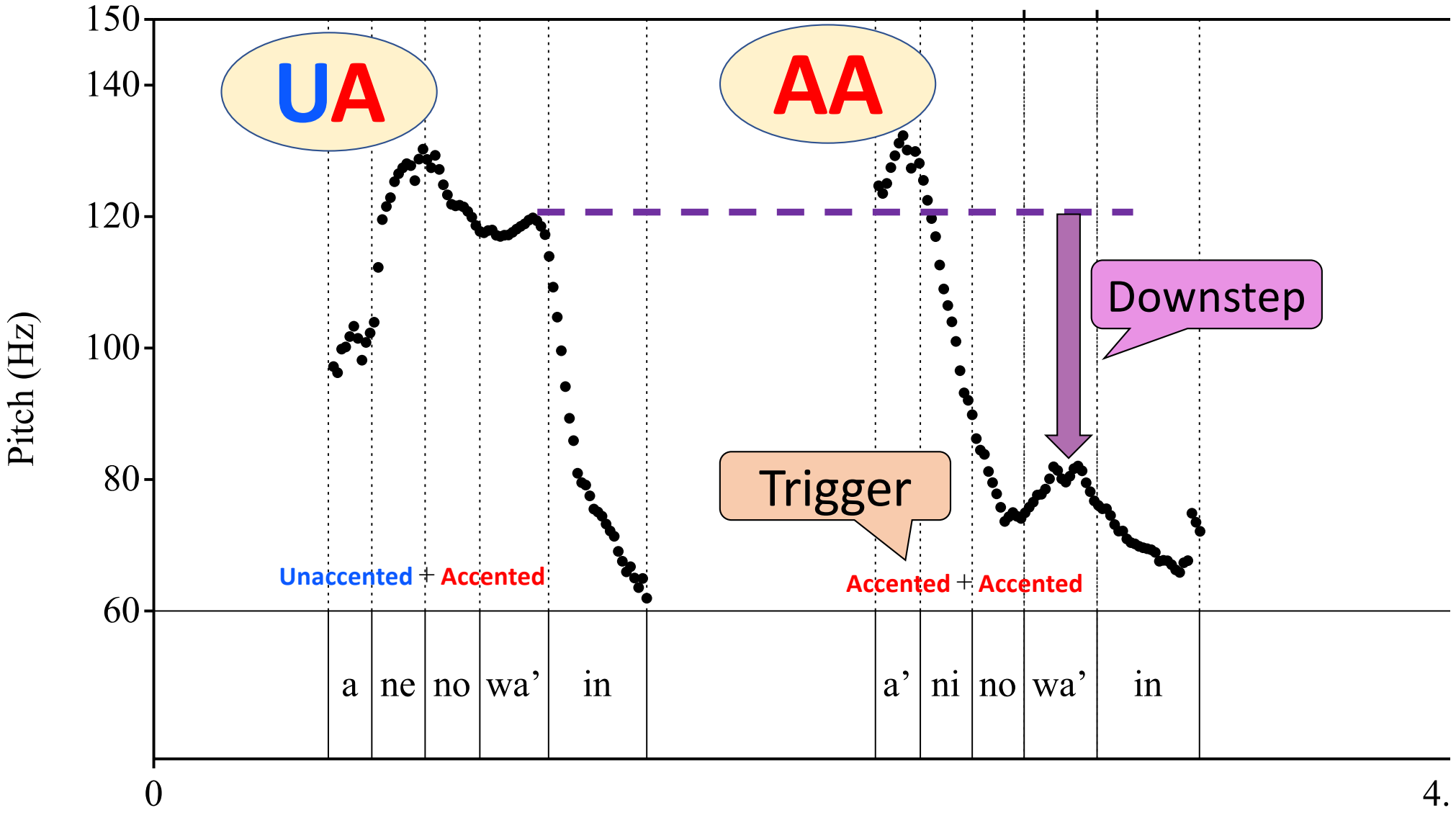


%LHH
Low-high-high

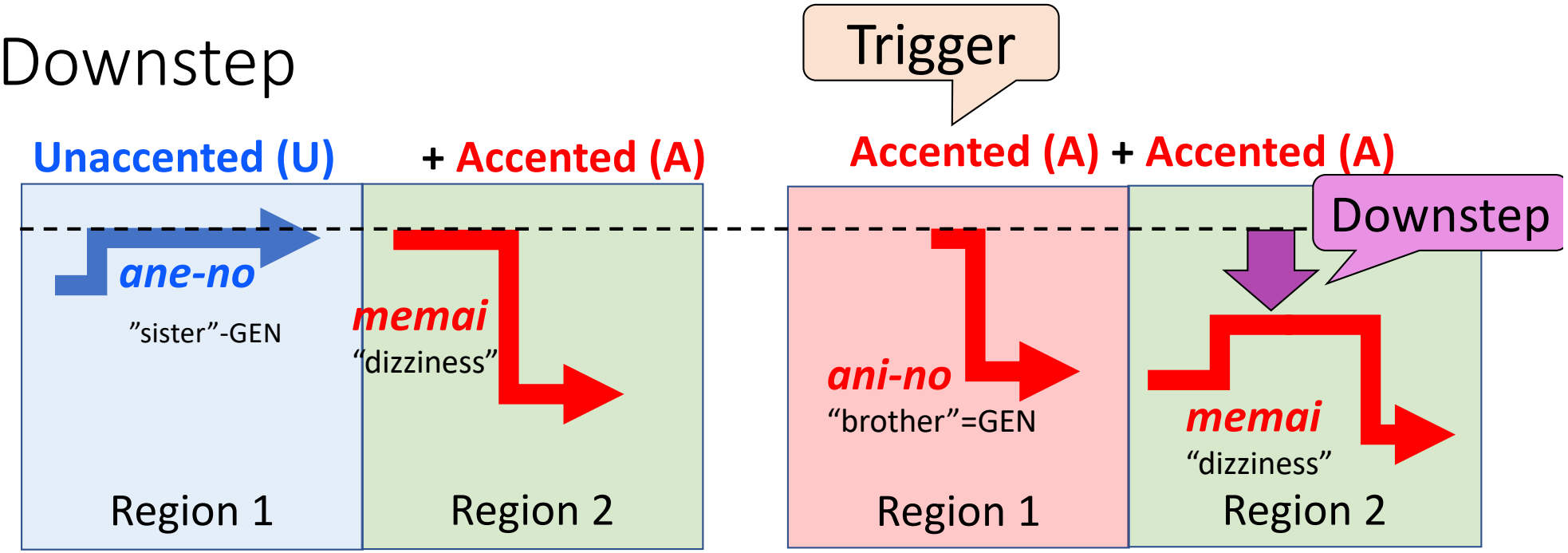
Accented (A) = H*L = F0 fall



%LH*L
Low-high-low

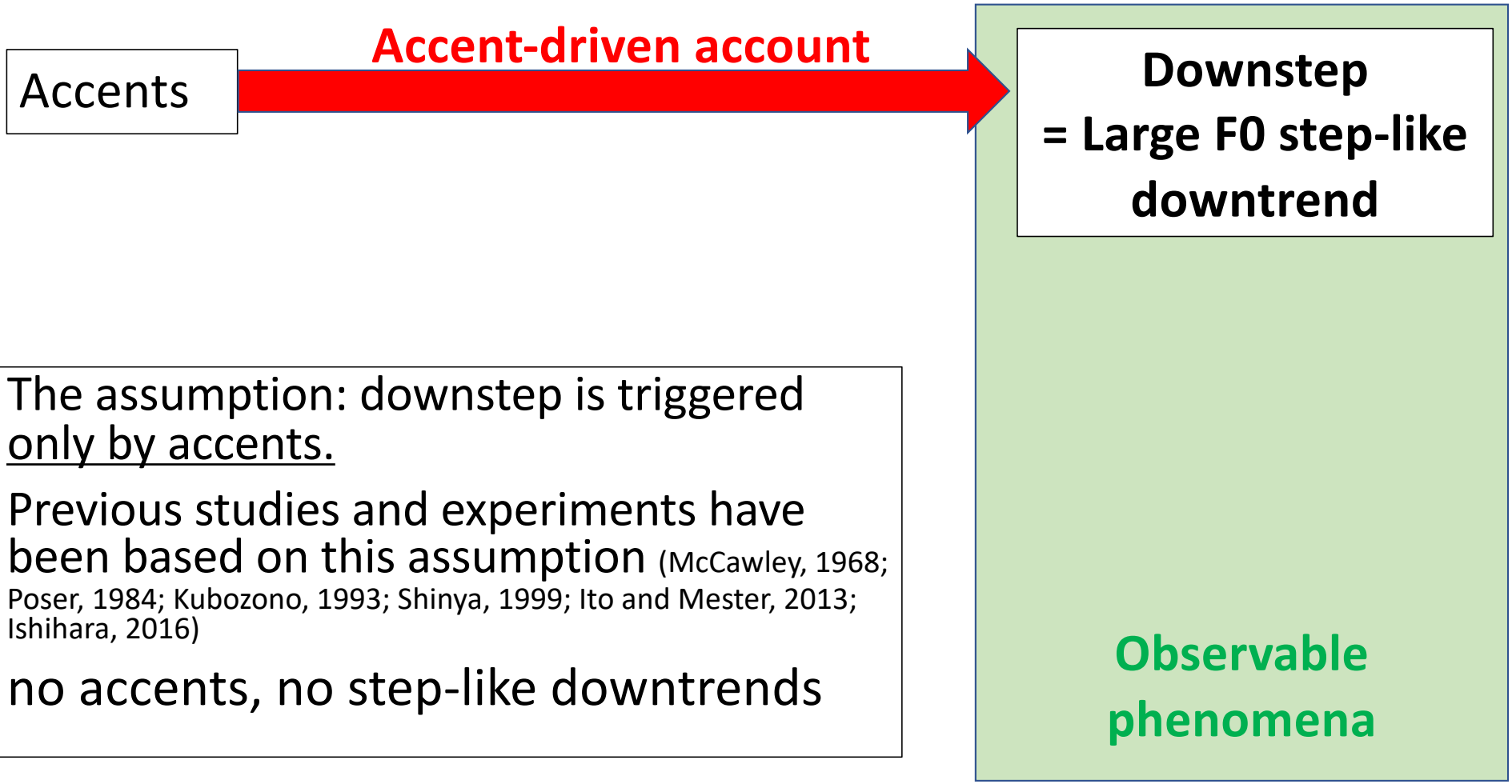

UA
AA
Downstep
Trigger
Unaccented + Accented
Accented + Accented
Pitch (Hz)
150
140
120
100
80
60
a ne no wa' in
a' ni no wa' in
0
4.

Downstep



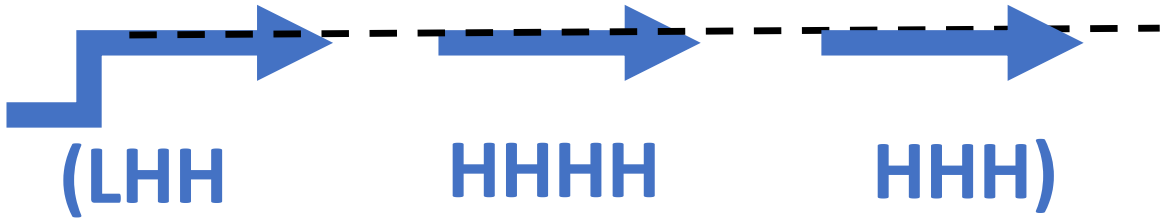
- Why is a step-like pitch downtrend observed only after accents?
- Downstep: pitch range compression triggered by accents (McCawley, 1968; Poser, 1984; Kubozono, 1993; Shinya, 1999; Ito and Mester, 2013; Ishihara, 2016)

What triggers downstep?



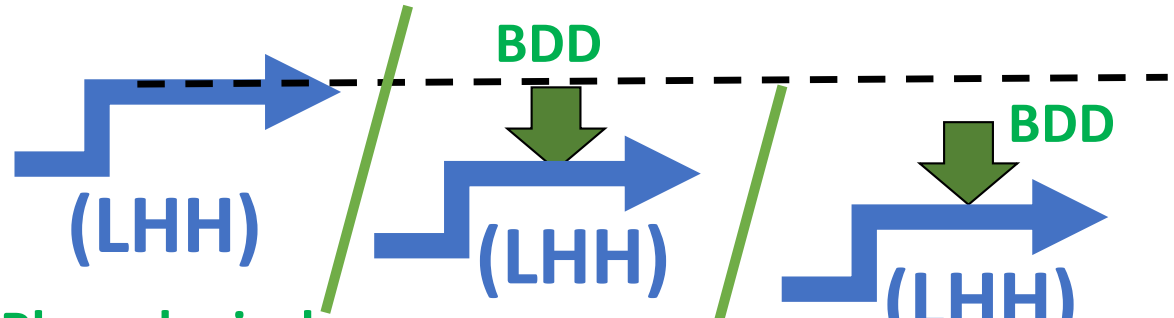
- The assumption: downstep is triggered only by accents.
- Previous studies and experiments have been based on this assumption (McCawley, 1968; Poser, 1984; Kubozono, 1993; Shinya, 1999; Ito and Mester, 2013; Ishihara, 2016)
- no accents, no step-like downtrends

Boundary-driven downstep (Furukawa & Hirose 2019)



Ane-no unagi-no omise
"Sister's eel restaurant"

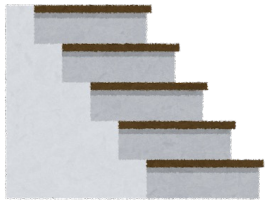
No accents
→ no step-like downtrends



Phonological boundary

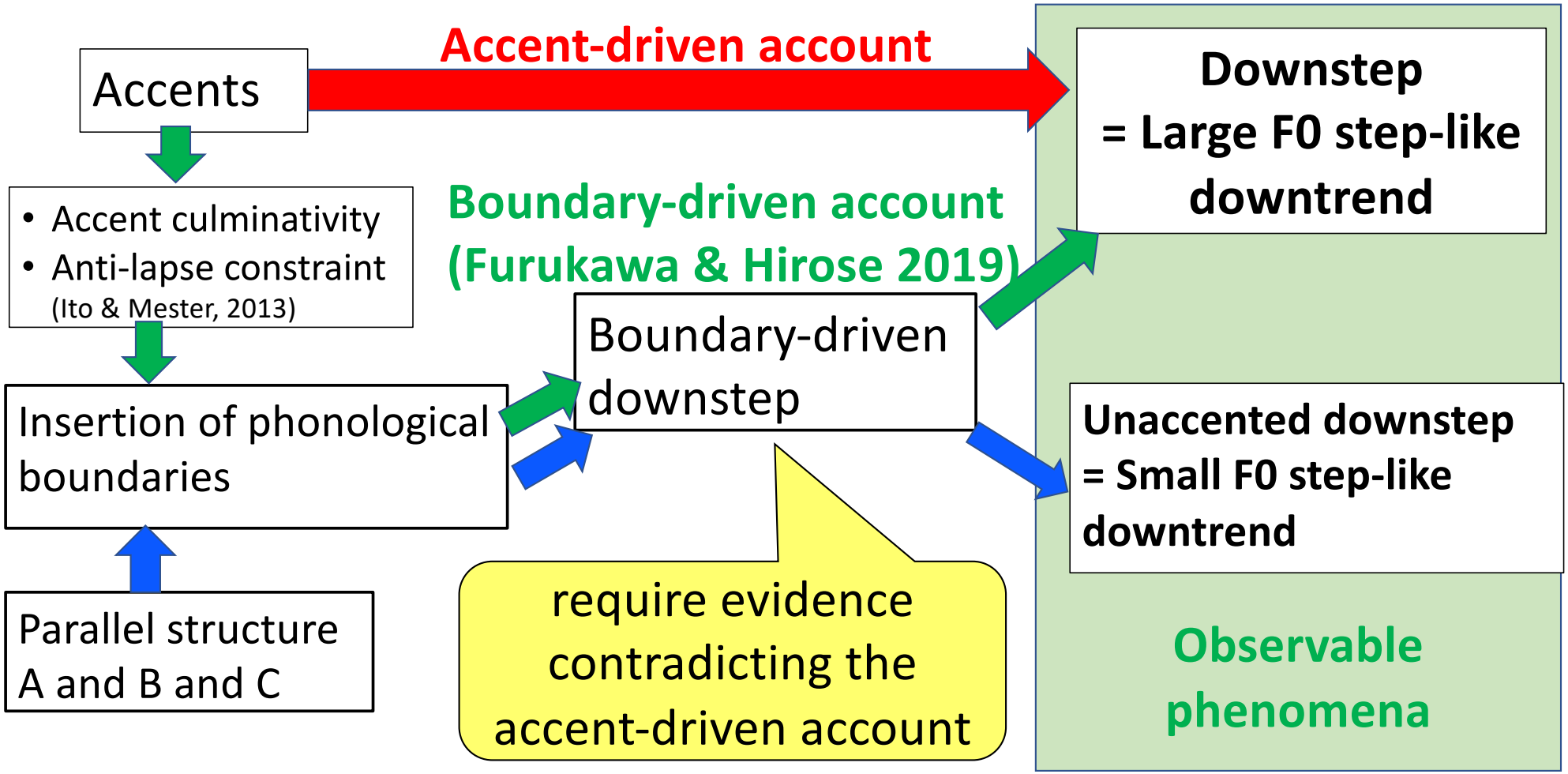
Unagi-ya yamame-ya namazu
"Eel, trout, and catfish"

If **boundaries** →
downstep-ish downtrend
Boundary-driven downstep (BDD)



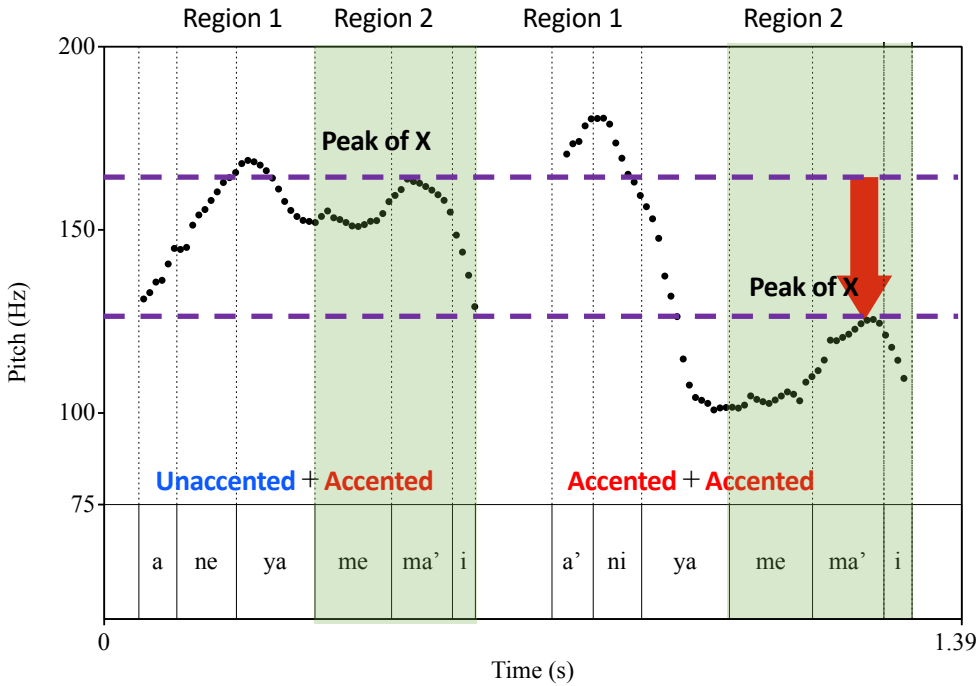
Furukawa & Hirose (2019)

What triggers downstep?



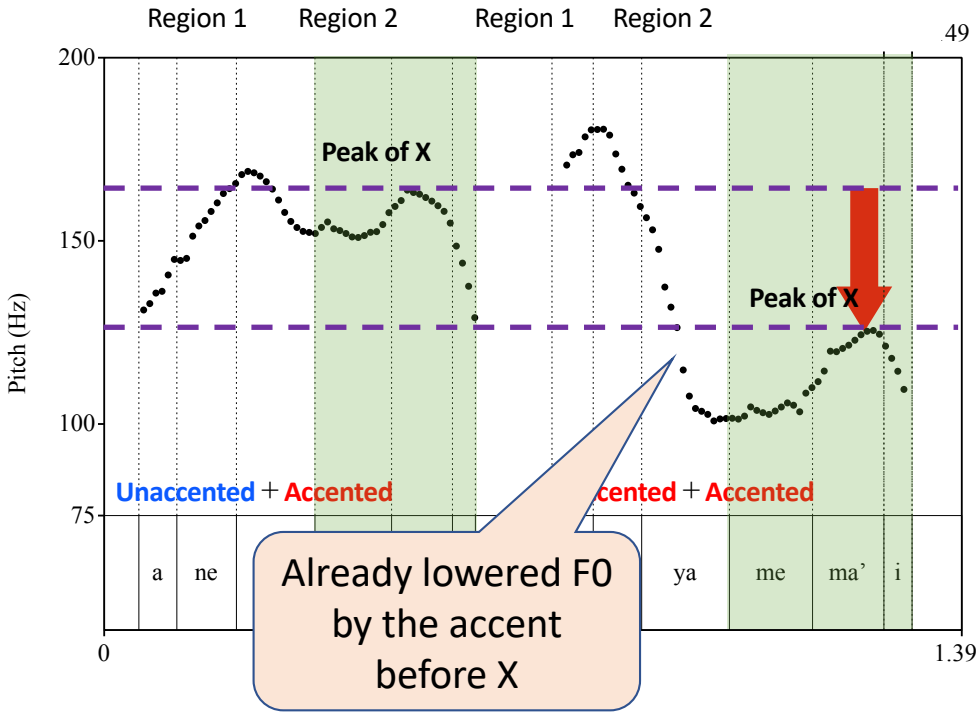
Paradigmatic diagnosis of downstep

- If F0 peak of X in AX << X in UX,
  - Then X in AX is diagnosed as downstepped
- Assumption: the F0 peak difference is solely due to downstep
  - X in UX: no downstep
  - X in AX: downstep
- <u>Two confounding factors</u>
  - (1) Spill-over effect of accents
  - (2) Phonological phrasing



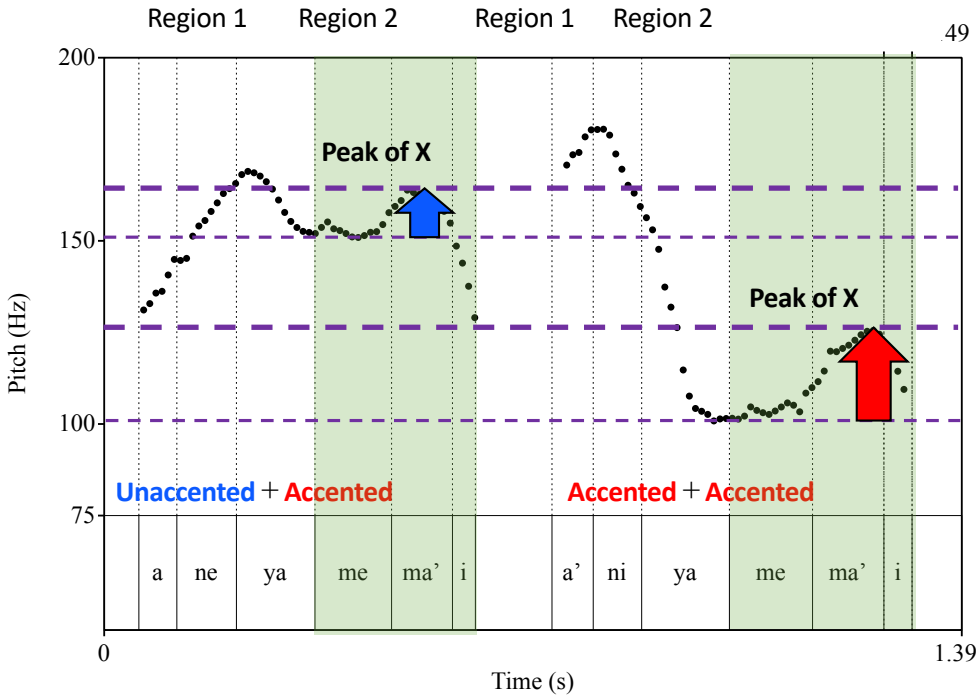
Confounding factor 1: spill-over effect of accents

- Assumption of paradigmatic diagnosis:
  - The F0 peak difference is solely due to downstep
  - X in UX: no downstep
  - X in AX: downstep
- However, F0 is already lowered before X of AX
  - X may be lowered by an accent before the effect of downstep



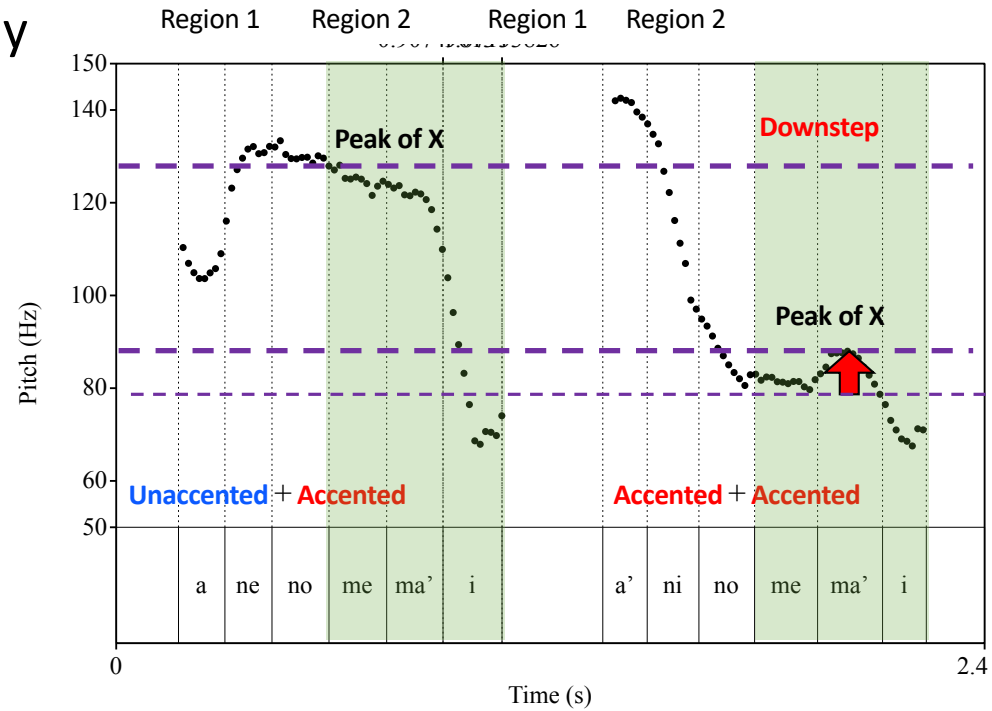
Confounding factor 1: spill-over effect of accents

- The proper measurement must be the differences between the AX and UX conditions that only develop after entering the X
  - **F0 rise at Region 2**
- UX(non-downstep condition) should show larger F0 rise at Region 2 than AX(downstep condition)
  - since AX is under the effect of downstep
- This prediction is also valid under Pierrehumbert and Beckman's model



Confounding factor 2: phonological phrasing

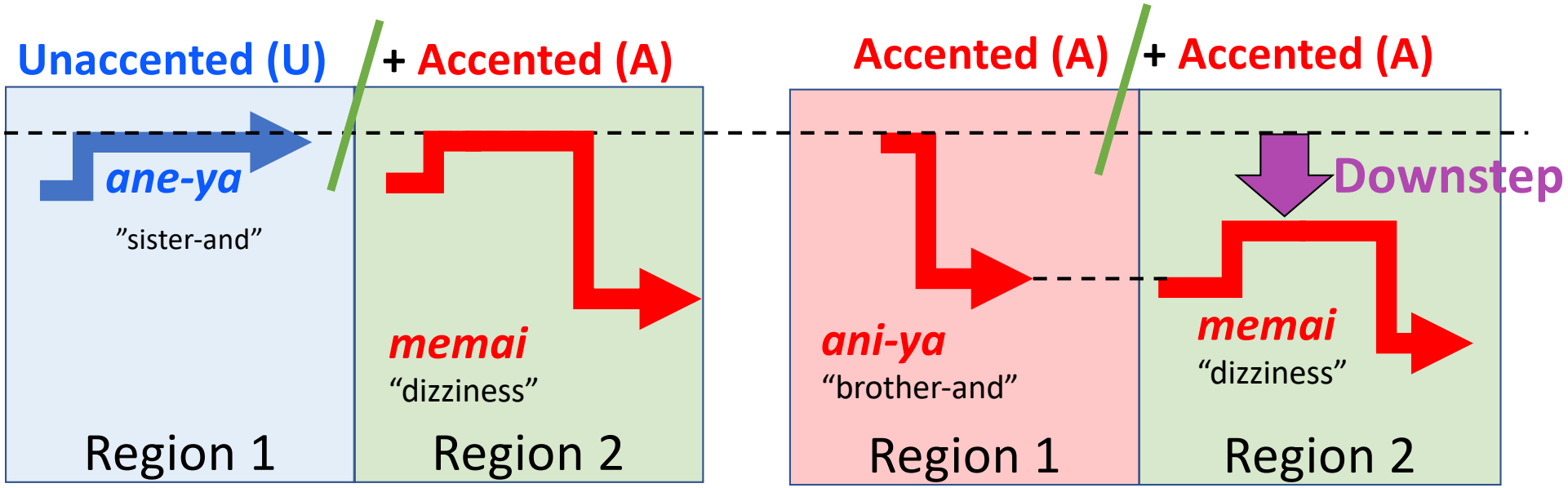
- Assumption: the F0 peak difference is solely due to downstep
  - X in UX: no downstep
  - X in AX: downstep
- However, phonological phrasing differs
  - **UX may form (UX)**
  - AX must form (A)(X) because of accent culminativity and anti-lapse constraint
- An F0 rise at Region 2 indicates a phonological boundary.
- To accurately diagnose downstep, phonological phrasing should be controlled



Experiment

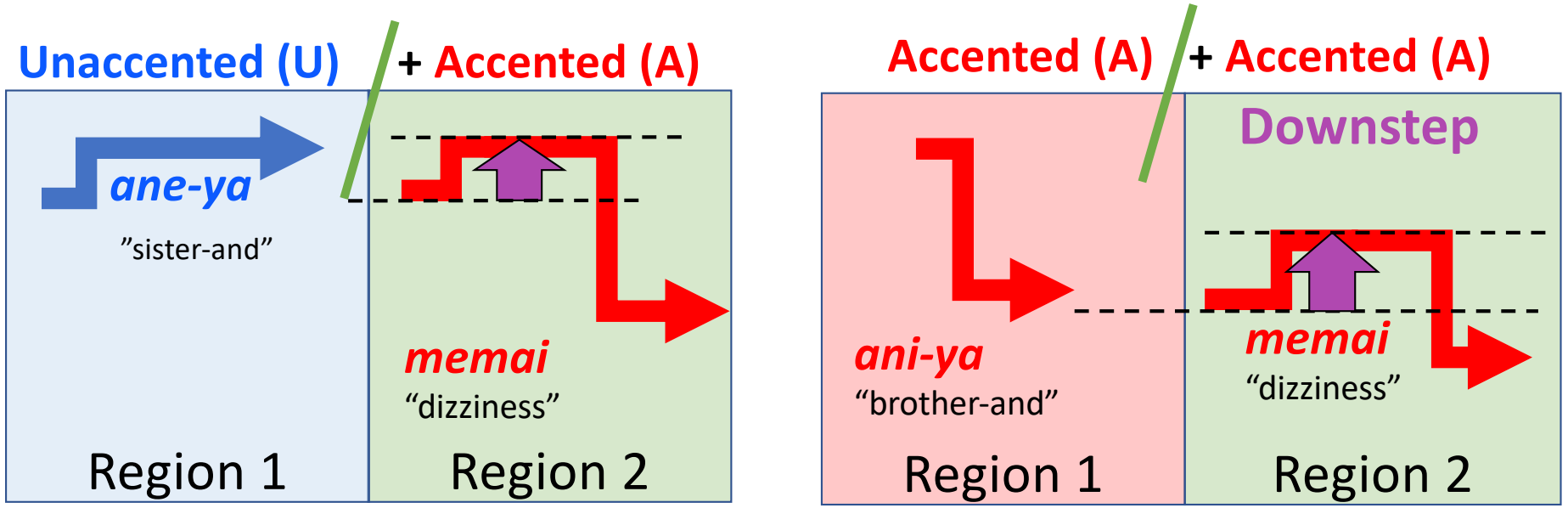
- Participants: 8 native speakers of Tokyo Japanese
- Procedure: Production experiment
- 6 items × 4 conditions × 3 repetitions = 72 tokens were recorded.
- Sixty sentences (360 tokens) fillers.

Item



- Parallel structure leads to the insertion of phonological boundaries
  - Controlling phonological phrasing (U)(A) vs. (A)(A)
- Two measurements
  - F0 peak at Region 2: traditional paradigmatic diagnosis
  - F0 rise in Region 2: Controlling the spill-over effect of accents

Measurement 2: F0 rise in Region 2



- **Accent-driven account: UA (no downstep) > AA (downstep)**
  - F0 rise in Region 2 in UA is **larger** than in AA because of downstep
- **Boundary-driven account: UA (no downstep) < AA (downstep)**
  - F0 rise at Region 2 in UA is **smaller** than in AA

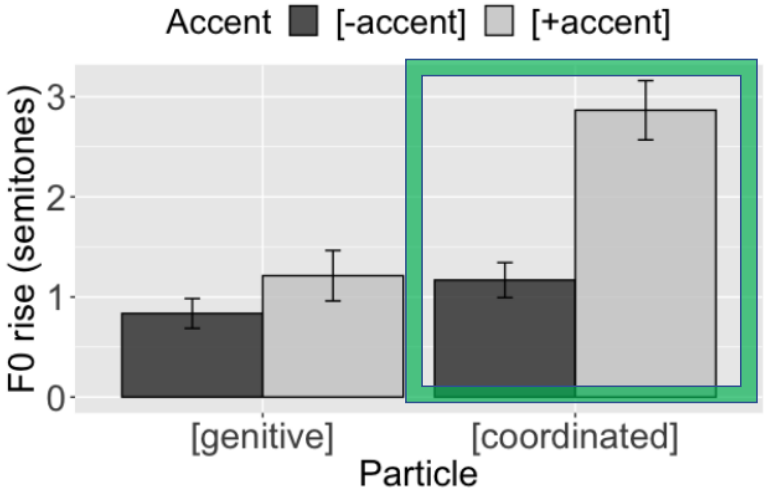
Analysis

- the linear mixed-effects model (LME) with backward selection (Bates et al., 2015)
- with subjects and items as random effects

Results: F0 rise in Region 2

- **Predictions**
  - **Accent-driven account: UA (no downstep) > AA (downstep)**
  - **Boundary-driven account: UA (no downstep) < AA (downstep)**
- **Results: UA (no downstep) < AA (downstep)**
  - **Supporting boundary-driven account**

Condition	Predictor	β	t	p
[-accent, genitive]	(Intercept)	1.024	6.092	<.001
vs. [+accent, genitive]	Accent	0.377	2.836	<.01
[-accent, coordinated]	(Intercept)	2.017	8.212	<.001
vs. [+accent, coordinated]	Accent	1.697	11.877	<.001
[-accent, genitive]	(Intercept)	1.002	7.685	<.001
vs. [-accent, coordinated]	Accent	0.333	3.198	<.01
[+accent, genitive]	(Intercept)	2.039	7.409	<.001
vs. [+accent, coordinated]	Accent	1.653	10.174	<.001



Conclusion: downstep is triggered by boundaries

- For 55 years, it has been believed that accents triger downstep (**accent-driven account**).
- The results from the esperiment show that not accents but rather phonological boundaries trigger downstep (**boundary-driven account**).

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Thank you!

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