Komaba campus, the University of Tokyo

Effects of intervocalic voicing on diminutive *-kko* suffixation in Tohoku Japanese

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Self-introduction

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- BA student at Aoyama Gakuin University
- **Domains**: Generative phonology and laboratory phonology, focusing on morphophonological phenomena in French and Japanese.
- Working to connect generative and psychological approaches.

Generative phonology: a key issue

Takeaway

Generative phonology has typically assumed **one-to-one mapping**.

- *SPE*-style phonology (Chomsky & Halle, 1968) and Optimality Theory (Prince & Smolensky, 2004).
- Underlying representation (input) maps to surface representation (output).

Issue

Language exhibits **variation** and is not always **categorical**.

- This conflicts with strict formalization.
- It motivates experimental approaches.

Formalizing variation

Maximum Entropy Harmonic Grammar (Goldwater & Johnson, 2003; Hayes & Wilson, 2008).

(1) Demonstrating hypocoristics of “Reiwa idols” (Yakuwa, 2026)

Base	Hypoc	*Redup $w = 2.29$	*Obs→Female $w = 14.25$	H-score	e^H	Obs	Exp
nagi(sa)	na.gi		-1	-14.25	1.5e+6	100%	>99.9%
nagi(sa)	na.**gi**.**gi**	-1	-2	-30.80	2.4e+13	0%	<0.1%
mire(e)	mi.ree			0	1	90.8%	90.8%
mire(e)	mi.**re**.**ree**	-1		-2.29	9.90	9.2%	9.2%

Statistical modeling

From tests to modeling

Problems with null hypothesis significance tests (NHSTs).

- Threshold of p-value: Type-I and II errors.
- Sensitivity to sample size.
- “Replication crisis” problem.

From frequentist to Bayesian

Estimating what we do not know.

Open science

Data accessibility via Open Science Framework (OSF: link)

Intuitive practice for inferential analysis!!

/ko/ suffixation in Tohoku Japanese

(2) /ko/ diminutives in Tohoku Japanese (Kushibiki, 2014)

a. *ame-kko* 'candy-DIM'

b. *o-cha-kko* 'HON-tea-DIM'

c. *sensei-kko* 'teacher-DIM'

Restriction

***<...ko + -kko>**

e.g. **hanko-kko*, 'stamp-DIM', **sooko-kko* 'shelf-DIM'

Effect of voicing

- When the base-final /ko/ is voiced to [go], this restriction does not apply. (Abe, 1999)
- **Intervocalic voicing (IV): In Tohoku Japanese, /k/ and /t/ between vowels voice to /g/ and /d/.** (Inoue, 1968)

(3) Compatibility of voiced /ko/ with the diminutive suffix /ko/ (Abe, 1999)

a. ✓ *tago-kko* 'octopus-DIM'
b. ✓ *hago-kko* 'box-DIM'
c. ✓ *nogo-kko* 'saw-DIM'

Research questions

1. Is the /ko/ contiguity prohibition stable across the Tohoku region?
   - Abe (1999) only refers to *Hirosaki-shi* (Aomori) Japanese.
2. Is the /ko/ contiguity prohibition actually observed?
   - This study aims to replicate the effect experimentally.
   - Does IV affect /ko/ adjacency?
3. How do region and generation affect the pattern?
4. What is the underlying representation: /ko/ or /kko/?

Procedure

- Production experiment in which participants produce /ko/-suffixed diminutives.
  - They are asked to add /ko/ for each stimulus after a brief instruction.
  - If the corresponding /ko/ diminutive form is not natural, they pronounce “I do not say it”.
- Online experiment coded with jsPsych (De Leeuw, 2015) and conducted on Cognition.run.

Participants

- 31 people born and raised in the Tohoku region (Aomori, Akita, Iwate, Yamagata, Miyagi, Fukushima) were recruited via Cloudworks.
- Another 17 people were recruited via snowball sampling.
  - The critical period for their native dialect is defined as up to junior high school graduation.
- Participants were also asked about their gender, age, and residence history.

Participants

- $N = 48$, F = 7, M = 9
- Mean age = 42.50
  SD = 21.44
- Aomori: 3
  Akita: 2
  Iwate: 4
  Yamagata: 2
  Miyagi: 2
  Fukushima: 3

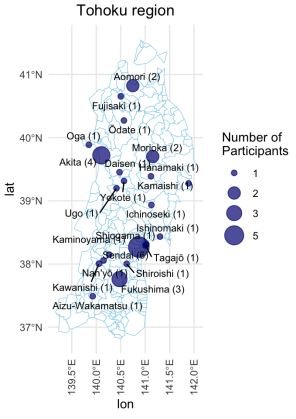

Figure: Participants' residences during the critical period

Carrier sentence

- Participants were instructed to fill the blank in the carrier sentence below with a /ko/-suffixed diminutive of the given stimulus.
- Dialect-specific expressions were used to elicit dialectal features.
- The carrier sentence was taken from Huang et al. (2023).

Actual carrier sentence

_dabe. ndanda, _ da.
'It should be _, yeah, it is _.

Stimuli

- Eighteen stimulus words were prepared.
  - Each word ends with /ko/
- Half contain intervocalic /k/.
  - Intervocalic /k/ is expected to undergo voicing, whereas the others are not.
- Non-intervocalic environments
  1. ⋯/N (nasal mora) ko/ as in *kinko*
  2. ⋯/Q (geminate mora) ko/ as in *iburigakko*
  3. ⋯/R (long vowel) ko/ as in *sooko*

Entire stimuli

Intervocalic		**Non-intervocalic**	
komugiko	‘flour’	*osinko*	‘a kind of pickles’
tarako	‘cod roe’	*rakko*	‘otter’
tabako	‘cigarette’	*iburigakko*	‘a kind of pickles’
taiko	‘drum’	*kinko*	‘vault’
ochoko	‘a kind of cup’	*hiyayakko*	‘tofu’
hudebako	‘pencil case’	*sooko*	‘warehouse’
namako	‘sea cucumber’	*patiNko*	‘pinball game’
takenoko	‘bamboo sprout’	*anko*	‘bean paste’
neko	‘cat’	*inko*	‘parakeet’

Online experiment sample

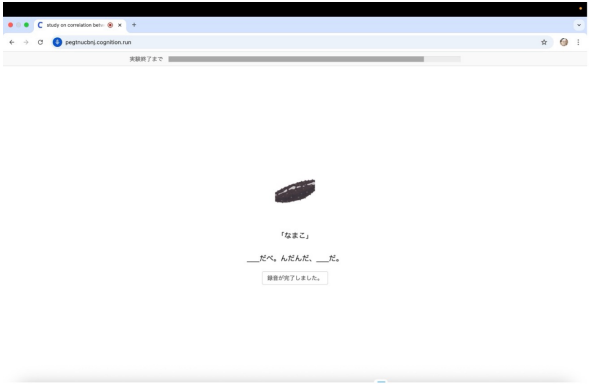

Figure: Screenshot of experiment interface

Data cleansing

- Recorded tokens were converted from BASE64 to 16 kHz monaural WAV files using Python.
- Stimulus words that participants altered were excluded.
  e.g., *tyape* for *neko* 'cat' *dego-duge* for *osinko* 'a kind of pickles'
- Finally, **631 tokens** from **46 participants** were analysed.
  - Sample size: **optional stopping** (Rouder, 2014).
  - Optional stopping protocol: 95% CI $\geq$ 0.0 and BF $\geq$ 3.0.

Raw data

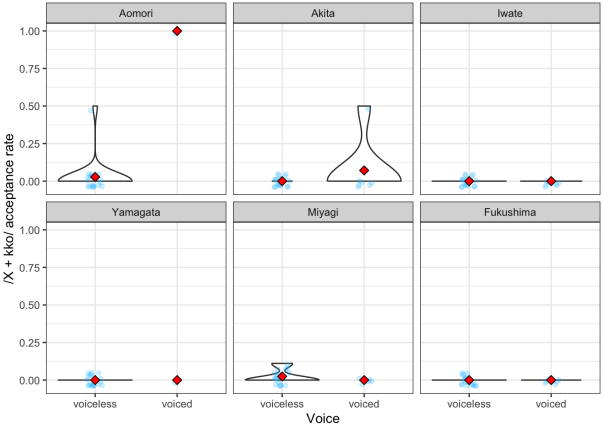

Figure: Acceptance and voice response rates by prefecture

Inferential analysis: model

- **Bayesian mixed effects model**
  - `brms` package (Bürkner, 2017) of R (R Core Team, 2025), implemented with R Studio.
  - **Prior setting**: normal (3,0) weakly informative prior (Lemoine, 2019).
  - **MCMC**: 4 chains, each with 2,000 iterations, were run. The first 1,000 iterations were discarded as warmup. No thinning (thin=1).

Model formula

$$\overbrace{\overbrace{acceptance}^{\text{dependent variable}} \sim \overbrace{voi\_qual + pref + age\_group}^{\text{independent variable (not interacted)}}}^{\text{fixed factor}} + \overbrace{(1|stimuli) + (1|participant)}^{\text{random factor}}$$

Inferential analysis: Overall result

Parameter	Estimate	pd	lower limit of 95%CI	upper limit of 95%CI	$\hat{R}$
voiceless - voiced	3.55	**99.10%**	**0.24**	**7.59**	1.00
younger - middle	1.39	66.30%	-5.64	8.02	1.00
younger - elder	2.80	72.95%	-7.01	11.52	1.00
middle - elder	1.32	64.12%	-7.52	9.96	1.00
Aomori - Akita	-2.30	72.90%	-9.58	5.38	1.00
Aomori - Iwate	-4.30	86.08%	-12.06	3.46	1.00
Aomori - Yamagata	-3.21	77.65%	-11.52	4.90	1.00
Aomori - Miyagi	-2.06	69.67%	-9.04	5.57	1.00
Aomori - Fukushima	2.66	68.53%	-7.67	14.10	1.00
Akita - Iwate	-2.00	71.25%	-8.69	5.65	1.00
Akita - Yamagata	-0.96	59.72%	-8.62	6.65	1.00
Akita - Miyagi	0.30	54.20%	-6.76	7.35	1.00
Akita - Fukushima	5.01	82.85%	-6.85	15.25	1.00
Iwate - Yamagata	1.00	60.22%	-6.89	8.36	1.00
Iwate - Miyagi	2.29	74.17%	-4.96	9.65	1.00
Iwate - Fukushima	7.08	89.85%	-4.32	18.02	1.00
Yamagata - Miyagi	1.23	62.40%	-7.10	8.62	1.00
Yamagata - Fukushima	5.91	85.55%	-5.13	17.79	1.00
Miyagi - Fukushima	4.62	81.92%	-5.93	15.73	1.00
Participant	11.20	–	5.05	22.79	1.00
Stimuli	1.00	–	0.04	3.01	1.00

Key findings from the result

- The four chains mixed well ($\hat{R}$ = 1.00).
- **Intervocalic voicing facilitates the acceptance of *-kko* suffixation.**
  95% CI: [0.24-7.59], pd = 99.10%: **probably present** (Makowski, Ben-Shachar, Chen, & Lüdecke, 2019).
- Regional effects are **not supported**.
- Generational effects are also **not supported**.
  - All 95% CI ranges include 0 and pds are too low to be compelling.
- **Inter-speaker variation** (Estimate = 11.20).
- Small stimulus-level variation (Estimate = 1.00).

Identity avoidance

- UR of [kko] $\rightarrow$ **/kko/ or /ko/?**
- **Identity avoidance** (IA) (Yip, 1998)
  Adjacency of identical segments is prohibited.
- Moraic identity avoidance in Japanese: **OCP(CV)**

Evidence 1: Sano (2013)

(4) IA in *ra*-deletion (*ra-nuki*)
  a. kari-**ra**re-ru $\rightarrow^{\checkmark}$[kari-re-ru] 'can borrow'
  b. ire-**ra**re-ru $\rightarrow^{?}$[ire-re-ru] 'can insert'

(5) IA in potential *sa*-insertion
  a. ik-ase-ru $\rightarrow^{\checkmark}$[ik-a**sa**se-ru] 'have somebody go'
  b. tobas-ase-ru $\rightarrow$*[tobas-a**sa**se-ru] 'have somebody fly'

Identity avoidance

Evidence 2: Rendaku

(6) IA in Rendaku (Sato, 1989)
   a. tobi-hi *tobi-bi ‘flew-fire’
   b. kizu-tukeru *kizu-dukeru ‘to hurt’

- Kawahara and Sano (2014) nonce word experiment

(7) **IA plays a role in catalyzing rendaku**
   a. ika-[ka→ga]-kaniro > ika-[ta→da]niro
   b. iga-[ka→ga]niro < ida-[ka→ga]niro

Underlying representation

/ko-kko/: Two /ko/s are **not adjacent**.
$\rightarrow$ IA is not applicable.

Proposal

1. *neko*
   $\Downarrow$ Intervocalic voicing
2. *ne**g**o*
   $\Downarrow$ Suffixation (+*ko*)
3. *nego-**ko***
   $\Downarrow$ Gemination
4. *nego-**k**ko*

1. *neko*
   $\Downarrow$ Suffixation (+*ko*)
2. No output

Conclusion

1. Intervocalic voicing of [go] facilitates acceptance of diminutive /ko/ adjacency.
   - This supports the literature (Abe, 1999).
2. Regional and generational differences were not confirmed.
3. Acceptance of /ko/ adjacency depends on phonological, semantic, and pragmatic factors.
4. Proposal: *-kko* suffixation is **opaque**.
   - **UR: /ko/**
   - A serial derivation can account for it.

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