

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. <b>gi.gi</b>	-1	-2	-30.80	2.4e+13	0%	<0.1%
mire(e)	mi.ree			0	1	90.8%	90.8%
mire(e)	mi. <b>re.ree</b>	-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)
- ✓ *tago-kko*      'octopus-DIM'
  - ✓ *hago-kko*      'box-DIM'
  - ✓ *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

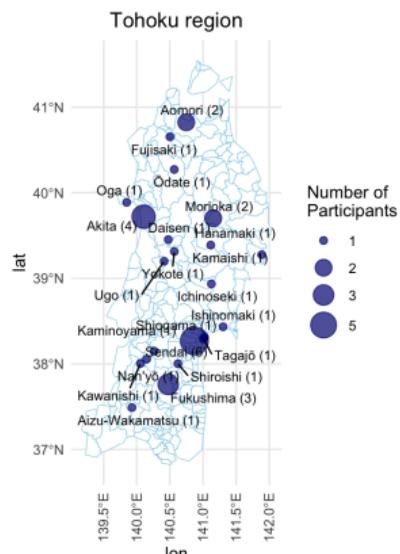


Figure: Participants' residences during the critical period

# 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

<i>komugiko</i>	'flour'
<i>tarako</i>	'cod roe'
<i>tabako</i>	'cigarette'
<i>taiko</i>	'drum'
<i>ochoko</i>	'a kind of cup'
<i>hudebako</i>	'pencil case'
<i>namako</i>	'sea cucumber'
<i>takenoko</i>	'bamboo sprout'
<i>neko</i>	'cat'

## Non-intervocalic

<i>osinko</i>	'a kind of pickles'
<i>rakko</i>	'otter'
<i>iburigakko</i>	'a kind of pickles'
<i>kinko</i>	'vault'
<i>hiyayakko</i>	'tofu'
<i>sooko</i>	'warehouse'
<i>patiNko</i>	'pinball game'
<i>anko</i>	'bean paste'
<i>inko</i>	'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:  $95\% \text{ CI} \geq 0.0$  and  $\text{BF} \geq 3.0$ .

# Raw data

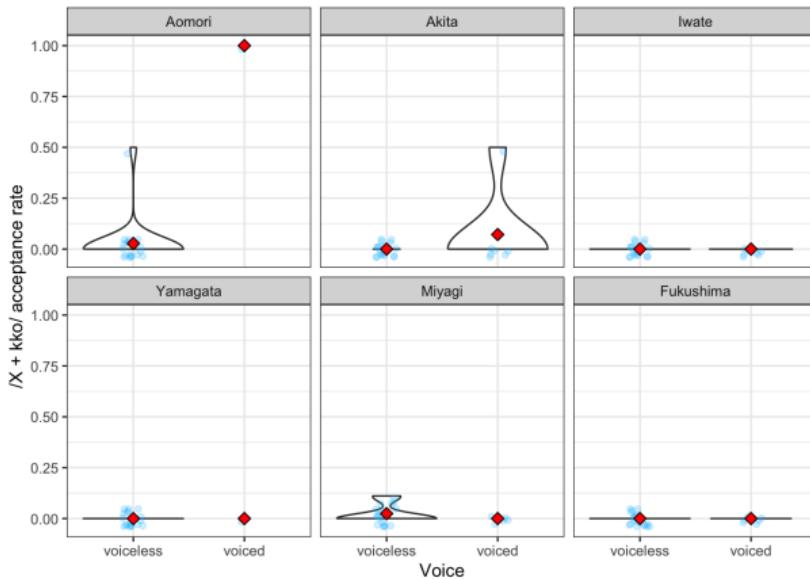


Figure: Acceptance and voice response rates by prefecture

# 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

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

# Inferential analysis: Overall result

Parameter	Estimate	pd	lower limit of 95%CI	upper limit of 95%CI	R̂
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] → /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-**rare**-ru →<sup>✓</sup> [kari-re-ru] 'can borrow'
  - b. ire-**rare**-ru →<sup>?</sup> [ire-re-ru] 'can insert'
- (5) IA in potential *sa*-insertion
  - a. ik-*ase*-ru →<sup>✓</sup> [ik-a**sase**-ru] 'have somebody go'
  - b. tobas-*ase*-ru →<sup>\*</sup> [tobas-a**sase**-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**.  
→ IA is not applicable.

## Proposal

- ① *neko*  
↓ Intervocalic voicing
- ② *nego*  
↓ Suffixation (+ko)
- ③ *nego-ko*  
↓ Gemination
- ④ *nego-kko*

- ① *neko*  
↓ Suffixation (+ko)
- ② No output

# Conclusion

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

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