Nasal substitution in vernacular Japanese

1 Introduction

1.1 Phonological knowledge: Emergent or generative?

The nature of phonological knowledge is perhaps the most central question in the domain of spoken word processing. On one hand, speakers’ phonological knowledge appears to be quite general, and is conceptualized as a collection of rules that apply to an input to produce an output. Speakers apply such knowledge when they generate novel sequences, such as nonce borrowings and unique sentences. Speakers also apply such knowledge when they comprehend words spoken with a wide range of variation in phonetic details, such as accent and co-articulation. These observations underlie a long history of abstract categories posited by linguists such as voiceless and sonorant, dating back to Chomsky and Halle (1968). In summary, speakers appear to apply rules that generate phonological forms.

On the other hand, speakers appear to have detailed phonological knowledge about specific words and patterns. Such detailed knowledge seems to emerge through the repeated processing of natural language, and leads to routinization and practice effects. Speakers store in memory individual productions. Furthermore, processing becomes easier with practice, so that frequently-produced productions are processed more easily than rarer productions (Bybee, 2010). Such an approach predicts that frequency is main factor to behind phonological variation such as assimilation and reduction (see Beckner et al., 2009; Bybee, 2010, and MacWhinney & O'Grady, 2015 for general reviews). Very commonly-occurring words and expressions are processed repeatedly, resulting in the gradual abbreviation of the articulatory gestures used to produce those words. Reduced articulatory gestures, in turn, lead to phonological assimilation and reduction. English examples illustrating this process include the production of frequently-occurring phrases *I’m going to* as *I’ma* [aɪmə] and *I don’t know* as *donno* [doʊnnoʊ] (see Bybee & Scheibman, 1999 for a discussion of the reduction of *don’t*). Thus, it appears that speakers’ phonological knowledge naturally emerges from exposure to language.

Another possible (although not necessarily incompatible) driving factor behind emergent linguistic phonological knowledge is effective and accurate communication (e.g., Jaeger & Buz, 2017). In this approach, a crucial part of phonological processing is the probabilistic inference made during speech production and perception. Speakers us their emergent linguistic knowledge to infer the relative probability of a word given the context. Highly predictable words need less phonetic cues to accurately process than less predictable words. Consequently, tokens with improvised phonetic cues due to reduced articulatory gestures are still accurately comprehended when they are predictable. Consequently, speakers need not produce canonical phonetic forms for words in predictable contexts. This approach predicts that that the main factor influencing phonological variation such as reduction and assimilation is the conditional probability of the linguistic unit in its context (see Clopper & Turnbull, 2018, Jaeger & Buz, 2017, and Ernestus, 2014). For example, Turnbull , Seyfarth, Hume, and Jaeger (2018) examined nasal place assimilation in a corpus of spoken English. They found that nasal place assimilation occurs more often when a target word was more predictable and when its trigger word was less predictable. Thus, nasal assimilation occurred more often in the /nb/ sequence in the phrase *ten bucks* than in the phrase *when both* (used in the previous sentence of this paper) since *ten* is more predictable before *bucks* than *when* is before *both*.

The last several decades have seen heated debate between the advocates of generative grammar on one side and emergent grammar on the other. This debate encompasses not only phonological knowledge, but all linguistic knowledge in general. A few recent examples of positions taken during this debate are as follows. Ibbotson and Tomasello (2016: 74) claim that “the notion of universal grammar is plain wrong” while Villavicencio (2020) presents the study of universal grammar as pseudoscience. Lin (2017) claims to refute universal grammar, which, he argues, is “deeply problematic,” but Wu (2020)…. This sentence is incomplete.

Relevant to this study, other researchers advocate a mixed approach (Guy, 2014, O'Grady, 2015). Such an approach is more compatible with the models of linguistic processing posited by neuro-linguists (for example, Bakker, MacGregor, Pulvermüller, & Shtyrov, 2013; Ullman, 2016; van Lancker Sidtis, 2012).

Add the following reference to advocates of a mixed approach.

Reuland, 2010

Pierrehumbert, 2016 “It is clear that a hybrid model is needed” (p.523)

1.1 Nasal substitution

Our goal is to contribute to this ongoing research on generative and emergent phonological knowledge with a corpus-based study of nasal substitution in vernacular Japanese. Nasal substitution refers to the synchronic process of replacing a non-nasal moraic syllable with the moraic nasal. The moraic nasal only occurs in coda position, contribute to the moraic weight of the syllable, and assimilates place of articulation to the following consonant (Kubozono, 2015: 9–10).

Nasal substitution occurs both in standard Japanese and vernacular Japanese. One example of nasal substitution in Standard Japanese is mimetic word intensification (Kubozono, 2015: 263). Intensification occurs as a moraic consonant infix /C/ between the first and second syllables, as shown in (1). In the case of a following voiceless obstruent (1a), the moraic consonant infix appears as a voiceless geminate, and in the case of a following voiced obstruent (1b), as the moraic nasal.

() /sa-C-pari/ *sappari* ‘clean, openhearted’

/ko-C-sori/ *kossori* ‘secretly, stealthily’

/za-C-buri/ *zamburi* ‘with a plop’

/ma-C-ziri/ *manziri* ‘without a wink of sleep’

(examples from Kubozono, 2015: 263)

An example of nasal substitution in vernacular Japanese is the substitution of a verb stem-final /r/ onset syllable with the moraic nasal. The examples given in (2) show the standard form on the left with the stem-final /r/ syllable (underlined), and the vernacular form on the right with the moraic nasal. Nasal substitution occurs not only at the right edge of a word (2a), but also word internally (2b, 2c). Since the moraic nasal assimilates the place of articulation of the following consonant, nasal substitution notably reduces the articulatory gestures required to produce a form.

() a. *taberu nen teben nen* eat + sfp[[1]](#footnote-1)

b. *wakara-nai wakan-nai* ‘do not understand’

*kawara-nai kawan-nai* ‘do not change’

c. *kaeri-nasai kaen-nasai* ‘Go home!’

In this paper, we focus exclusively on the commonly-occurring case of word-final nasal substitution (hereafter, just nasal substitution). Such a study makes two notable contributions beyond the above-mentioned contribution to our theoretical linguistic knowledge on generative and emergent grammar. To date, variationist studies on Japanese are still relatively limited in number, and in the case of nasal assimilation nonexistent. A search for nasal assimilation (Japanese *hatuonbin*) on CiNii yields only three hits, and all three works are about historical Japanese.[[2]](#footnote-2) Contrast this void with, for example, the rich history of studies on t/d deletion in English, beginning over half a century ago with studies such as Fasold (1972), and still continuing today (for a recent example, see Pavlík, 2017). A similarly well-studied phenomenon occurring in the Japanese language is case marker omission (see for example, Heffernan, Imanishi, & Honda, 2018, Fujii & Ono, 2000, and Yoshizumi, 2016). Thus, the first of these two contributions is reporting on a previously undocumented linguistic phenomenon.

1.2 Traditional and non-traditional contexts

Traditional context

The second contribution concerns the nature of nasal substitution. The data that we present in this study is of interest when we consider the contexts in which the nasal substitution variants occur. According to Hirayama (1997: 17), nasal substitution optionally occurs before a following particle beginning with either /n/ or /d/, as illustrated by the example sentences given in (3). In all examples, the location of nasal substitution underlined. Similar context standard form examples are given in (4).

() *nanka* *an* *nen.yan* (KSJ/058/m/1)[[3]](#footnote-3)

something exist dm

‘There’s like this thing.’

*hitori-bun-te tukun-no muzukasii yaro* (TKC/031/m/6)

one.person-volume-top make-nmlz difficult dm

‘Making for just one person is tough, isn’t it?’

*kore 425 kirokarorii an de* (KYT/014/f/3)

this 425 kilocalorie exist sfp

‘This has 425 kilocalories!’

() *sima-ga* *aru nen* (KSJ/018/m/6)

island-nom exist sfp

‘So there’s this island.’

*zibun-de tukuru-no kekkoo taihen ya kara* (KSJ/095/m/4)

self-dat make-nmlz quite ordeal cop sfp

‘Making it by yourself is quite an ordeal.’

*iroiro aru de* (KSJ/040/f/4)

various exist sfp

‘There’s a variety.’

Hereafter, we refer to the context of a following particle beginning with either /n/ or /d/ as traditional, and differentiate it from other contexts.

Neutralization of the context

One of the traditional contexts for nasal substitution is preceding the frequently-occurring morpheme *no*, which when following a verb may be a genitive case marker, a nominalizer, a sentence-final particle, or a discourse marker. In vernacular Japanese, this morpheme is variably realized as the moraic nasal *n*. Nasal substitution naturally occurs before the moraic nasal variant as well. In such as case, the resulting double moraic nasal sequence reduces to a single moraic nasal, as indicated in (5).[[4]](#footnote-4) The examples given in (6) illustrate the reduction of a double moraic nasal sequence to single moraic nasal. For comparison, similar non-reduced sequences are given in (7).

() verb-*ru* + *no* → verb-*ru* + *n* → verb-*n* + *n* → verb-*n*

standard form *no* reduces to *n* nasal substitution reduce *n*+*n* sequence

() *doo sun* (KSJ/049/f/5)

how do.qm

‘What will you do?’

*tanbo-te nan sun yaro* (KSJ/164/f/7)

rice.field-top what do dm

‘What was that we do with the rice fields?’

*onna-ni tuko-ten-wa omae* (KSJ/066/m/2)

women-dat use-hab.nmlz-top you

‘The one that is spending (money) on women is you.’

() *doo suru n* (KSJ/010/f/2)

how do qm

‘What will you do’

*benkyoo-ga deki-naku naru n.yaro* (KSJ/020/f/4)

study-nom can.do-neg.adv become dm

‘It’ll become so that you cannot study, won’t it?’

*maitoshi het-teru no-wa tasika ya-kara* (KSJ/016/m/5)

every.year reduce-prs.perf nmlz-top certain cop-dm

‘That it is becoming less every year is for sure.’

The frequency of occurrence of the nasal substitution variant in the neutralized context appears to be skewed. For example, consider the usage of the variant preceding discourse phrases. The Japanese language has a collection of discourse phrases that occur at the end of the utterance, and that indicate that the utterance is intended to explain something, like the English phrase “It’s just that…” Table 1 lists some examples these phrases. The phrase consists of two components, a particle (*no*, *n*, *nan*, *ne*, *nen*, *non*, etc.) and a copula (*da*, *daro*, *ya*, *yan*, etc.), with a rich variety of possible variants for either component.

Consider the rate of occurrence of nasal substitution by neutralization of the context. As Table 1 shows, the nasal substitution variant is used relatively infrequently in the neutralized environment. This disparity in usage creates an excellent testing ground for our theories of synchronic variation. On one hand speakers may be applying their abstract knowledge of the phonological process that results in the neutralization of the context, as outlined in (5).

On the other hand, the distribution pattern presented in Table 1 may simply reflect more general collocation patterns. Usage-based theories argue that such patterns emerge from the collocation rates of specific forms. Forms that co-occur frequently tend to show phonetic and phonological reduction to a greater extent than less frequently-occurring combinations (Clopper & Turnbull, 2018). For example, both the conditional probability of the target word given the following word and the phrase frequency of the word pair are significant predictors of t/d deletion in English (Jurafsky, Bell, Gregory, & Raymond, 2001; Pavlík, 2017). The pattern seen Table 1 may be explainable by the phrase frequency of the preceding verb and the following particle. Similarly, the distinction between the traditional context and the non-traditional context may also simply reflect co-occurrence patterns.

**Table 1.** The rate of occurrence of the nasal substitution variation preceding certain Standard Japanese (SJ) and Kansai Japanese (KJ) discourse phrases

|  |  |  |  |
| --- | --- | --- | --- |
| Group | Neutralization? | Examples | Nasal substitution rate |
| SJ *n* phrases | yes | *n-da*, *n-de*, *n-daro*, etc. | 7/152 (9.5%) |
| KJ *n* phrases | yes | *n-ya*, *n-yatte*, *n*-*yaro*, *n-yan*, etc. | 83/861 (9.6%) |
| KJ *ne* phrases | no | *ne*-*ya*, *ne*-*yatte*, *ne*-*yaro*, *ne*-*yan*, etc. | 306/325 (94.2%) |
| KJ *nen* phrases | no | *nen*-*ya*, *nen*-*yatte*, *nen*-*yaro*, *nen*-*yan*, etc. | 116/147 (78.9%) |
| KJ *no* phrases | no | *no-ya*, *no-yatte*, *no-yaro*, etc. | 31/35 (88.6%) |

Non-traditional contexts

Interestingly, nasal substitution also occurs infrequently in non-traditional contexts, as illustrated by the examples given in (8), with similar context standard form examples given in (9). In these examples we see nasal substitution occurring before non-nasal sounds. In these examples, the nasal substitution site could hypothetically conceal a following *no* particle that has merged with the preceding moraic nasal, as per (5). However, the sequences *no-zo* and *no-kedo* do not occur in the corpus, ruling out this possibility. When considered from a generative perspective, the usage of the nasal substitution form in the examples given in (8) appears to be an anomaly. The second contribution of our study is an attempt to shed some light on the usage of the nasal substitution variants in non-traditional contexts.

() *ore Oozi.kooen-ni sun-den kedo* (KSJ/004/m/2)

I Oji Park-loc live-hab dm

‘I live in Oji Park.’

*setumee si-yoo to omot-ten kedo* (KSJ/002/f/2)

explain do-vol quot think-cont sfp

‘I’m thinking that I’ll explain.’

*komban maajan sun zo* (KSJ/133/m/6)

tonight mahjong do sfp

‘Tonight we’re playing mahjong!’

() *hon-mo iPod-de yon-deru kedo na* (KSJ/021/m/5)

book-add iPod-ins read-hab dm sfp

‘I also read books on the iPod.’

*ii ka.na to omot-teru kedo* (KYT/018/m/2)

good sfp quot think-cont dm

‘I’m thinking that is good.’

*sororo kekkon suru zo* (KSJ/102/f/1)

soon marriage do sfp

‘It’s about time we got married!’

2 Methodology

2.1 The data

The source of our data is the *Corpus of Vernacular Japanese*. The data consists of 194 sociolinguistic interviews conducted by university students attending a private university in Japan, following the methodology described in Tagliamonte (2006). The interviewees are either family members or close acquaintances of the interviewers. Both the interviewers and the interviewees self-reported that they are native speakers of the Kansai dialect. The interviewers were instructed to speak in a casual manner using the local vernacular variety of Japanese. The topics discussed were chosen by the interviewers, and included school life, dating, work, family life, and tragic events. The interviews lasted approximately one hour. Each interview was transcribed, checked for accuracy, parsed at the morpheme level, and tagged with part of speech information using the MeCab parser (Kyoto University Graduate School of Informatics & Nihon Telegraph and Telephone Corporation, 2013). Every line of the tagged data was checked by hand and mistakes corrected. This methodology yielded approximately 2.2 million lines of data, of which 1.5 million lines were produced by the interviewees. In this study, we only examine the speech of the interviewees (hereafter speakers).

2.2 Initial considerations

The nasal substitution variant form verb+*ten* (standard form verb+*teru*) overlaps with the vernacular past-tense suffix variant verb-*ten* (standard form verb-*ta*). The etymology of the two forms differs: The former form is derived via nasal substitution; the latter form is derived from the past tense verb suffix -*ta* plus the sentence-final particle *no*. Thus, only the former form is relevant to this study.

The MeCab parser is not capable of accurately differentiating these two forms and therefore it encodes both forms with the same part of speech information. The form verb+*ten* occurs a total of 4,560 times in the data. Each of these tokens was recoded by hand according to its corresponding standard form, either -*teru* or -*ta*, based on the context. For the most part, determining the standard equivalent form was straightforward. However, some tokens were ambiguous, and we were unable to clearly determine the verb’s tense. An example of an ambiguous case is given in (10). For the purposes of this project, ambiguous cases were coded as equivalent to -*ta* and were excluded from analysis. This coding process resulted in 1,304 (28.6%) of the -*ten* tokens being coded as equivalent to -*teru*.

() *si-te mi-tai na to omot-ten* (TKC/005/f/2)

do-inf see-des sfp quot think-prog/pst

‘I thought/am thinking that I want to try that.’

As pointed out in Section 1, the nasal substitution variant occurs in non-traditional contexts, albeit, relatively infrequently. To better understand the factors that correlate with nasal substitution in a non-traditional context, we did not constrain the scope of the study to the tradition context. Specifically, we extracted the following items from the corpus, regardless of the context of occurrence: verb forms that end in *-ru*; and verb forms that end in -*n*, and whose equivalent standard form ends in -*ru*. We coded the former as the standard variant and the latter as the nasal substitution variant.

Three of the 194 speakers did not use nasal substation variants. The data for these three speakers were removed from the study.

2.3 Social characteristics of the speakers

We included three social characteristics in the analysis: age cohort, gender, and speech style. As a preliminary investigation of age suggested that it would not be a significant factor in the final analysis, we did not concern ourselves with equal representation of all age cohorts. Consequently, the age cohorts are not balanced. Specifically, number of speakers in a cohort range from 10 to 33, with an average of 21.5. The age range of each age cohort is as follows: 1, 15 to 18 years old (N=23); 2, 19-23 years old (N=33); 3, 24-29 years old (N=22); 4, 30-39 years old (N=16); 5, 40-49 years old (N=22); 6, 50-59 years old (N=21); 7, 60-69 years old (N=23); 8, 70-79 years old (N=21); 80-85 years old (N=10).

Gender is balanced with 98 female speakers and 93 male speakers.

Speech style index is a value that theoretically ranges from zero to one, and indicates the extent to which a speaker used standard Japanese during the interview (see Heffernan & Hiratuka, 2017 for details). For this study, we calculated speech style index by averaging the following six measures:

• Proportion of standard versus regional copula variants (for example, *da* vs. *ya* ‘be’)

• Proportion of standard versus regional verbal negative suffixes (for example, *tabe-nai* vs. *tabe-hen* ‘not eat’)

• Proportion of standard versus regional verbs of existence (*iru* vs. *oru* ‘be’);

• Proportion of non-regional versus regional sentence-final particles (for example, *yo* vs. *de*)

• Proportion of non-regional versus regional adverbial intensifiers (for example, *erai* vs. *kekko* ‘very’)

• Proportion of standard *ii* ‘good’ versus regional variant *ee* ‘good’

This methodology resulted in speech style index scores that ranged from 0.099 to 0.819, with an average value of 0.338 standard deviation of 0.144.

2.4 Grammatical factors

2.4.1 Traditional context

As mentioned, Hirayama (1997: 17), claims that nasal substitution occurs before a following a following /n/ or /d/ phoneme. This observation may fall out from the collocation frequencies of verbs and the following words. One of our goals is to test the hypothesis that nasal substitution tends to occur in more-frequently co-occurring word pairs. If the second word in these word pairs tends to start with /n/ or /d/, then the traditional context for nasal substitution is an epiphenomenon of phrase frequency. To test this possibility, we coded each token according to the initial phoneme of the trigger. If the initial phoneme is /n/ or /d/, then we coded the token as occurring in the traditional environment; otherwise we coded the token as not occurring in the traditional environment.

2.4.2 Neutralization of the triggering context

If the trigger word consisted of the moraic nasal (see Table 1 for examples), then nasal substitution results in the neutralization of the triggering context. We coded each token for the possibility of neutralization (regardless of whether the nasal substitution variant was used).

2.4.3 Location of nasal substitution target

The tokens were coded by the location of the nasal substitution target. The target may directly follow the uninflected main verb root, or there may be intervening morphological material between the main verb root and the target, such as an auxiliary verb root or verbal inflection. We coded the cases without intervening material as adjacent and cases wither intervening material as non-adjacent. Targets occurring at the end of compound verbs such as *furi-kaeru* ‘look back’ were coded as adjacent. Examples of adjacent targets are given in (11) and non-adjacent targets in (12).

() *tamatama ore-ga ki-ni naru nen* (KSJ/122/m/7)

coincidently I-nom attention-dat become sfp

‘I unintentionally became aware of it.’

*tyotto ore ki-ni nan nen kedo* (TKC/024/m/2)

a.little.bit I attention-dat become sfp dis

‘I become a bit concerned’

() *ato Tookyoo-ni hikooki ton-deru shi* (KSJ/016/m/5)

also Tokyo-dat airplane fly-hab dis

‘There are also planes flying to Tokyo.’

*ue-wa hikooki ton-den de* (KSJ/080/f/9)

above-top airplane fly-prog sfp

‘There are bomber airplanes flying above us.’

2.4.2 Part of speech of following word

The traditional context for nasal substitution is a particle that begins with either /n/ or /d/ (Hirayama, 1997). It is not clear to the extent that speakers’ usage of nasal substitution varies by the grammatical role of the following particle. To explore this possibility, we coded the word following the nasal substitution target for its part of speech according to the categories listed in Table 2.

Table 2. Part of speech categories and example words

|  |  |
| --- | --- |
| **Category** | **Example words** |
| case marker | *ga, mo, yori* |
| discourse phrase | *kedo, n-ya, n-tyau* |
| nominalizer | *no, non, n* |
| noun | *ningen*, *mono*, *nihongo* |
| other grammatical | *sakai*, *node*, *hodo* |
| other lexical | *mae*, *mittu*, *yuumee* |
| pause | *--* |
| sentence-final particle | *de, na, nen, yo, zo* |

2.5 Usage-based factors

2.5.1 Frequency

Usage-based theories of linguistic knowledge claim that repeated processing of a single form leads the gradual abbreviation of the articulatory gestures used to produce that form. Since nasal substitution notably reduces the articulatory gestures required to produce a form, we predict frequency correlates with rate of nasal substitution. Previous work that examined phonetic and phonological reduction at the right edge of the word in English, such as /r/-sandhi (Cohen-Goldberg, 2015), t/d deletion (Pavlík, 2017), and nasal place assimilation (Turnbull et al., 2018) consider the word frequency. Furthermore, there emerging evidence that the frequency of the word phrase (the target word plus the trigger word) may be a better predictor of reduction than just the frequency of the target word. Cohen-Goldberg and Pavlik also examined phrase frequency, and both found a stronger relationship for phrase frequency than for word frequency. In this study, we consider both word frequency and phrase frequency.

The concept of a word is less clear in Japanese than in English, and it may be that morpheme boundaries make for more natural cognitive divisions. To take into consideration such a possibility, we examined four measures of frequency, when are listed in Table 3. These four measures allow us to consider word frequency at different levels of granularity. The measure of frequency was determined by taking the log of the count of the number of occurrences of in the *Corpus of Vernacular Japanese*.

Table 3. The four measures of frequency considered in this study

|  |  |  |
| --- | --- | --- |
| Measure | Contains | Example |
| morpheme frequency | target morpheme only | *-teru* |
| word frequency | from the root verb to the target location | *tabe-teru* |
| morpheme phrase frequency | target morpheme plus following word | *-teru nen* |
| word phrase frequency | as word frequency, plus following word | *tabe-teru nen* |

2.5.2

3. Analysis

We follow the Romanization rules of the journal of the Linguistics Society of Japan, as described in http://www.ls-japan.org/modules/documents/LSJpapers/j-gkstyle2017.pdf

Turnbull et al. 2018

p.10

Target Word Predictability: bigram probability of target word given trigger word

Target Sound Predictability: the probability of the target segment (phoneme) conditioned on the preceding segments within the word

Trigger Word Predictability: bigram probability of trigger word given target word

Trigger Sound Predictability: the probability of the trigger segment (phoneme) conditioned on a preceding word boundary (i.e., the segment is word initial)

Turnbull 2018

Number of phonemes in target word

Biphone probability (the probability of the phoneme given the previous phoneme)

Pavlik 2017

Target word conditional probability given the next word

Turnbull (2018) investigated the reduction of phonemes both at the word level and the phoneme level in the *Corpus of Spontaneous Japanese.* At the word level, he found that longer words and more frequent words tended to contain reduced phonemes. At the phoneme level, he found that the biphone probability (the probability of a phoneme given the previous phoneme) correlated with rate of reduction. He also investigated the probability of reduction of each phoneme, and found that /u/ tended to reduce but /r/ did not.

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1. The following glosses are used: add = additive, adv = adverb(ializer), conj = conjunctive, cont = continuative, cop = copula, dat = dative, des = desiderative, dm = discourse marker, hab = habitual, inf = infinitive, ins = instrumental, neg = negative, nmlz = nominalizer, nom = nominative, prog = progressive, pst = past, perf = perfective, prs = present, qm = question marker, quot = quotative, sfp = sentence-final particle, top = topic, vol = volitional. Two glosses separated by / indicates an ambiguous choice. [↑](#footnote-ref-1)
2. CiNii is the search engine for academic literature written in Japanese. The URL is https://ci.nii.ac.jp/ja. [↑](#footnote-ref-2)
3. Examples taken from the *Corpus of Vernacular Kansai Japanese* are followed by brackets containing the following speaker characteristics: corpus code, eitherKSJ, KYT, or TKC; identifier number; gender, either female (f) or male (m); and age cohort (1 through 9; see Section 3 for details). [↑](#footnote-ref-3)
4. We acknowledge that such an explanation is bias in favor of a genitive account and bias against an emergent account. We consider both possibilities during the analysis of the results. [↑](#footnote-ref-4)