


*The diachronic origins of Lyman's Law: evidence from phonetics, dialectology and philology**

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Modern Japanese has a set of morphophonemic alternations known collectively as *rendaku* that involve initial consonants in second elements of compounds, as in /jama+dera/ ‘mountain temple’ (cf. /tera/ ‘temple’). An alternating element like /tera/ ~ /dera/ has an initial voiced obstruent in its *rendaku* allomorph and an initial voiceless obstruent in its non-*rendaku* allomorph. Lyman’s Law blocks *rendaku* in a second element containing a medial voiced obstruent. This paper gives three arguments that Lyman’s Law originated as a constraint prohibiting prenasalisation in consecutive syllables. First, constraints on similar consonants in close proximity generally apply not to voicing but to features with phonetic cues that are more spread out, such as prenasalisation. Second, in some Japanese dialects with prenasalised voiced obstruents, *rendaku* cannot occur if it would result in adjacent syllables containing these marked consonants. Third, phonographically attested Old Japanese compounds are consistent with a constraint on adjacent syllables.

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1 Introduction

Lyman's Law was first proposed as a constraint on a well-known morpho-phonemic phenomenon in modern Tokyo ('standard') Japanese called *rendaku* (see §2), which yields alternations such as /k/ ~ /g/, as in /kame/ 'turtle' and /umi+game/ 'sea turtle' (cf. /umi/ 'sea'). Lyman's Law prohibits *rendaku* from occurring in the second element of a compound if that element already contains a medial voiced obstruent. Consequently, we find compounds like /ita+kabe/ 'wooden wall' (cf. /ita/ 'board', /kabe/ 'wall'), in which the medial /b/ in the second element prevents the form with *rendaku*: */ita+gabe/.¹

We argue that Lyman's Law originated as a prohibition against prenasalisation in consecutive syllables, and that this prohibition is what held in 8th-century Old Japanese. Support for this claim comes partly from the phonetics of Old Japanese, which we consider briefly in the following paragraph, and more thoroughly in §3 and §4. Additional support comes from modern dialects of Japanese that retain both prenasalisation and the original prohibition (§5), as well as from philological analyses of Old Japanese compounds, which are entirely consistent with a prohibition against prenasalisation in adjacent syllables (§6.1).

The earliest substantial written documents for Japanese record varieties of Old Japanese. At that time, the consonants corresponding to modern Tokyo /b d ɖ ɡ/ were pronounced [ᵐb ᵐd ᵐz ᵐg] and, we assume, triggered salient nasalisation on an immediately preceding vowel (see §3.2).² The evidence for prenasalisation is overwhelming, but even a cursory review would take us far beyond the scope of this paper. We also find prenasalised voiced obstruents in some highly stigmatised modern dialects of Japanese (§5), and this prenasalisation is generally regarded as a retention from Old Japanese times.

Rendaku was already well established in Old Japanese, but, as noted above, the Old Japanese precursor of Lyman's Law seems to have been a straightforward ban on prenasalised voiced obstruents in adjacent syllables (§3.4). Stanton (2019) thoroughly documents a phonetically natural and typologically common restriction against /NCVNC/ sequences (where /N/ is a nasal consonant and /C/ an obstruent), and the Old Japanese version of Lyman's Law follows from this restriction, provided that prenasalised obstruents are like /NC/ clusters in the relevant respects (§4).

The details of the transition to the modern Tokyo version of Lyman's Law are not well understood. In Old Japanese, *rendaku* yielded a

¹ There is no consensus about how modern Tokyo Japanese should be transcribed phonemically. We adopt the analysis underlying the 'surfacy' system of Vance (2008), but many of our phonemic symbols differ. In particular, we use /ɸ ts ɖ ɕ tɕ ɖ ʃ/ here instead of /f c z š č ʃ y/. On the other hand, we maintain /r w u/ for the phonemes typically realised as [r uɰ u].

² Although we use [ᵐz] in our phonetic transcriptions of Old Japanese forms, it is very likely that the actual pronunciation was [ᵐɖ], given that segments described as prenasalised fricatives are usually and perhaps always realised as prenasalised affricates (Steriade 1993: 410).

prenasalised voiced obstruent at the beginning of the second element of a compound (§3.3), as in OJ /asi+^ɸgamo/ 'reed duck' (cf. /asi/ 'reed', /kamo/ 'duck'), but the constraint on adjacent syllables blocked rendaku when there was a prenasalised voiced obstruent in the syllable immediately preceding or immediately following a potential rendaku site (§3.4). In modern Tokyo Japanese, a voiced obstruent anywhere in the second element of a compound prevents rendaku; the inhibitor consonant need not be in the syllable immediately following a potential rendaku site (§2). Furthermore, a voiced obstruent preceding a potential rendaku site has no effect; even if it is in the immediately preceding syllable, it does not block rendaku (§3.4). Lyman's Law has thus undergone a metamorphosis from a phonetically natural restriction on adjacent syllables into a phonetically unnatural and cross-linguistically rare long-distance restriction on voicing.

2 Rendaku and Lyman's Law in modern Tokyo Japanese

Many modern Tokyo morphemes have one allomorph that begins with a voiceless obstruent and another allomorph that begins with a voiced obstruent, as in (1).

- (1) a. /take/ 'bamboo'
b. /take+jabu/ 'bamboo grove' cf. /jabu/ 'grove'
c. /sao+dake/ 'pole bamboo' /sao/ 'pole'

The initial voiced obstruent in the /dake/ allomorph in (1c) is an instance of rendaku, and the prototypical environment for rendaku is the beginning of the second element of a two-element compound. There are, however, some instances of rendaku in the second elements of words that can be analysed as prefix + base derivatives rather than as compounds. Also, many compounds have more than two elements, and some instances of rendaku are in third or later elements. Only the non-rendaku allomorph of an alternating morpheme can occur word-initially, such as /take/ in (1a) and (b).

A few words have been coined by exploiting a well-known phonaesthetic association between voiced obstruents and mostly negative attributes, particularly in initial position in native words (Suzuki 1962: 23–24, Endō 1977: 222–228, Komatsu 1981: 87–88). One example is /ɕama/ 'sorry state', which is obviously related to /sama/ 'state, condition'. Since /ɕama/ and /sama/ differ both in pronunciation and in meaning, they cannot be analysed as allomorphs of the same morpheme; they are separate lexical items, and the /ɕ/ in /ɕama/ is not an instance of rendaku. A word like /ɕama/ can be treated as a derivative, marked by replacing a voiceless obstruent with its voiced partner (Suzuki 1962: 26–27), although this analysis is not always appropriate synchronically, since native speakers do not see the connection in every such pair. The subsegmental exponent of this derivational morpheme just happens to be homophonous with the

exponent of *rendaku* in an analysis that treats *rendaku* as the manifestation of a subsegmental linking morpheme joining elements of a compound (as in §4). We should also note here that, in a few cases, a *rendaku* allomorph has ousted its non-*rendaku* counterpart diachronically. For example, the ancestor of the second element in /migi+gawa/ ‘right side’ was /kawa/, but most speakers today pronounce the independent word meaning ‘side’ as /gawa/. Once a morpheme ceases to alternate in this way, its initial voiced obstruent is no longer a synchronic instance of *rendaku*.

Since the 1960s, *rendaku* has attracted a great deal of attention from theoretical phonologists. Although *rendaku* always pairs a voiceless obstruent with a voiced obstruent, the phonetic difference between the two phonemes in each pair is in many cases more than just the absence *vs.* presence of voicing (Vance 2016: 3–4). The examples in (2) show the pairings. All the modern Tokyo obstruent phonemes except /p/ are involved in the alternations. Each voiceless obstruent phoneme other than /p/ (i.e. / ϕ h t tc c ts s k/) appears on the left in at least one of the pairings, and each voiced obstruent (i.e. /b d dz dz g/) appears on the right in at least one of the pairings. Notice that / ϕ / [ϕ] and /h/ [ç , h] both alternate with /b/ [b], / tc / [tc] and / c / [c] both alternate with / dz / [dz], and /ts/ [ts] and /s/ [s] both alternate with / dz / [z, dz].

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|--------|---|--------------|-------------------------------|------------------------------------|
| (2) a. | / ϕ / [ϕ] ~ /b/ [b] | /asa/ | + / ϕ uro/ | → /asa+buro/ |
| | | ‘morning’ | ‘bath’ | ‘morning bath’ |
| b. | /h/ [ç] ~ /b/ [b] | /tabi/ | + /hito/ | → /tabi+bito/ |
| | | ‘journey’ | ‘person’ | ‘traveller’ |
| c. | /h/ [h] ~ /b/ [b] | /iei/ | + /haei/ | → /iei+baei/ |
| | | ‘stone’ | ‘bridge’ | ‘stone bridge’ |
| d. | /t/ [t] ~ /d/ [d] | /jaku/ | + /toei/ | → /jaku+doei/ |
| | | ‘misfortune’ | ‘year’ | ‘unlucky year’ |
| e. | / tc / [tc] ~ / dz / [dz] | /soko/ | + / tc ikara/ | → /soko+ dz ikara/ |
| | | ‘bottom’ | ‘strength’ | ‘latent strength’ |
| f. | / c / [c] ~ / dz / [dz] | /tate/ | + / c ima/ | → /tate+ dz ima/ |
| | | ‘vertical’ | ‘stripe’ | ‘vertical stripe’ |
| g. | /ts/ [ts] ~ / dz / [z, dz] | /hana/ | + /tsuna/ | → /hana+ dz una/ |
| | | ‘nose’ | ‘rope’ | ‘nose halter’ |
| h. | /s/ [s] ~ / dz / [z, dz] | /hai/ | + /sara/ | → /hai+ dz ara/ |
| | | ‘ash’ | ‘dish’ | ‘ashtray’ |
| i. | /k/ [k] ~ /g/ [g] | /umi/ | + /kame/ | → /umi+game/ |
| | | ‘sea’ | ‘turtle’ | ‘sea turtle’ |

The historical changes that led to the pairings in (2) are well understood (Vance 2015: 397–398), and the pairings before these changes began will be described below in §3.3. For the minority of Tokyo speakers who maintain a conservative variety with word-medial syllable-initial [ŋ] (Hibiya 1999),

the pairing in (2i) is [k] ~ [ŋ], not [k] ~ [g]. This additional deviation from straightforward [±voice] will be relevant below in §4.³

The constraint known as Lyman's Law (Vance 2015: 402–408) prevents rendaku in a two-element compound if the second element (E2) contains a medial voiced obstruent. The examples in (3) illustrate.

- (3) a. /me/ + /tama/ → /me+dama/
 'eye' 'ball' 'eyeball'
 b. /hana/ + /taba/ → /hana+taba/ * /hana+daba/
 'flower' 'bunch' 'bouquet'

There are very few exceptions to Lyman's Law in the existing vocabulary (Kindaichi 1976: 5, Martin 1987: 115, Suzuki 2005). The best-known exception is probably /nawa+baēigo/ 'rope ladder' (cf. /nawa/ 'rope', /haēigo/ 'ladder'). It does not seem to matter whether the inhibiting voiced obstruent is in the syllable immediately following the potential rendaku site or later in E2 (Lyman 1894: 161–162, Martin 1952: 48). The examples in (4) are typical.

- (4) a. /umi/ + /sudzume/ → /umi+sudzume/ * /umi+dzudzume/
 'sea' 'sparrow' 'murrelet'
 b. /ko/ + /hitsudzi/ → /ko+hitsudzi/ * /ko+bitsudzi/
 'child' 'sheep' 'lamb'

The results of some psycholinguistic experiments (Vance 1980: 258–259, Ihara & Murata 2006: 21–22) have been consistent with a small 'distance effect' in responses to compounds containing nonsense E2s: the more syllables there were between the potential rendaku site and the inhibitor voiced obstruent, the more likely participants were to choose responses with rendaku. A more recent study by Kawahara (2012), however, using a different methodology, found no such effect. The apparent distance effect in the earlier studies was probably due to some other variable that was uncontrolled (Vance 2015: 403–404).

The term 'rendaku-eligible' can be used to refer to an element that begins with a voiceless obstruent as an independent word. Words that begin with a vowel, with a sonorant consonant or with a voiced obstruent, like the examples in (5), are not rendaku-eligible elements, because rendaku cannot apply.

³ We should point out that in most of the pairings in (2), a voiceless obstruent is paired with the voiced obstruent whose phonetic realisation is the closest available to the result of simply adding voicing. Our point is just that rendaku cannot be characterised as straightforward phonetic voicing, but a more abstract feature can be made to work in most cases. Such a feature would add voicing to the phonetic realisation of a voiceless obstruent phoneme and then change as little as possible to get to the realisation of one of the voiced obstruents that the language has. This approach will not work for /h/ ~ /b/ in (2b) and (2c), of course. Nor will it work for speakers who pair /k/ with [ŋ]. Such speakers also have [g], and whether or not [ŋ] and [g] are allophones of a single phoneme (see §4), [g] is not phonotactically inadmissible word-medially.

- (5) a. /*aei*/ ‘leg’ e.g. /*ato+aei*/ ‘hind leg’
 b. /*nami*/ ‘wave’ /*joko+nami*/ ‘side wave’
 c. /*dzeni*/ ‘money’ /*hi+dzeni*/ ‘daily wages’

As Kawahara (2016: 33) notes, some accounts in the literature can easily be misinterpreted to mean that *rendaku* always applies to *rendaku*-eligible E2s unless Lyman’s Law would be violated. In fact, however, *rendaku* is intractably irregular. Many phonological, morphological and semantic factors are known to influence the likelihood of *rendaku*, but there is no overarching generalisation that predicts when it occurs and when it does not.

First, some *rendaku*-eligible elements are idiosyncratically immune (Irwin 2016: 104–105), including /*kasu*/ and /*himo*/, as shown in (6).

- (6) a. /*abura*/ + /*kasu*/ → /*abura+kasu*/ * /*abura+gasu*/
 ‘oil’ ‘dregs’ ‘oily dregs’
 b. /*kutsu*/ + /*himo*/ → /*kutsu+himo*/ * /*kutsu+bimo*/
 ‘shoe’ ‘string’ ‘shoelace’

The allomorphs */*gasu*/ and */*bimo*/ simply do not exist, despite the fact that neither contains a medial voiced obstruent. Here, and throughout, we mark all non-occurring forms with an asterisk, regardless of whether there is any principled explanation for their non-occurrence. That is, a form marked with an asterisk is not necessarily ‘ungrammatical’ in any meaningful sense.

Second, many *rendaku*-eligible elements behave inconsistently as E2s, appearing sometimes with *rendaku* but sometimes without, even when no putative inhibiting factor is relevant. The examples in (7) illustrate.

- (7) a. /*nama*/ + /*twi*/ → /*nama+twi*/ * /*nama+dzi*/
 ‘fresh’ ‘blood’ ‘fresh blood’
 /*hana*/ + /*twi*/ → /*hana+dzi*/ * /*hana+twi*/
 ‘nose’ ‘blood’ ‘nosebleed’
 b. /*asa*/ + /*hi*/ → /*asa+hi*/ * /*asa+bi*/
 ‘morning’ ‘sun’ ‘morning sun’
 /*niei*/ + /*hi*/ → /*niei+bi*/ * /*niei+hi*/
 ‘west’ ‘sun’ ‘westering sun’

Both E2s in the compounds in (7) are polysemous (as almost all content morphemes are), but the compounds were chosen so that E2 in each pair of compounds would have the same sense. This precaution is necessary because the probability of *rendaku* in an E2 can differ dramatically depending on its sense (Vance 2015: 433, Irwin 2016: 104–105).

Third, there are individual compounds, such as those in (8), that can be pronounced either with or without *rendaku*.

- (8) a. /waru/ + /kutei/ → /waru+kutei/ ~ /waru+gutei/
 'bad' 'mouth' 'bad mouthing'
- b. /kara/ + /seki/ → /kara+seki/ ~ /kara+ɕzeki/
 'emptiness' 'cough' 'dry cough'

There are many well-known examples of compounds gaining or losing *rendaku* over time (Vance 2007a: 163), and variability like that in (8) is often symptomatic of a shift in progress.

Despite the pervasive irregularity of *rendaku*, Lyman's Law is a very robust constraint. It is only natural that the interaction between this constraint and the *rendaku* alternations has attracted the attention of many phonologists (e.g. Kawahara & Zamma 2016: 18–26). The primary aim of this paper is to shed light on the nature of Lyman's Law by investigating its historical origin. In §3 we look at Old Japanese phonology, and in §4 we show that widely accepted inferences about Old Japanese phonetics motivate an origin scenario involving a prohibition against prenasalisation in adjacent syllables. In §5 we look at non-standard modern dialects of Japanese that retain prenasalisation and the original prohibition. In §6 we show that the philological evidence is consistent with our claim that the Old Japanese forerunner of Lyman's Law was a constraint on adjacent syllables, although some inflectional forms and lexicalised phrases present a challenge. We offer a plausible explanation for these apparent exceptions in §6.2.

3 Old Japanese and the strong version of Lyman's Law

3.1 Overview

To investigate the historical origin of Lyman's Law, we first review the basic phonological structure of Old Japanese in §3.2, focusing on prenasalised voiced obstruents. We then present a plausible account of how *rendaku* originated in §3.3. Finally, in §3.4 we examine the Old Japanese precursor of Lyman's Law (often called the 'strong version' of Lyman's Law).

3.2 Prenasalised obstruents in Old Japanese

As noted in §1, *rendaku* was already well established in Old Japanese, but voiced obstruents were prenasalised. The phoneme chart in (9) displays the consonant system that most historical linguists infer for Old Japanese (Miyake 2003: 74, Frellesvig 2010: 34–36, Bentley 2012: 191).

- (9) p t s k
 mb nd nz ng
 m n
 r
 w j

The chart in (9) makes Old Japanese look like a language in which prenasalisation could be characterised as a voicing enhancement, since there is no series of plain voiced obstruents (Riehl & Cohn 2011: 554). There are good reasons to believe, however, that the Old Japanese ‘voiceless’ obstruents were allophonically voiced word-medially, i.e. intervocally (Frellesvig 2010: 35). It follows that prenasalisation was the distinctive feature, not just an enhancement, for word-medial ‘voiced’ obstruents. Understandably, many historical linguists avoid describing the prenasalised obstruents of Old Japanese as voiced and the contrasting obstruent series as voiceless. Frellesvig (2010: 34–36) adopts the terms ‘media’ (for the prenasalised series) and ‘tenuis’ (for the non-prenasalised series). Other scholars prefer ‘lax’ and ‘tense’.

Old Japanese prenasalised obstruents occurred only word-medially in the non-mimetic native vocabulary (Frellesvig 2010: 43, Takayama 2015: 627–629). The usual diachronic explanation for this phonotactic restriction attributes prenasalised obstruents to prehistoric NC clusters that originated as contracted NVC sequences (Ramsey & Unger 1972: 278, Miyake 2003: 73, Frellesvig 2010: 42–43). It appears that such contraction was not possible in word-initial NV syllables. Since Old Japanese did not allow coda consonants, it is not really necessary to assume that the inferred contraction process produced phonological consonant clusters in prehistoric Japanese. Consider the example in (10).

- (10) Pre-OJ /mura+nusi/ > OJ /muraⁿzi/ ‘village headman’
 cf. OJ /mura/ ‘village’, /nusi/ ‘master’
 [muranusi] > [murānsi] > [murāⁿzi]

Assuming that intermediate phonetic forms like [murānsi] actually occurred, they could have been fast-speech variants whose phonemic forms still included the elided vowel. But once voicing assimilation took place (yielding [nz] or [ⁿz]), reanalysis as a prenasalised consonant would have been compelling for later generations of speakers, assuming the prohibition against closed syllables remained active. Since prenasalisation seems to be unstable in word-initial position cross-linguistically (Herbert 1986: 18), it could be that even word-initial NV contraction was phonetically possible in prehistoric Japanese, but that postnasal voicing and reanalysis were blocked.

On the other hand, the scenario in (10) depends crucially on the anticipatory nasalisation of the vowel preceding the contracted NV syllable. Cross-linguistically, such regressive assimilation is typically stronger and more likely to be marked in a phonetic transcription when the immediately following nasal consonant is in the coda of the same syllable rather than in the onset of the next syllable (Herbert 1986: 126, Stanton 2019: 658). This generalisation is what motivates the [ā] assumed in (10) for contracted [mu.rān.si], but not for uncontracted [mu.ra.nu.si]. The transcription [ā] also appears in reanalysed [murāⁿzi], because vowel nasalisation is typical

immediately preceding a prenasalised obstruent, but not immediately preceding a simple nasal (Herbert 1986: 134). This difference is hard to explain if the relevant prenasalised obstruents and ordinary nasals are all simple onset consonants, and it is one of the reasons that Herbert (1986: 134) gives for analysing prenasalised obstruents as contour segments which are 'ambisyllabic' in the sense that the nasal portion affiliates with the syllable to its left, while the oral portion affiliates with the syllable to its right.

Needless to say, we cannot prove that the Old Japanese nasalisation facts were as we describe them here in §3.2. According to Jeong (2012: 450), some languages seem to have strong anticipatory nasalisation immediately preceding an onset nasal consonant. If this was true in Old Japanese, it would undermine our argument that Old Japanese prenasalised obstruents were ambisyllabic in Herbert's sense. Jeong also reports that some languages seem to have relatively weak anticipatory nasalisation immediately preceding a coda nasal consonant, although stronger than immediately preceding an onset nasal consonant. If the nasalisation of the first vowel was weak both in Old Japanese $\tilde{V}NV$ and in Old Japanese \tilde{V}^{NCV} and too similar to discriminate reliably, this would also undermine our argument.

3.3 The origin of rendaku

The scenario in §3.2 for the historical development of prenasalised obstruents dovetails with a widely accepted account of the origin of rendaku. In contrast to the modern Tokyo phoneme pairings shown by the examples above in (2) in §2, the Old Japanese pairings, shown below in (11), were phonetically uniform.

- (11) –rendaku /p/ /t/ /s/ /k/
 +rendaku /^mb/ /ⁿd/ /ⁿz/ /ⁿg/

In a typical Old Japanese noun + noun compound noun with rendaku, such as OJ /matu+^mbara/ 'pine grove' (cf. /matu/ 'pine', /para/ 'field'), it is reasonable to suspect that prenasalised /^mb/ developed from a prehistoric sequence of the form /NVp/. The obvious candidate for the NV syllable here is the ancestor of the Old Japanese genitive particle /no/ (cf. modern Tokyo /no/) (Murayama 1954: 107, Unger 1975: 8–9, Vance 1982: 335–338, Frellesvig 2010: 40–43), as in (12).⁴

⁴ Non-mimetic reduplicated words strongly favour rendaku in modern Tokyo Japanese (Vance 2015: 417–418), and Old Japanese examples like /koto+goto/ 'various matters' (cf. OJ /koto/ 'matter') are attested. It is unlikely that a genitive would have connected the two elements in the prehistoric ancestors of such examples, and Lyman (1894: 172), like several later researchers (Martin 1987: 103–104, Frellesvig 2010: 41), suggests the ancestor of dative OJ /ni/ (used to mean 'in addition to, and') as the prehistoric NV syllable.

- (12) Pre-OJ /matu+no+para/ > OJ /matu+m̄bara/ ‘pine grove’
 cf. modern Tokyo /matsu+bara/
 [matunopara] > [matūnpara] > [matū^mbara]

Like Pre-OJ /mura+nusi/ in (10), the prehistoric form in (12) is, of course, hypothetical. The authoritative dictionary of Old Japanese (*Jōdaigo Jiten Henshū Inkai* 1967) lists the compound /matu+m̄bara/, as well as its two elements as headwords, but not a frozen phrase in which the two elements are linked by the genitive particle. The phonographic attestations of this compound and of those in (13) below are all unambiguous, in the sense explained below in §4. Prenasalisation is transcribed phonetically throughout this paper as nasalisation on the immediately preceding vowel, followed by a short nasal with oral closure (see §3.2 above), but actual realisations in the present-day Kahoku-chō dialect (see §5 below) sometimes lack a measurable oral closure (Miyashita *et al.* 2016: 186). Herbert (1986), Maddieson & Ladefoged (1993) and Riehl & Cohn (2011) provide cross-linguistic surveys of the phonetics and phonology of prenasalised consonants.

There is, however, no reason to assume that every Old Japanese noun + noun compound noun developed from an ancestor of the form Pre-OJ noun + /no/ + noun. Modern Tokyo Japanese has frozen noun + /no/ + noun phrases like /te+no+hira/ ‘palm of the hand’ (cf. /te/ ‘hand’, /hira/ ‘flat’) as well as noun + noun compounds without *rendaku* like /te+kase/ ‘hand shackles’ (cf. /kase/ ‘shackles’). The situation in prehistoric Japanese was probably much the same. In Old Japanese, as expected, *rendaku* did not occur in frozen phrases (aside from one puzzling exception; Vance 2007a: 164), and there are also many compounds without *rendaku* (presumably created by simple noun + noun juxtaposition). The examples in (13) illustrate; the first element in both is OJ /ko/ (~ /kwi/) ‘tree, wood’.

- | | | | | | | | |
|---------|----|--------|--------|------|--------|-----------------------------|-----------------------------------|
| (13) a. | OJ | /ko/ | + | /no/ | + | /pa/ | <i>uncontracted frozen phrase</i> |
| | | ‘tree’ | | GEN | | ‘leaf’ | /ko+no+pa/ ‘leaf of a tree’ |
| | b. | OJ | /ko/ | + | /kupa/ | <i>simple juxtaposition</i> | |
| | | | ‘wood’ | | ‘hoe’ | /ko+kupa/ ‘wooden hoe’ | |

Assuming that the prehistoric ancestors of the examples in (13), when they were first coined, were essentially identical to their Old Japanese forms, they are entirely compatible with the account proposed above for the origin of *rendaku*: (13a) contains an NV particle that did not contract, and (13b) never had an NV particle in the first place. These examples also show why *rendaku* was intractably irregular in Old Japanese, just as it continues to be in modern Japanese (as noted above in §2): both noun + noun combinations (as in (13b)) and noun + genitive + noun combinations (as in (12)) were possible.

The irregularities have never been levelled out, and sporadic changes continue to this day, with some vocabulary items gaining *rendaku* and

others losing it, as noted above in §2. Labrune (2016) surveys irregularly occurring compound markers in several languages; many of these markers seem to have originated historically as contracted genitive markers. As Frellesvig (2010: 40–41) points out, there are examples of *rendaku* in Old Japanese that do not seem to be derivable from any earlier phrase with an NV syllable between the elements, and he draws the reasonable conclusion that ‘*rendaku* already in OJ was established as a morphophonemic process’ that could trigger analogical extensions.

3.4 Lyman's Law in Old Japanese

The precursor of Lyman's Law in Old Japanese was markedly different from the modern Tokyo version described above in §2. It appears that *rendaku* was blocked if there was a (prenasalised) voiced obstruent in an adjacent syllable on either side of the target segment. This stricter constraint is known as the ‘strong version’ of Lyman's Law (Ramsey & Unger 1972: 287–289). The examples in (14) illustrate.

- (14) a. OJ /apa^mbi/ + /tama/ → /apa^mbi+tama/ * /apa^mbi+ⁿdama/
 ‘abalone’ ‘jewel’ ‘abalone jewel’
- b. OJ /suⁿzu/ + /pune/ → /suⁿzu+pune/ * /suⁿzu+^mbune/
 ‘bell’ ‘boat’ ‘belled boat’
- c. OJ /aka/ + /tama/ → /aka+ⁿdama/
 ‘red’ ‘jewel’ ‘red jewel’
- d. OJ /opo/ + /pune/ → /opo+^mbune/
 ‘large’ ‘boat’ ‘large boat’

There was no (prenasalised) voiced obstruent in OJ /tama/ (14a) or in OJ /pune/ (b), but there was in the last syllable of OJ /apa^mbi/ (14a) and in the last syllable of OJ /suⁿzu/ (b). Neither E2 was idiosyncratically immune to *rendaku*, as shown by (14c) and (d).

The Old Japanese examples cited above are all attested phonographically, which means that they appear in Old Japanese texts represented in *man'yōgana*, i.e. Chinese characters used as phonograms (mostly syllabograms). OJ /suⁿzu+pune/ in (14b) appears only once, written 須儒赴泥, with each character representing a syllable. This sole occurrence of OJ /suzu+pune/ is in poem 51 in *Nihon shoki* (720).⁵ The character 儒 unambiguously represents OJ /ⁿzu/, and the character 赴 unambiguously represents OJ /pu/ (see §4 and §6.2 below for more details on ambiguous phonogram spellings). The three logographic occurrences of OJ /apa^mbi+tama/ (14a) are written 鰐玉 or 鰐珠, with each character representing a morpheme. The two phonographic occurrences (poems 4101 and 4103) are both in book 18 of *Man'yōshū* (ca. 760), and both are written 安波妣多麻. The character 妣 unambiguously represents OJ /^mbi/, and 多 unambiguously represents OJ /ta/. It is, of course, inappropriate to use the inferred pronunciation

⁵ The Oxford-NINJAL Corpus of Old Japanese (<https://oncoj.ninjal.ac.jp>) makes virtually all Old Japanese texts publicly available in searchable electronic form.

of a logographic attestation as evidence in phonological analysis. In particular, there is no direct evidence for the presence or absence of *rendaku* in a logographically written compound. At the same time, a phonographic representation of a compound is not necessarily an accurate reflection of that compound's actual phonemic form. No existing Old Japanese texts are original; they are handwritten copies of handwritten copies, sometimes with discrepancies between different copies (Frellesvig 2010: 22), and it is implausible to imagine that the critical editions on which scholars rely are entirely free of transmission errors. Furthermore, some individual *man'yōgana* characters were used inconsistently, sometimes representing a syllable beginning with a 'voiceless' obstruent and sometimes representing a syllable beginning with the corresponding (prenasalised) voiced obstruent. In addition, for some compounds attested phonographically more than once, it appears that forms with and without *rendaku* coexisted. Consequently, for a compound attested only once, there is no way to know for sure whether or not it was variable with respect to *rendaku*. Historical linguists working on Old Japanese simply have to keep these philological facts of life in mind, and do the best they can with the material that is available. Several other phonographically attested Old Japanese compounds will be cited below; these examples all need to be interpreted with caution. We report carefully on inconsistently used phonograms below in §4 and in §6.2, where they are directly relevant to our arguments, but there is no getting around the possibility that an unambiguous phonogram could simply be an error.

The strong version of Lyman's Law clearly does not hold in modern Tokyo Japanese. There are many examples like those in (15), in which *rendaku* occurs even though the last syllable in E1 contains a voiced obstruent. Since this voiced obstruent is not in the same element as the *rendaku* site, the modern version of Lyman's Law (§2) does not apply.

- (15) a. /fude/ + /hako/ → /fude+bako/ */fude+hako/
 'writing brush' 'box' 'brush case'
 b. /kadze/ + /kusuri/ → /kadze+gusuri/ */kadze+kusuri/
 'cold' 'medicine' 'cold medicine'

The results of a psycholinguistic study (Kawahara & Sano 2014) indicate that the strong version of Lyman's Law is not psychologically real for modern speakers.

4 Lyman's Law and the Obligatory Contour Principle

We described the Old Japanese strong version of Lyman's Law just above in §3.4 as a ban on prenasalisation in adjacent syllables. In this section, we construe this ban as an instance of a cross-linguistically common dispreference for /NCVNC/ sequences (where N is a nasal stop and C is an obstruent). As Stanton (2019) demonstrates, perceptual confusion provides a

clear phonetic basis for disfavouring such sequences. The version of Lyman's Law that we see in modern Tokyo Japanese prevents multiple instances of voicing within a morph, and the relevant syllables need not be adjacent (§2). Such a constraint on voicing is cross-linguistically rare, presumably because it lacks phonetic motivation, as we will argue below.

Ever since an influential article by Itô & Mester (1986), it has been popular to interpret Lyman's Law as a manifestation of the Obligatory Contour Principle (OCP). Originally proposed as a prohibition against sequences of identical tones in underlying representations (Leben 2011: 326), the OCP was incorporated into autosegmental phonology as a constraint on the tonal tier (Goldsmith 1990: 309–318). The notion of putting non-tonal features on separate tiers made it possible to treat such features as effectively suprasegmental, and a ban on multiple occurrences of voicing could then be formulated as a subcase of the OCP: OCP[voice] (Odden 2011: 22).

To make this approach work for Lyman's Law, voicing must be a monovalent feature applicable only to obstruents, the sole class of segments for which voicing is distinctive in Japanese. Itô & Mester (1986), Mester & Itô (1989) and Rice (1993) offer different theoretical implementations of this idea. If the non-distinctive voicing of vowels and sonorant consonants were also specified, any morpheme with two or more voiced segments in a row, such as /kidzu/ 'wound' or /ame/ 'rain', would violate OCP[voice]. If voicing were treated as a traditional binary feature that specifies voiced obstruents as [+voice] and voiceless obstruents as [–voice], the OCP would not block rendaku in compounds like /ko+hitsudzi/ in (4b), because the [+voice] specifications in */ko+bitsudzi/ associated with /b/ and /dz/ would be separated by the [–voice] specification associated with /ts/.

Rendaku itself can be treated as a subsegmental linking morpheme that joins the two elements of a compound (Itô & Mester 1986: 56–57, Vance 2015: 406–407, Labrune 2016). This morpheme has to be something more abstract than just the phonetic feature [voice], of course, since it converts a voiceless obstruent into its rendaku partner, as in (2) above (Vance 2018: 193–197). The linking element must also be prevented from docking onto anything other than an obstruent at the beginning of the second element of a compound (Vance 2015: 406). Otherwise, it could produce forms like */jugi+jama/ instead of /juki+jama/ 'snowy mountain' (cf. /juki/ 'snow', /jama/ 'mountain') or */ura+machi/ instead of /ura+machi/ 'backstreet district' (cf. /ura/ 'rear', /machi/ 'town').

Given these assumptions, Lyman's Law works as shown in (16). For the sake of illustration, the autosegmental representations are simplified to show a separate voicing tier, with all other segmental information consolidated into a single tier. OCP[voice] blocks rendaku in /ao+kabi/ 'blue-green mould' in (16a) (cf. /ao/ 'blue, green', /kabi/ 'mould'), but not in /iro+gami/ 'coloured paper' in (b) (cf. /iro/ 'colour', /kami/ 'paper').

In conservative varieties of modern Tokyo Japanese that have word-medial [ŋ] (<OJ [ŋg]) instead of [g], [ŋ] blocks rendaku, just as a voiced obstruent does (Kawahara & Zamma 2016: 25–26). The examples in (17) illustrate.

- (17) a. /koi/ + /ϕumi/ → /koi+bumi/ * /koi+ϕumi/
 'love' 'letter' 'love letter'
- b. /tsuri/ + /ϕune/ → /tsuri+bune/ * /tsuri+ϕune/
 'fishing' 'boat' 'fishing boat'
- c. /tora/ + /ϕu[ŋ]u/ → /tora+ϕu[ŋ]u/ * /tora+bu[ŋ]u/
 'tiger' 'blowfish' 'tiger blowfish'

E2s with medial [m] (17a) or [n] (17b) do not block rendaku. Along with the phonetically opaque pairings of voiceless and voiced obstruents in (2) (§2), the inhibiting power of velar nasals shows that Lyman's Law in modern Tokyo Japanese has lost its phonetic grounding. It presumably has to be learned as a language-specific constraint.

The question of whether syllable-initial [ŋ] is an allophone of /g/ or a separate phoneme is controversial (Vance 2008: 214–222) and will not be addressed here. Native speakers of Tokyo Japanese who do not have [ŋ] tend to assume that [ŋ] and [g] must be allophones of the same phoneme. On the assumption that the relationship between [ŋ] and [g] is allophonic, the interaction with Lyman's Law leads to an opacity problem in an OT analysis. This assumption may well be wrong, but Ito & Mester (2003b) accept it, and as a result, they have to resort to a stratal version of OT. For discussions of opacity, sound change, and phonetically unnatural patterns, see Sanders (2003), Hayes & White (2015) and Beguš (2020).

Furthermore, Kawahara (2008: 324–327) has argued that OCP[voice] does not seem like a plausible universal constraint in the first place. Cross-linguistically, OCP constraints on consonants seem to target adjacent syllables and features with acoustic correlates that are more 'spread out' over time. Such features, which include aspiration (e.g. Grassmann's Law) and prenasalisation, are susceptible to perceptual confusion (Ohala 1981: 189–196, 1993: 249–257, Gallagher 2010). That is, it is easy for a listener to perceive such a feature as linked to a segment other than its original host, and in the case of two hosts in adjacent syllables, listeners are likely to attribute the feature's phonetic correlates to a phonological specification on a single segment. The confusion engendered by hosts in adjacent syllables can be resolved by dissimilation (Blevins 2004: 148–149, Bennett & Rose 2017: 475), or prevented from arising by the OCP. Restrictions against multiple instances of voicing are cross-linguistically rare and phonetically unnatural (Ohala 1993: 253–254). All known cases of restriction on multiple instances of voicing seem to have arisen diachronically from restrictions on other features (Kawahara 2008: 327).⁷

⁷ The Niger-Congo language Moro disfavors voiceless consonants in adjacent syllables, and Bennett & Rose (2017) propose an OT analysis involving surface

We now turn our attention specifically to prenasalisation. On the basis of a wide-ranging survey of the avoidance of /^NCVNC/ sequences in several languages, Stanton (2019) argues that there is a universal dispreference for [NCṼ] sequences, rooted in the perceptual difficulty of assigning nasality to the underlying phonemes in such sequences. If the phonetic details inferred for Old Japanese in §3.2 are essentially correct, prenasalised obstruents in adjacent syllables (/^NCV.^NCV/) would have produced [^NCṼ] sequences ([^N.CṼ.^N.CV]). The strong version of Lyman's Law thus fits the cross-linguistic pattern, as long as [^NC] can be treated as analogous to [NC]. As Stanton (2019: 657–658) notes, languages that have salient anticipatory nasalisation on a vowel preceding an onset nasal consonant will also avoid /^NCVNV/ sequences, but, as we saw in §3.2, such nasalisation is atypical, and we assume that it did not occur in Old Japanese.

If salient nasalisation had occurred in /^NCV.NV/ sequences in Old Japanese, resulting in [^N.CṼ.NV], we would expect rendaku to have been avoided in compounds containing E2s such as OJ /tama/ 'jewel' and /pana/ 'flower', but no such tendency is apparent. In the 62 relevant phonographically attested compound nouns, there are 26 different E2s of the form /CVNV.../. For four of these E2s, the evidence for rendaku is unclear. As noted in §3.4, some phonograms were used inconsistently, sometimes representing a syllable beginning with a 'voiceless' obstruent and sometimes representing a syllable beginning with the corresponding prenasalised voiced obstruent. We use the label 'ambiguous' to refer to these phonograms. The four E2s in questions are all attested at least once with an E2-initial phonogram that is ambiguous, but not with an E2-initial phonogram that unambiguously represents a prenasalised voiced obstruent. In contrast, twelve of the 26 relevant E2s have at least one token written with an E2-initial phonogram that unambiguously represents a prenasalised voiced obstruent. (See Table I below for a summary.) We can be reasonably confident that these twelve E2s were susceptible to rendaku. The remaining ten E2s are attested only with E2-initial phonograms that unambiguously represent a 'voiceless' obstruent. Thus there is no evidence that any of these ten E2s was susceptible to rendaku, although we can never be certain, since they might have had rendaku in unattested compounds.

The figures reported in the preceding paragraph and in the following two paragraphs come from an exhaustive search for relevant tokens in the Oxford-NINJAL Corpus of Old Japanese (cf. note 5). The relevant compounds exclude those that would be expected to resist rendaku for some other reason. The excluded examples are: (i) those in which rendaku would violate the strong version of Lyman's (e.g. OJ /su^ŋga+para/ 'sedge plain'); (ii) those with coordinate meaning (e.g. OJ /tuju+simo/ 'dew and frost'); (iii) those with a numeral E1 (e.g. OJ /ja+kumo/

correspondence theory dissimilation, which does not limit dissimilating features to those with 'spread out' acoustic cues.

'multilayer [literally 'eight'] clouds'); (iv) those with honorific OJ /mi/ as E1 (e.g. OJ /mi+tama/ 'honourable spirit'). The number of phonographically attested tokens of each relevant compound varies widely, ranging from 1 to 51. To identify ambiguous phonograms, we relied on the character values from the table of phonogram usage in *Jōdaigo Jiten Henshū Inukai* (1967: 891–903). Whether a phonogram was ambiguous or not can depend on the OJ text in which it occurs.

Of the 62 compounds described above, 17 have at least one token written with an E2-initial phonogram that unambiguously represents a prenasalised voiced obstruent. Some of these 17 compounds almost certainly varied between a form with *rendaku* and a form without, but there is little doubt that they had or could have *rendaku*. One of them is OJ /aka+ⁿdama/ 'red jewel', used above in §3.4 as example (14c). This compound is attested phonographically twice, once in *Kojiki* (712), with unambiguous 院 representing OJ /ⁿda/, and once in *Nihon shoki*, with unambiguous 娜 representing OJ /ⁿda/. Another 32 of the 62 compounds are attested only with E2-initial phonograms that unambiguously represent a 'voiceless' obstruent. One of these is OJ /patu+pana/ 'first flower', which is attested phonographically four times in *Man'yōshū*, with 波 unambiguously representing OJ /pa/ in each token. Of course, some of these compounds might have allowed an alternative form with *rendaku*, but there is no phonogram evidence to back up such a claim. The remaining 13 compounds are all attested at least once with an E2-initial phonogram that is ambiguous, but not with an E2-initial phonogram that unambiguously represents a prenasalised voiced obstruent. (See again Table I below.) One of these is OJ /pito+tuma/ ~[?]/pito+ⁿduma/ 'another's spouse', attested phonographically five times in *Man'yōshū*, with unambiguous 都 representing OJ /tu/ in two cases and ambiguous 豆 representing OJ /tu/ or OJ /ⁿdu/ in three cases. Philologists agree that most of these 13 had or could have *rendaku*, and the headword in *Jōdaigo Jiten Henshū Inukai* (1967) is given as OJ /pito+ⁿduma/, with *rendaku*, but the phonogram evidence is equivocal.

In stark contrast to Old Japanese /CVNV.../ E2s, there is virtually no doubt that E2s containing a prenasalised voiced obstruent in the second syllable (OJ /CV^NC.../) never had *rendaku*. In a total of 32 compound nouns, 19 different OJ /CV^NC.../ E2s are phonographically attested. For 31 of these compounds, the E2-initial phonogram in every token unambiguously represents a syllable beginning with a voiceless obstruent. (See Table I.) One of these is OJ /aki+kaⁿze/ 'autumn wind', attested phonographically four times in *Man'yōshū*, with unambiguous 可 representing OJ /ka/ in three cases and unambiguous 加 representing OJ /ka/ in one case. The remaining compound combines the E1 OJ /sita/ 'bottom' with the E2 OJ /kaze/ 'wind', and the sole phonographic attestation of this compound has ambiguous 賀 representing the E2-initial syllable. There is no real doubt that the compound was pronounced OJ /sita+kaⁿze/, without *rendaku*, but the phonogram evidence is equivocal. The sole phonographic attestation of this compound is in *Hitachi fudoki* (714–718), and

	distinct /CVNV.../ E2s	compounds with /CVNV.../ E2	compounds with /CV ^N V.../ E2
attested unambiguously at least once as +rendaku	12	17	0
attested unambiguously only as -rendaku	10	32	31
attested ambiguously	4	13	1

Table I

Old Japanese: distinct /CVNV.../ E2s ($N = 26$); compounds with /CVNV.../ E2 ($N = 62$); compounds with /CV^NC.../ E2 ($N = 32$).

man'yōgana 賀 was ambiguous between OJ /ka/ and /^uga/ in this text, as it was in most of the Old Japanese texts in which it was used.

The pattern for /CV^NC.../ compounds is clear, and markedly different from those above. We can say with a high degree of confidence that Old Japanese compound nouns with a prenasalised voiced obstruent in the second syllable of E2 never show rendaku. In short, Old Japanese was consistent with Stanton's (2019) generalisation, assuming, as we have, that an onset nasal did not induce salient nasalisation on an immediately preceding vowel.

5 Northern Tōhoku dialects

5.1 Northern Tōhoku rendaku

Japanese dialects spoken in the northern part of the Tōhoku region of northern Honshū preserve the prenasalisation of voiced obstruents, and it appears that Lyman's Law has remained a ban on prenasalisation in adjacent syllables in some of these dialects. In 2012, fieldwork on rendaku in one representative dialect was carried out in Kahoku-chō, a small town in northern Yamagata Prefecture (Miyashita *et al.* 2016: 180–183). This survey was led by Miyashita, who is a Kahoku-chō native, and the participants were 24 locally born and raised native speakers (13 male, 11 female), ranging in age from 63 to 94 at the time of recording.

The outcome of rendaku in conservative northern Tōhoku dialects is typically a prenasalised voiced obstruent. The Kahoku-chō survey participants produced many such forms (Miyashita *et al.* 2016: 183–192), including those in (18).

- (18) a. Kahoku-chō [tɛ̃] + [ɸuɠuɾo] → [tɛ̃^mbuɠuɾo]
 'hand' 'bag' 'glove'
 b. Kahoku-chō [hama] + [kuɾi] → [hamā^uɠuɾi]
 'beach' 'chestnut' 'clam'

In most northern Tōhoku dialects, OJ [ᵐg] has shifted to [ŋ], but many older Kahoku-chō speakers retain [ᵐg], as in Kahoku-chō [hamãᵐguuri] (18b).

Another salient characteristic of northern Tōhoku dialects is that, in most cases, the consonants corresponding to Tokyo ‘standard’ voiceless stops and voiceless affricates are voiced (but not prenasalised) intervocalically in word-medial position, as shown in (19).⁸

(19) Kahoku-chō	[hada]	‘flag’	cf. Tokyo	/hata/	[hata]
	[maɕɕi]	‘town’		/matsi/	[matsi]
	[maɕɕi]	‘pine’		/matsu/	[matsu]
	[oɕa]	‘tea’		/otɕa/	[otɕa]
	[tagɕ]	‘bamboo’		/take/	[take]

The expectation is that a counterpart to Lyman’s Law in the Kahoku-chō dialect would involve prenasalised voiced obstruents, and as Kahoku-chō [tɕᵐbuguro] in (18a) shows, a simple voiced obstruent in E2 ([g] in this example) does not block rendaku.

5.2 Prenasalisation in adjacent syllables in northern Tōhoku

Modern Tokyo Japanese has the compound /nabe+buta/ ‘pot lid’, which exhibits rendaku (cf. /nabe/ ‘pot’, /ɸuta/ ‘lid’). The corresponding compound is not ordinarily used in the Kahoku-chō dialect. As a result, only 20 of the 24 Kahoku-chō survey participants were able to come up with something like the expected form in response to a picture prompt. (Kahoku-chō speakers do use a phrase corresponding to Tokyo /nabe no ɸuta/, with the two nouns linked by a genitive particle: [nãᵐbɛnoɸɪta].) Six of these 20 speakers produced a near-standard form with no prenasalisation and no voicing of the stop in the last syllable, as in Table II. Two other speakers had a prenasalised medial stop in E1, but a voiceless medial stop in E2, and another six speakers had a voiced medial stop in E2, but no prenasalisation.

The 14 productions in Table IIa all display a lack of full integration into the traditional phonological system of the Kahoku-chō dialect, indicating non-nativeness. Even the oldest of the Kahoku-chō participants were born too late not to be impacted by the relentless standardisation policy of the Japanese national government, which began in the Meiji period (1868–1912). Like most northern Tōhoku speakers, Kahoku-chō speakers are

⁸ As noted in §3.2, it is likely that Old Japanese ‘voiceless’ obstruents, too, were allophonically voiced in intervocalic position (Frellesvig 2010: 34–36), but the word-medial voiced consonants in the Kahoku-chō forms in (20) are probably not retentions. For one thing, Frellesvig (2010: 36) says that OJ /s/ was voiced word-medially (i.e. intervocalically), but northern Tōhoku fricatives corresponding to OJ /s/ are voiceless intervocalically, as in Kahoku-chō [kasa] ‘umbrella’ (cf. Tokyo /kasa/ [kasa]). Also, vowel devoicing pre-empts intervocalic stop voicing in northern Tōhoku dialects, suggesting that vowel devoicing preceded stop voicing diachronically. For example, in Table II below, we see Kahoku-chō [ɸɪta] ‘lid’ (not [ɸɪda]), which corresponds to Tokyo /futa/ [ɸɪta].

a.	[nabɛbuta]	6 speakers
	[nã ^m bɛbuta]	2 speakers
	[nabɛbuda]	6 speakers
b.	[nã ^m bɛbuda]	5 speakers
	[nã ^m bɛ ^m buda]	?1 speaker

Table II

Kahoku-chō speaker responses to picture prompt for
E1: [nã^mbɛ] ‘pot’ + E2: [ɸɯta] ‘lid’.

acutely aware that voiced obstruents corresponding to Tokyo voiceless obstruents and prenasalised obstruents corresponding to Tokyo voiced obstruents are salient and highly stigmatised. Most Kahoku-chō speakers, especially those who are educated, have a tacit understanding of the correspondences between the local dialect and the Tokyo standard.⁹ Consequently, they are capable to some degree of converting local forms to standard forms and *vice versa*, and both the almost fully standardised form and the partially standardised forms in Table IIa are natural outcomes under these circumstances.

The remaining six survey participants who produced a form corresponding to modern Tokyo /nabe+buta/ all had prenasalised [m̥b] for the medial consonant in E1 and voiced [d] for the medial consonant in E2, but only one had prenasalisation on the initial consonant of E2, as shown in Table IIb. Furthermore, this sole instance of E2-initial prenasalisation is not entirely unambiguous phonetically, as indicated by the question mark.

What is hard to understand about the form Kahoku-chō [nã^mbɛbuda] in Table IIb is that it contains both stigmatised features (prenasalisation and stop voicing), but deviates from the correspondence pattern at the rendaku site. The key to understanding the form was provided in a presentation about another northern Tōhoku dialect, spoken in the town of Shizukuishi-chō in Iwate Prefecture (Uwano 2015). In the Shizukuishi-chō dialect, prenasalised obstruents in consecutive syllables are phonotactically prohibited. For example, consider the Shizukuishi-chō compound in (20), which corresponds to Tokyo /hana+bi/ ‘fireworks’ (cf. /hana/

⁹ This complex diglossic situation, which we find even in the most traditional northern Tōhoku communities, is the reason we have refrained from offering a consonant phoneme chart like the one for Old Japanese in (9) in §3.2. There is such a chart in one of the published reports of the 2012 Kahoku-chō survey (Miyashita *et al.* 2016: 175), but that chart assumes that present-day speakers identify a word-initial voiced obstruent and a word-medial prenasalised voiced obstruent with the same place of articulation as allophones of the same phoneme. This analysis leads to a variety of thorny problems (Vance *et al.* 2014: 36–38), because ordinary natives of the northern Tōhoku who are senior citizens today are bidialectal and literate (in Tokyo ‘standard’ Japanese). There is no point in trying to grapple with these sociolinguistic issues in this paper.

'flower', /hi/ 'fire') and shows the expected prenasalisation at the rendaku site.

- (20) Shizukuishi-chō [hana] + [hi] → [hanã^mbi]
 'flower' 'fire' 'fireworks'

Now consider the Shizukuishi-chō compound corresponding to Tokyo /kaba+bi/ 'ceremonial fire' (cf. /kaba/ 'birch', /hi/ 'fire'), shown in (21). The prenasalisation in the preceding syllable blocks prenasalisation at the rendaku site, although rendaku does occur.

- (21) Shizukuishi-chō [kã^mba] + [hi] → [kã^mbabi]
 'birch' 'fire' 'ceremonial fire'

Although the Shizukuishi-chō dialect preserves prenasalised [^mbⁿd^ɰz], OJ /ⁿg/ [ɰg] has become [ŋ], just as in (conservative) Tokyo pronunciation. This [ŋ] does not block prenasalisation in an adjacent syllable, i.e. the constraint has maintained its phonetic grounding. For example, compare two compound verbs corresponding to Tokyo /nige+dasu/ 'run away' (22a) and /tobi+dasu/ 'fly away' (22b).

- (22) a. Shizuku- [niŋe] + [dasu] → [niŋẽⁿdasu] * [niŋedasu]
 ishi-chō 'flee' 'move away' 'run away'
 b. Shizuku- [tõ^mbi] + [dasu] → [tõ^mbidasu] * [tõ^mbĩⁿdasu]
 ishi-chō 'fly' 'move away' 'fly away'

In (22b), prenasalisation following E1 would produce the disfavoured phonetic sequence [^NC^ɰ], as in the asterisked form. The constraint against prenasalisation in adjacent syllables prevents this sequence from arising, as explained in §4 in connection with the strong version of Lyman's Law in Old Japanese. In (22a), on the other hand, prenasalisation following E1 does not produce the disfavoured [^NC^ɰ] sequence. We saw in §2 and §4 that, for modern Tokyo speakers who have onset [ŋ], a medial [ŋ] in an E2 blocks rendaku, i.e. [ŋ] behaves like a voiced obstruent with respect to the modern Tokyo version of Lyman's Law. In contrast, onset [ŋ] in the Shizukuishi-chō dialect does not behave like a prenasalised obstruent with respect to the constraint against prenasalisation in adjacent syllables, despite the fact that it derives historically from prenasalised [ɰg]. Notice that if the same constraint holds in the closely related Kahoku-chō dialect, then [nã^mbẽⁿbuta] in Table IIb is actually the fully nativised form corresponding to Tokyo /nabe+buta/.

When we look beyond compounds, however, we find examples that pose a serious challenge to our hypothesis that there is a straightforward ban on prenasalisation in adjacent syllables in the northern Tōhoku dialects we have considered. In the Shizukuishi-chō dialect, the conditional form of a verb ends with a suffix that is ordinarily pronounced /^mba/, and some verb stems end in a syllable that has a prenasalised onset consonant. The

question that arises, of course, is whether these forms are pronounced with prenasalisation in adjacent syllables. The answer is that these forms are variable, as the examples in (23) show.¹⁰

- | | | | | |
|---------|--------------|------------------------|---|-------------------------|
| (23) a. | Shizukuishi- | [kagũ ^m ba] | *[kagu ^m ba] | |
| | chō | ‘write-COND’ | cf. Tokyo /kake-ba/ | |
| | b. | Shizukuishi- | [jō ^m bũ ^m ba] ~ [jō ^m bu ^m ba] | *[jobũ ^m ba] |
| | | chō | ‘call-COND’ | cf. Tokyo /jobe-ba/ |

We propose that the variability in examples like (23b) can be understood as a conflict between faithfulness (in this case, the desire to avoid allomorphy by maintaining the ‘basic’ form of the suffix) and the constraint prohibiting prenasalisation in adjacent syllables. Since speakers cannot have it both ways, they vacillate as to whether or not to apply dissimilation. In an OT analysis, neither of the two constraints would outrank the other. As the asterisked form in (23b) shows, dissimilation can alter only the initial consonant of the suffix, not the last consonant of the stem, which an OT analysis might handle by ranking root/stem faithfulness higher than affix faithfulness (McCarthy & Prince 1995: 364–365).

Although Miyashita is a proficient speaker of the Kahoku-chō dialect (thanks to spending a lot of time with her grandparents as a child), she does not have the secure native intuitions of Kahoku-chō speakers a generation older. As noted in §5.1, many older Kahoku-chō natives retain prenasalised [ŋ]. Does the Kahoku-chō dialect in fact have a phonotactic constraint prohibiting prenasalisation in consecutive syllables? If so, does Kahoku-chō [ŋ] block prenasalisation, just like other prenasalised voiced obstruents? And do Kahoku-chō inflectional forms show the kind of variability that we see in Shizukuishi-chō? Unfortunately, these are questions that the 2012 Kahoku-chō survey did not address. Our fragmentary knowledge at the time did not give us any reason to probe in these directions. Since all northern Tōhoku dialects are endangered, we feel extremely fortunate to have learned what we have about the phonotactics of the closely related Shizukuishi-chō dialect, and there is still hope that the necessary follow-up fieldwork in Kahoku-chō can be carried out in the near future.

6 The domain of Lyman’s Law in Old Japanese

6.1 Compounds

We have argued in this paper that Lyman’s Law in Old Japanese (the ‘strong’ version of Lyman’s Law) was a constraint that blocked

¹⁰ The data reported in this paragraph comes from Zendō Uwano (personal communication), a native speaker of the Shizukuishi-chō dialect and the author of the paper cited above in this section (Uwano 2015). Uwano informs us that his grandparents had stem-final vowel [ē] preceding the conditional suffix (matching the vowel in the corresponding Tokyo forms), but that speakers of his own generation have [ũ].

prenasalised obstruents in adjacent syllables (§3.4), but we have not considered whether there is any evidence that might cast doubt on the claim that adjacency was crucial. In this section, we report a thorough search for examples that could be construed as instances of a non-adjacent prenasalised voiced obstruent inhibiting rendaku. As noted in §3.4, the extant Old Japanese materials have serious limitations, but the results of our search give us no reason to doubt that adjacency was in fact crucial.

As explained in §2, Lyman's Law in modern Tokyo Japanese blocks rendaku when there is a voiced obstruent anywhere in E2. Adjacency is not relevant; a voiced obstruent in E2 blocks rendaku even if it is not in the immediately following syllable. Furthermore, a voiced obstruent in the last syllable of E1 does not block rendaku, even though it is adjacent to the syllable containing the rendaku site.

In northern Tōhoku dialects, on the other hand, the evidence cited in §5.2 from Shizukuishi-chō indicates that what is prohibited is prenasalised voiced obstruents in adjacent syllables. The strong version of Lyman's Law in Old Japanese (§3.4) was also a constraint involving prenasalised voiced obstruents, and the examples cited in §4, repeated in (24), are consistent with the claim that adjacency was relevant.

- (24) a. OJ /joroⁿdu/ + /ta^mbi/ → /joroⁿdu+ta^mbi/ * /joroⁿdu+ⁿda^mbi/
 'myriad' 'time' 'many times'
- b. OJ /tuⁿgi/ + /tuⁿgi/ → /tuⁿgi+tuⁿgi/ * /tuⁿgi+ⁿduⁿgi/
 'next' (redup) 'again and again'

Each of the examples in (24) contained two prenasalised voiced obstruents, but not in adjacent syllables.

The question that remains to be addressed is whether the strong version of Lyman's Law prevented rendaku only when rendaku would have resulted in prenasalised voiced obstruents in adjacent syllables. The situation in Old Japanese is hard to assess, for two reasons. First, the number of phonographically attested compounds is limited. Second, very few Old Japanese morphemes were longer than two syllables.

One important example is given in (25).

- (25) OJ /swoⁿde/ + /tuke/ → /swoⁿde+tuke/
 'sleeve' 'attaching' 'sleeved'
- /swoⁿde+tuke/ + /koromo/ → /swoⁿde+tuke+ⁿgoromo/
 'garment' * /swoⁿde+tuke+koromo/
 'sleeved garment'

In the sole phonographic attestation of OJ /swoⁿde+tuke+ⁿgoromo/, each of the five obstruent-initial syllables is written with an unambiguous phonogram (see §4). This example shows that a prenasalised voiced obstruent not in the morph immediately preceding the rendaku site did not block rendaku. It is not clear from (25), however, whether the domain of the inhibiting effect in E1 was the entire preceding morph or

four cases. If the E2 in (27b) was actually pronounced /tatipana/, then the absence of rendaku is irrelevant here.

For OJ /pototo^ŋgisu/ 'cuckoo' in (27a), Martin (1987: 416) gives the etymology in (28).

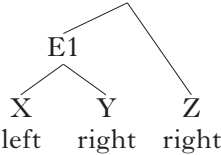
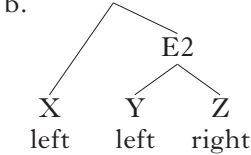
- (28) Pre-OJ /poto/ + /to/ + /naki/ + /su/
 (onomatopoeic) QUOT 'crying' 'bird'
 [pototonakisu] > [pototō^ŋgisu]

Mimetic morphemes are usually characterised as consistently rendaku-immune in modern Tokyo Japanese (Vance 2015: 416–417). The immunity may not have been quite so consistent in Old Japanese, but distinction between mimetic and non-mimetic is difficult to draw, because the boundary between these two sectors of the vocabulary has always been fuzzy and porous (Hamano 1998: 6–7). In any case, if the first two syllables of OJ /pototo^ŋgisu/ derive from a rendaku-immune morpheme, there is no reason to attribute the absence of rendaku in (27a) to the non-adjacent pre-nasalised voiced obstruent OJ /^ŋg/.

For OJ /tati^mbana/ 'tangerine' in (27b), Martin (1987: 543) gives the etymology in (29).

- (29) Pre-OJ /ta/ + /ti/ + /no/ + /pana/
 'paddy' 'path' GEN 'flower'
 [tatinopana] > [tati^mbana]

It seems likely that speakers would have seen the morpheme for 'flower' in OJ /tati^mbana/, and, as long as the entire word was felt to be compound of some sort, its resistance to rendaku could have developed because of the right-branch condition, which restricts rendaku to a right branch in constituent structure (Otsu 1980: 217–222, Vance 2007b, Kumagai 2014). The diagrams in (30) illustrate.

- (30) a.  b. 

In most three-element compounds X + Y + Z, the middle element Y combines with X to form a complex E1, as in (30a), or with Z to form a complex E2, as in (30b). Assuming that neither Y nor Z is immune to rendaku, the right-branch condition predicts that rendaku is possible in both Y and Z in (30a), but only in Z in (30b). If the pre-Old Japanese ancestor of the word for 'mountain tangerine' had the structure /jama/ + {/tati^mbana/}, the middle element /tati/ was on a left branch, like Y in (30b). If the right-branch condition was active in pre-Old Japanese, it

would have made any complex (Y + Z) E2 immune to *rendaku*, regardless of whether or not there was a prenasalised voiced obstruent anywhere in that E2. The upshot is that the absence of *rendaku* in OJ /jama+tati^mbana/ (27b) may originally have had nothing to do with the OJ /^mb/ in /tati^mbana/.

The claim that adjacency was crucial for the strong version of Lyman's Law would be greatly strengthened if there were an example of *rendaku* in a two-element Old Japanese compound with an E2 that (i) was unambiguously monomorphemic, (ii) had more than two syllables and (iii) contained a prenasalised voiced obstruent in the third syllable or later. Unfortunately, there are simply no such examples. Nevertheless, the available evidence from compounds is consistent with the idea that Lyman's Law in Old Japanese reflected a phonetically motivated prohibition against prenasalised voiced obstruents in adjacent syllables, as proposed in §3.4.

6.2 Inflectional forms and frozen phrases

Just as we saw above in §5.2 in connection with northern Tōhoku dialects, when we look beyond compounds in Old Japanese, there are examples that pose serious problems for our hypothesis that Old Japanese had a straightforward ban on prenasalisation in adjacent syllables. First, there were inflectional suffixes that began with a prenasalised voiced obstruent and attached to verb stems. Since some Old Japanese verb stems ended in a syllable with a prenasalised onset, such inflectional forms were a potential source for prenasalisation in adjacent syllables. Second, the genitive particle OJ /ⁿga/ linked nouns, just like OJ /no/ (see §3.3). Many noun + /ⁿga/ + noun phrases were lexicalised and thus appear as headwords in *Jōdaigo Jiten Henshū Iinkai* (1967). Since many Old Japanese nouns ended in a syllable with a prenasalised onset, these frozen phrases are another potential source for prenasalisation in adjacent syllables within a phonological word.

The examples in (31) are inflectional forms of verbs that are phonographically attested, and appear to have had prenasalised obstruents in consecutive syllables. A systematic search of the Oxford-NINJAL Corpus of Old Japanese yielded only two other relevant examples. Both are negative forms like (31a) and (b), and thus add little information.

- (31) a. OJ /jo^mba-ⁿzu/ 'call-NEG'
 b. /iⁿde-ⁿzu/ 'emerge-NEG'
 c. /aswo^mbe-ⁿdomo/ 'play-CONCESSIVE'
 d. /meⁿde-^mba/ 'appreciate-COND'

The phonemic transcriptions in (31) obviously violate the proposed ban on prenasalisation in adjacent syllables, but there is room for doubt about whether these transcriptions accurately reflect Old Japanese pronunciation. As noted above in §3.4, some *man'yōgana* characters were used inconsistently, sometimes representing a syllable beginning with a

'voiceless' obstruent and sometimes a syllable beginning with the corresponding prenasalised voiced obstruent. In the single phonographic attestation of (31a), OJ /jo^mba-ⁿzu/, the character that represents the second syllable (婆) was used sometimes for OJ /^mba/, but sometimes for OJ /pa/. In the single phonographic attestation of (31b), /iⁿde-ⁿzu/, the character that represents the second syllable (豆) was normally used for OJ /te/, but not for OJ /ⁿde/. There are three phonographic attestations of (31c), /aswo^mbe-ⁿdomo/, and in two of them the character that represents the fourth syllable (等) was normally used for OJ /to/, but not for OJ /ⁿdo/.

Turning next to Old Japanese frozen noun + /ⁿga/ + noun phrases, (32) shows the only two phonographically attested examples we have found. Like the examples in (31), we found these in a systematic search of the Oxford-NINJAL Corpus of Old Japanese.

- (32) a. OJ /suⁿzu/ + /ⁿga/ + /ne/ → /suⁿzu+ⁿga+ne/
 'bell' GEN 'sound' 'tone of a bell'
 b. OJ /taⁿdu/ + /ⁿga/ + /ne/ → /taⁿdu+ⁿga+ne/
 'crane' GEN 'sound' 'cry of a crane'

The phonemic transcriptions in (32), like those in (31), clearly violate the proposed ban on prenasalisation in adjacent syllables, but here again there is room for doubt whether the transcriptions accurately reflect Old Japanese pronunciation. There is only one phonographic attestation of (32a), OJ /suⁿzu+ⁿga+ne/ (in *Man'yōshū*), and the phonograms 受 for OJ /ⁿzu/ and 我 for OJ /ⁿga/ are unambiguous. There are four phonographic attestations of (32b), OJ /taⁿdu+ⁿga+ne/. Three of them are from *Man'yōshū* and have unambiguous 我 (OJ /ⁿga/) for the genitive particle but unambiguous 頭 (OJ /tu/, not OJ /ⁿdu/) for the second syllable. In the fourth phonographic attestation (in *Kojiki*), the character 豆 for the second syllable was used sometimes for OJ /ⁿdu/ and sometimes for OJ /tu/, and the character 賀 for the genitive particle was used sometimes for OJ /ⁿga/ and sometimes for OJ /ka/.

We suggest that the phonogram spellings described in the preceding two paragraphs can be construed as evidence that dissimilation may have applied to Old Japanese inflectional forms and frozen phrases that would have violated our proposed constraint against prenasalisation in adjacent syllables. We can also surmise that such instances of dissimilation would have been especially susceptible to 'correction' by copyists working in later centuries, although we have no evidence to offer. (As noted in §3.4, there are undoubtedly transmission errors in the earliest extant manuscripts of Old Japanese texts, which are handwritten copies of handwritten copies.) It is quite possible, of course, that Old Japanese forms like those in (31) and (32) showed variability of the kind we saw in §5.2 for Shizukuishichō inflectional forms like (23b), [jō^mbū^mba] ~ [jō^mbū-ba]). That is, faced with the dilemma of avoiding prenasalisation in adjacent syllables but also avoiding allomorphy, Old Japanese speakers may have wavered, as in (33).

(33) OJ $\text{?} / \text{aswo}^{\text{m}} \text{be-}^{\text{n}} \text{domo} / \sim / \text{aswo}^{\text{m}} \text{be-tomo} /$ ‘play-CONCESSIVE’

Some of the phonogram spellings noted suggest that, in contrast to the Shizukuishi-chō dialect, even altering a root or stem may have been an option in Old Japanese, as in (34).

(34) OJ $\text{?} / \text{ta}^{\text{n}} \text{du} + ^{\text{n}} \text{ga} + \text{ne} / \sim / \text{ta}^{\text{n}} \text{du} + \text{ka} + \text{ne} / \sim / \text{tatu} + ^{\text{n}} \text{ga} + \text{ne} /$
 ‘cry of a crane’

We acknowledge that we are speculating here on the basis of very little evidence, but we would rather not simply stipulate that our proposed constraint against prenasalisation in adjacent syllables applied to compounds but not to inflectional forms and frozen phrases in Old Japanese. Inflectional forms like those in (31) and frozen phrases like those in (32) created a conflict between this phonetically motivated constraint and the equally natural desire to avoid allomorphy. The suggestion we have just outlined is that the hypothesised constraint was overridden in such circumstances, but perhaps only variably.

If we compare compounds in which *rendaku* would have violated the strong version of Lyman’s Law, the same conflict would not arise. As we noted in §4, *rendaku* in modern Tokyo Japanese can be treated as a subsegmental linking morpheme that joins the two elements of a compound. Diachronically, this linking morpheme is the descendant of the prehistoric Japanese genitive particle /no/, as explained in §3.3, and its Old Japanese counterpart was prenasalisation that docked onto the first segment in the second element of a compound, as in (35). The E2-initial syllables in the phonographically attested tokens of examples (35)–(37) are all represented by unambiguous phonograms (in the sense explained above in §4).

(35) OJ $/ \text{satwo} / + / \text{n} / + / \text{pito} / \rightarrow / \text{satwo} + ^{\text{m}} \text{bito} /$
 ‘village’ ‘person’ ‘village person’

The presence or absence of the Old Japanese linking morpheme was unpredictable, just as the presence or absence of its diachronic source (the genitive particle) was unpredictable in prehistoric Japanese (see §3.3). In an example like (36), the linking morpheme was absent.

(36) OJ $/ \text{mija} / + / \text{pito} / \rightarrow / \text{mija} + \text{pito} /$
 ‘palace’ ‘person’ ‘palace retainer’

In the examples in (37), *rendaku* would have resulted in prenasalisation in adjacent syllables, and we assume that the linking morpheme was predictably absent in such cases.

(37) a. OJ $/ \text{aki} / + / \text{ka}^{\text{n}} \text{ze} / \rightarrow / \text{aki} + \text{ka}^{\text{n}} \text{ze} /$ * $/ \text{aki} + ^{\text{n}} \text{ga}^{\text{n}} \text{ze} /$
 ‘autumn’ ‘wind’ ‘autumn wind’
 b. OJ $/ \text{u}^{\text{n}} \text{du} / + / \text{sipo} / \rightarrow / \text{u}^{\text{n}} \text{du} + \text{sipo} /$ * $/ \text{u}^{\text{n}} \text{du} + ^{\text{n}} \text{zipo} /$
 ‘whirlpool’ ‘tide’ ‘whirlpool tide’

Just as there is no exponent of the linking morpheme in (36), there is none in (37): (37a) has OJ /k/, not /^ŋg/, and (37b) has OJ /s/, not /^ŋz/. An Old Japanese speaker had no reason to infer underlying forms that contained a morpheme that never surfaced. Rendaku in the examples in (37) would have created both prenasalisation in adjacent syllables and E2 allomorphy; the actual forms had neither. The proposed constraint against prenasalisation in adjacent syllables affected Old Japanese compounds in the sense that it prevented an optional linking morpheme from occurring when its realisation would have produced a violation. Prehistorically, the constraint presumably prevented contraction of genitive Pre-OJ /no/ (see §3.3) from leading to the same undesirable outcome. If such a prehistoric noun + /no/ + noun phrase became conventional, speakers could have either maintained it uncontracted or replaced it with a compound involving the simple juxtaposition of the two nouns.

To summarise our discussion of the proposed prohibition against prenasalised voiced obstruents in adjacent syllables, we saw in §6.1 that compounds are consistent with this statement of the constraint. Specifically, the strong version of Lyman's Law in Old Japanese (§3.4) prevented rendaku in any compound in which a prenasalised voiced obstruent appeared in the syllable immediately preceding or immediately following a potential rendaku site. We have seen in this section, however, that there are inflectional forms of verbs and frozen phrases that presumably were phonological words and yet appear to have contained prenasalised voiced obstruents in adjacent syllables. We cited peculiarities of phonogram usage that cast doubt on whether such sequences were actually permissible, but this evidence is less than compelling. It could be that the strong version of Lyman's Law that we see in Old Japanese reflected a purely phonetic constraint that held in prehistoric Japanese, and that the original constraint had already begun to weaken by Old Japanese times.

7 Conclusion

This paper has looked at three kinds of evidence that support the claim that Lyman's Law originated as a constraint prohibiting prenasalisation in consecutive syllables. First, in §3 and §4, we considered phonetic motivation. Constraints on similar consonants in close proximity generally involve features with phonetic cues that are spread out over time. Prenasalisation is one such feature, and our account of Lyman's Law in Old Japanese is compatible with the results of cross-linguistic research on nasality and perceptual confusion. Second, in §5, we looked at Lyman's Law in some endangered dialects of modern Japanese that, unlike Tokyo 'standard' Japanese, still retain prenasalised voiced obstruents. The dialects we examined appear to prohibit these prenasalised consonants from occurring in adjacent syllables. Third, in §6.1, we looked carefully at the compounds recorded in phonograms in Old Japanese texts. None of the relevant examples conflicts with our interpretation of Lyman's Law in Old Japanese as a

constraint that applies to adjacent syllables. On the other hand, as we saw in §6.2, some inflectional forms and lexicalised phrases challenge the claim that this constraint held across the board without regard to morphological structure. Nonetheless, the phonogram spellings of the few phonographically attested examples contain enough oddities to cast doubt on whether these forms were truly counterexamples to our hypothesis.

Needless to say, this account of the strong version of Lyman's Law in Old Japanese does not explain how it morphed into the constraint that we find in modern Tokyo Japanese. Modern Lyman's Law applies not to words but to compound elements (morphemes in the case of native elements), and adjacency does not seem to be relevant (§2). Recent studies on the diachronic development of consonant co-occurrence constraints by Coetzee (2014) and Gallagher (2016) offer some tantalising hints, but we leave this problem for future research.

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