

## Two Types of Nasal in Okinawan

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**Abstract:** This paper claims that it is necessary to distinguish obstruent nasals from sonorant nasals in the phonology of Okinawan and Japanese; the former are underlyingly specified with [+nasal, –continuant] and the latter with [+nasal] only. Just as in the adjustment of C/h/ to *pp* in the two genetically related languages, it is necessary that the feature specification of an obstruent nasal should be adjusted by a phonotactic constraint on consonant clusters and acquire [+voice] when followed by a consonant with [+voice]. In Okinawan, there is a sharp contrast between obstruent nasals (/N/, /M/) and sonorant nasals (/n/, /m/) when they occur before suffix-initial /t/; the former trigger voicing assimilation and undergo some other rules, but the latter do not. In Japanese, recognizing obstruent nasals, /M/ and /N/, makes more natural the voicing change of suffix-initial /t/ to *d* after stem-final /M/ and /b/ in /yom+ta/ ‘read’ and /yob+ta/ ‘called’ and a subsequent change of both *m* and *b* to *n* before suffix-initial *d*, because these changes take place between the same type of segment, i.e., (voiced) non-continuants. In the proposed analysis of Japanese, whether the suffix-initial consonant undergoes voicing or deletion in post-consonantal position depends on the value of continuancy, [ $\pm$ continuant].\*

**Key words:** obstruent nasals, sonorant nasals, voicing, non-continuant, Okinawan

### 1. Introduction

This paper argues that two types of nasal need to be distinguished in the phonological systems of Okinawan and Japanese: obstruent nasals and sonorant nasals.<sup>1</sup> Obstruent nasals trigger voicing assimilation, undergo deletion, and are derived by a certain rule while sonorant nasals involve none of these changes. The constellation of these three properties indicates that there is a systematic difference between the two classes of nasals. Nasals are produced with a total blockage of the air stream through the center of the oral cavity, i.e., they are [–continuant], and involve spontaneous voicing as sonorants (cf. Rice 1993). The question is what distinguishes obstruent nasals from sonorant nasals. The feature [+voice] is the marked value for obstruent nasals while it is the unmarked value for sonorant

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<sup>1</sup> I owe the names “obstruent nasals” and “sonorant nasals” to one of the referees.

nasals. We will see that post-consonantal voicing involves the features [–continuant, +voice] in Okinawan and Japanese and that the two types of nasals differ in whether the feature [–continuant] is underlyingly specified or not.

To illustrate in Okinawan, the root-final obstruents /m/, /b/, and /n/ in (1a) trigger voicing assimilation, so that the suffix-initial non-continuant /t/ is voiced. Subsequently, the root-final obstruents in (1a) are deleted.

- |     |    |                |   |              |                       |
|-----|----|----------------|---|--------------|-----------------------|
| (1) | a. | /yum+ta+n/     | → | yu_+da+n     | ‘read+Past+Indic’     |
|     |    | /tub+ta+n/     | → | tu_+da+n     | ‘fly+Past+Indic’      |
|     |    | /sin+ta+n/     | → | ʃi_+dʒa+n    | ‘die+Past+Indic’      |
|     | b. | /yum+ran+ta+n/ | → | yum+_an+ta+n | ‘read+Neg+Past+Indic’ |
|     |    | /tub+ran+ta+n/ | → | tub+_an+ta+n | ‘fly+Neg+Past+Indic’  |
|     |    | /sin+ran+ta+n/ | → | sin+_an+ta+n | ‘die+Neg+Past+Indic’  |

In contrast, the final sonorant nasal /n/ of the Negative suffix /+ran/ in (1b) causes no such progressive voicing.

For the sake of convenience, we use  $C^f$  to represent a stem-final consonant and  $C^i$  to represent a suffix-initial consonant. As in (2),  $C^f$  also represents the final consonant of a suffix (e.g., Negative /+ran/, Indicative /+n/, etc.) and  $C^i$  the initial consonant of another following suffix (e.g., Indicative /+n/, Complementizer /+ndi/, etc.); ‘+’ is a morpheme boundary.

- (2)  $C^f+C^i$

We will discuss many phonological phenomena concerning  $C^f+C^i$  in Okinawan and Tokyo Japanese, and argue for a distinction between obstruent nasal and sonorant nasal.

## 2. Consonant Clusters in Okinawan

The Okinawan referred to here is a local language spoken in Shuri, which is located in the central part of the main island of Okinawa. This language is, in principle, more closely related to old versions of Japanese rather than to Modern Japanese; Miyara (2000, 2008) briefly gives the overall properties of lexico-semantics, phonology, morphology, and syntax in Okinawan which are independent of those of Japanese. Okinawan has the largest speaking population among the Ryukyuan language group, which constitutes the Japonic family together with the Japanese language (Serafim 2003, Miyara (forthcoming)). In what follows, we will argue for a distinction between nasals with distinctive [+voice] and those with non-distinctive [+voice] in Okinawan.

A brief sketch of phonemes in Okinawan is supplied in (3) below. There are six vowel phonemes in Okinawan.<sup>2</sup> The velar obstruents /k/ and /g/, as well as the

<sup>2</sup> Typologically speaking, Ryukyuan languages have a system of six vowel phonemes including the high central /i/. The Okinawan language is one of the Northern Ryukyuan languages, in which /i/ shows a regular correspondence to Japanese /e/. In Southern Ryukyuan languages, /i/ regularly corresponds to Japanese /i/.

coronal obstruents /t/, /d/, /s/, and /z/, undergo palatalization before the high non-back non-consonants /i/ and /y/ in Okinawan; cf. Miyara (1995) for details of the palatalization. The high central vowel /ɨ/ does not trigger palatalization. When the non-Past morpheme /yɨ/ is preceded by consonant-final verb stems, /y/ is deleted and /ɨ/ is realized as *u* (e.g., *kam+u+n* 'eat'; cf. (21d)); otherwise, it is realized as *i* (e.g., *tu+(y)i+n* 'take').<sup>3</sup> The nasals in (3) are the focus of this paper.

(3) Phonemic Inventory of Okinawan<sup>4</sup>

(p)	t	kw	k	ʔ
	b	gd	g	
	Φ	s		h
		z		
m	n			
	r			
		y	w	
		i	ɨ	u
		e	o	
		a		

Itô and Mester (1995) discuss three constraints on consonant clusters in

<sup>3</sup> For a detailed discussion of /ɨ/, see Miyara and Arakawa (1994) and Miyara (1996, 1997, 2000). Also see fn. 8 for related discussion.

<sup>4</sup> In Okinawan, as shown in (i), /w/ occurs before all vowel phonemes excluding /ɨ/. If [Φ] were analyzed as /hw/, it would be wrongly expected from the five possible occurrences of /w/ and vowels in (i) that /hwo/(=[Φo]) in (ii) should also be possible though in fact it is not.

(i) /wa/, /wi/, /wu/, /we/, /wo/

(ii) /hwa/(=[Φa]), /hwi/(=[Φi]), /hwu/(=[Φu]), /hwe/(=[Φe]), /hwo/(=[Φo])

(iii) /hwa/(=[Φa]), /hwi/(=[Φi]), /hwe/(=[Φe])

Since the appearance of *Okinawa-go Jiten* (Kokuritsu-Kokugo-Kenkyuujō 1963), the analysis of deriving [Φ] from two consecutive phonemes /h/ and /w/ in (iii) has been predominant, but this analysis invites the question of why /hwu/ is not allowed though /wu/ is possible in Okinawan. Japanese has undergone a diachronic change of *p* > Φ > *h* (Ueda 1898). In Ryukyuan languages, the original *p* still remains in the northern dialects of Okinawan (e.g., [pa:] 'leaf') and in languages spoken in Miyako and Yaeyama, while Φ remains in many southern dialects of Okinawan (e.g., [Φa:] 'leaf'). Hence, the present analysis based on the phoneme /Φ/ in (iv) can be related to the diachronic change of *p*.

(iv) /Φa/, /Φi/, /Φu/, /Φe/, \*/Φo/

Along the same line of reasoning, /kw/(or /k<sup>w</sup>/) in (v) and /gw/(or /g<sup>w</sup>/) in (vi) are each taken as independent phonemes rather than the combination of /k/ or /g/ and /w/.

(v) /kwa/, /kwi/, /kwe/, \*/kwu/, \*/kwo/

(vi) /gwa/, /gwi/, /gwe/, \*/gwu/, \*/gwo/

Japanese. Okinawan phonology shares two of the three constraints, i.e., (i) a constraint against single /p/ (only *pp* and *mp* are permitted) and (ii) one ruling out voiced obstruent geminates (*\*bb*, *\*dd*, *\*gg*, *\*zz*). In Japanese, (iii) Yamato morphemes or words obey a constraint ruling out nasal/voiceless obstruent clusters like *\*nt*, *\*mp*, *\*ŋk*. In Okinawan, however, post-nasal obstruents can be either voiceless or voiced, as in the following:

- (4) a. *ntʃa* 'soil', *ntʃu* 'three years', *ntʃun* 'to peel', *ŋkeeyun* 'to meet',  
*ŋkaʃi* 'the old days', *mpana* 'nose (honorific)'  
 b. *ndiyun* 'to get wet', *ʔmbusan* 'heavy', *ʔndʒasun* 'to take out',  
*ndʒasan* 'bitter', *ndʒasun* 'to polish', *ndʒi* 'a thorn', *nzo* 'sweetheart'

In this respect, the Okinawan Native morphemes in (4) are similar to Sino-Japanese and Foreign morphemes in Japanese. In sections 3 and 4, we will discuss post-obstruent voicing and a rule for deriving obstruent nasals from voiced obstruents pre-consonantly, and further examine the contrastive nature of obstruent nasals and sonorant nasals.

### 3. Obstruent Voicing and Deletion in Okinawan

In Okinawan, most verbs with vowel-final stems take the Past suffix *+ta*, but stem-final voiced obstruents, *C'*s, trigger progressive voicing of suffix-initial /t/ (*C'*). Let us suppose that in Okinawan the stem-final nasals in (5a) and (5c) are obstruent nasals, /M/ and /N/, with the distinctive feature [+voice]. Since the feature [+voice] in /M/ and /N/, as well as /b/ and /g/, in (5a) and (5c) causes progressive voicing of the immediately following /t/ (*C'*), the obstruent nasals /M/ and /N/ will constitute the natural class [-continuant, +voice] together with the voiced stops /b/ and /g/. Before this voicing rule takes place in (5b)–(5d), non-labial consonants like /k/, /s/, /g/, /n/, and /t/ as *C'* cause the insertion of *y* in the onset position of the Past suffix *+ta*. The resultant form *+tya* and the voiced form *+dya* both undergo palatalization.<sup>5</sup> Deletion of stem-final consonants takes place after the progressive voicing assimilation rule; the ordering relation between the two rules creates a counterbleeding opacity. ( \_ ) indicates the deletion site of *C'*.

- (5) a. /kam+ta+n/ → kam+da+n → ka\_+da+n 'eat+Past+Indic'  
 /tub+ta+n/ → tub+da+n → tu\_+da+n 'fly+Past+Indic'  
 b. /kak+ta+n/ → kak+tya+n → ka\_+tya+n → ka\_+tʃa+n 'write+Past+Indic'  
 /nas+ta+n/ → nas+tya+n → na\_+tya+n → na\_+tʃa+n 'bear+Past+Indic'  
 c. /nug+ta+n/ → nug+tya+n → nug+dya+n → nu\_+dya+n → nu\_+dʒa+n  
 'take off+Past+Indic'  
 /sin+ta+n/ → sin+tya+n → sin+dya+n → ʃi\_+dya+n → ʃi\_+dʒa+n  
 'die+Past+Indic'  
 d. /kat+ta+n/ → kat+tya+n → kat+tʃa+n → kat+tʃa+n 'win+Past+Indic'

<sup>5</sup> See Miyara (1995) for a detailed discussion of palatalization in Okinawan, where alveolar and velar obstruents are palatalized before /i/ and /y/.

In (5a), the suffix-initial /t/ in C<sup>i</sup> becomes *d* after voiced bilabial C's (i.e., /m/ and /b/). In (5b) and (5d), both *y*-epenthesis and palatalization derive +*f**a* after non-bilabial voiceless C's (i.e., /k/, /s/, and /t/). When, as in (5c), /+ta/ is preceded by non-labial voiced C's (i.e., /g/ and /N/), the successive application of *y*-epenthesis, voicing, and palatalization derives +*dʒa*.

All the root-final C's (i.e., /m/, /b/, /g/, and /N/ in (5) and (7)–(9) below) share the distinctive features [–continuant, +voice], of which [+voice] triggers voicing. This progressive voicing is represented as in (6):

(6) Non-Continuant Voicing

$$[-\text{cont}] \rightarrow [\alpha\text{voice}] / [+syll] \left[ \begin{array}{l} -\text{cont} \\ \alpha\text{voice} \end{array} \right] \text{ \_\_\_\_}$$

In the present analysis of /m/ and /N/ as obstruent nasals, obstruent nasals and voiced obstruents form the natural class [–continuant, +voice], and rule (6) applies to the latter of the two adjacent non-continuant only when the preceding one is voiced. In section 4, we will see that rule (6) is only applicable to a sequence of the two adjacent non-continuant, not CC<sup>f</sup>+C<sup>i</sup>; the feature [+syll] blocks the presence of three adjacent consonants.

In the derivations shown in (5), both the voiced-voiceless contrast of C's and the bilabial vs. non-bilabial contrast of C's are carried over to the Past tense suffix /+ta/, giving rise to allomorphic variation: +*ta* ~ +*da* ~ +*f**a* ~ +*dʒa*. In (5), it is stem-final voiced consonants of verb stems that trigger voicing and undergo deletion in front of the initial stop /t/ of Past tense /+ta/. Exactly the same processes apply with the infinitive suffix /+ti/ in (7), the Stative (Progressive) aspect suffix /+too/ in (8), and the Resultative suffix /+tee/ in (9); thus, the conditioning environment, suffix-initial /t/, is defined phonologically rather than morphologically. For a further discussion of these derivations, see Miyara (2000, 2007).

- (7) a. /kam+ti/ → kam+d̥i → ka\_<sub>-</sub>d̥i 'eat+Infv'  
 /tub+ti/ → tub+d̥i → tu\_<sub>-</sub>d̥i 'fly+ Infv'
- b. /kak+ti/ → kak+t̥y̥i → ka\_<sub>-</sub>t̥y̥i → ka\_<sub>-</sub>t̥ʃ̥i 'write+Infv'  
 /nas+ti/ → nas+t̥y̥i → na\_<sub>-</sub>t̥y̥i → na\_<sub>-</sub>t̥ʃ̥i 'bear+Infv'
- c. /nug+ti/ → nug+t̥y̥i → nug+d̥y̥i → nu\_<sub>-</sub>d̥y̥i → nu\_<sub>-</sub>d̥ʒ̥i 'take off+ Infv'  
 /sin+ti/ → sin+t̥y̥i → sin+d̥y̥i → ʃ̥i\_<sub>-</sub>d̥y̥i → ʃ̥i\_<sub>-</sub>d̥ʒ̥i 'die+Infv'
- d. /kat+ti/ → kat+t̥y̥i → kat+t̥ʃ̥i → kat+t̥ʃ̥i 'win+Infv'
- (8) a. /kam+too+n/ → kam+doo+n → ka\_<sub>-</sub>doo+n 'eat+Prog+Indic'  
 /tub+too+n/ → tub+doo+n → tu\_<sub>-</sub>doo+n 'fly+Prog+Indic'
- b. /kak+too+n/ → kak+tyoo+n → ka\_<sub>-</sub>tyoo+n → ka\_<sub>-</sub>tʃoo+n 'write+Prog+Indic'  
 /nas+too+n/ → nas+tyoo+n → na\_<sub>-</sub>tyoo+n → na\_<sub>-</sub>tʃoo+n 'bear+Prog+Indic'
- c. /nug+too+n/ → nug+tyoo+n → nug+dyoo+n → nu\_<sub>-</sub>dyoo+n → nu\_<sub>-</sub>dʒoo+n  
 'take off+Prog+Indic'  
 /sin+too+n/ → sin+tyoo+n → sin+dyoo+n → ʃ̥i\_<sub>-</sub>dyoo+n → ʃ̥i\_<sub>-</sub>dʒoo+n  
 'die+Prog+Indic'
- d. /kat+too+n/ → kat+tyoo+n → kat+tʃoo+n → kat+tʃoo+n 'win+Prog+Indic'

- (9) a. /kaM+tee+n/ → kaM+dee+n → ka\_+dee+n 'eat+Rslt+Indic'  
 /tub+tee+n/ → tub+dee+n → tu\_+dee+n 'fly+Rslt+Indic'
- b. /kak+tee+n/ → kak+tyee+n → ka\_+tyee+n → ka\_+fjee+n 'write+Rslt+Indic'  
 /nas+tee+n/ → nas+tyee+n → na\_+tyee+n → na\_+fjee+n 'bear+Rslt+Indic'
- c. /nug+tee+n/ → nug+tyee+n → nug+djee+n → nu\_+djee+n → nu\_+djee+n  
 'take off+Rslt+Indic'  
 /sin+tee+n/ → sin+tyee+n → sin+djee+n → si\_+djee+n → si\_+djee+n  
 'die+Rslt+Indic'
- d. /kat+tee+n/ → kat+tyee+n → kat+fjee+n → kat+fjee+n 'win+Rslt+Indic'

As indicated in (5d), (7d), (8d), and (9d), application of *y*-epenthesis, voicing, and palatalization does not involve deletion of  $C^f$  when  $C^f$  and  $C^i$  are both /t/.

All the root-final  $C^o$ s (i.e., /m/, /b/, /g/, and /N/ in (5) and (7)–(9)) that are not identical to the initial /t/ of the Past suffix /+ta/ end up being deleted. Such a deletion rule is represented as in the following:

- (10) Non-Identical Obstruent Deletion  
 [-son] →  $\varnothing$  / \_\_\_\_\_ + [-cont] (when  $C^f \neq C^i$ )

The two obstruents ( $C^f$ ,  $C^i$ ) involved in rule (10) must not be identical so that it does not apply to the sequence /t+t/ in (5d), (7d), (8d), and (9d). This non-identity condition comes from Itô's (1986) Coda Condition, which blocks obstruents from the coda unless they are geminate.<sup>6</sup> In (17d), we will see the application of rule (10) to the sequence /d+t/. Note that in Okinawan there are no stem-final sonorants such as /r/ and /w/; stem-final consonants are all obstruents, i.e., [-sonorant]. The stems which correspond to the Japanese verb roots /kar/ 'reap' and /kaw/ 'buy' are /ka/ and /koo/ respectively in Okinawan.

Stem-final consonant deletion is also observed in cases of adjective stems. In Okinawan, adjective stems end with either /s/ or /sy/<sup>7</sup> and have to be followed by the auxiliary verb /a/ 'be'; this then takes tense suffixes (e.g., Past /+ta/) and mood suffixes (e.g., Indicative /+n/). Two Past-tense forms are illustrated in (11).

<sup>6</sup> I thank one of the readers for the idea that the non-identity condition should be related to Itô's (1986) Coda Condition.

<sup>7</sup> See Miyara (2007) for a discussion of different derivations of stem-final /s/ and /sy/. Adjectives with stem-final /sy/ are characterized by the appearance of *s* in (i) or *fi* in (ii). As illustrated in (ii), stem-final sonorant /y/ blocks the application of Non-Identical Obstruent Deletion in (12) so that it becomes the vowel *i* in pre-consonantal position, yielding the output *fi* by palatalization. (i) illustrates the strong tendency that /s/ in the sequences /sy+/ and /s+y/ in Okinawan fails to undergo palatalization and is realized as a simple *s*.

- (i) yaasy+a+ta+n → (\*yaaʃatan) yaasatan 'hungry+be+Past+Indic'  
 ik+i+busy+a+ta+n → (\*iʃibuʃatan) iʃibusatan 'was eager to go'
- (ii) yaasy+ku-ya neen → yaaʃikoo neen 'is not hungry'  
 ik+i+busy+ku-ya neen → iʃibuʃikoo neen 'is not eager to go'

- (11) a. takas+a+ta +n ‘was high’  
 high+be+Past+Indic  
 b. magis+a+ta +n ‘was big’  
 big+be+Past+Indic

Just as the final consonants of verb stems in (5) and (7)–(9) are deleted before the stop /t/, the final obstruent /s/ of adjective stems is deleted when followed by the initial stop /k/ of the adverbial-forming suffix /+ku/ in (12). This is because the two neighboring consonants are not identical.

- (12) a. takas+ku-ya neen → taka\_+ko-o neen ‘is not high’  
 high+adv-Cntr be-not  
 b. magis+ku-ya neen → magi\_+ko-o neen ‘is not big’  
 big+adv-Cntr be-not

In the word-final position, deletion of the initial /y/ of the contrastive particle /ya/ derives the diphthong *u-a*, which undergoes a further change of vowel coalescence, yielding *o-o*.

In the formation of compounds with the noun *kkwa* ‘child’, the initial consonant cluster /kkw/ of the second member *kkwa* is voiced by so-called *rendaku*-voicing (Itô and Mester 1986), yielding the voiced output *ggw*.<sup>8</sup> ‘#’ indicates compounding from (13) on.

- (13) a. /wikiga#kkwa/ → wikiga#ŋgwa ‘male#child (boy)’  
 b. /winagu#kkwa/ → winagu#ŋgwa ‘female#child (girl)’  
 c. /tyui#kkwa/ → tʃui#ŋgwa ‘an only child’

As was explored in McCawley (1968: 96–97, 125), any voiced consonant in Japanese Native morphemes must be a nasal in pre-consonantal position.

<sup>8</sup> In compound nouns, the initial /kw/ of the second member (/kwii/ ‘voice’, /kwii+i/ ‘crossing’, and /kwee+i/ ‘growing fat’—in the examples below) is voiced by *Rendaku* and changed into *gʷ*.

- (i) /atta # kwii/ → atta # gwii ‘a sudden voice, a scream’  
 /magis # kwii/ → magi # gwii ‘a big voice’  
 /abi+i # kwii/ → abi+i # gwii ‘a shouting voice’  
 (ii) /dan # kwii+i soo # kwii+i/ → dan # gwii soo # gwii ‘crossing over the rank’  
 (iii) /maas+a # kwee+i/ → maas+a # gwee+i ‘plump as a partridge’  
 /Φuri+i # kwee+i/ → Φuri # gwee+i ‘foolish obesity’

When, as in /kwii/ ‘to cross, go over’ in (ii) and /Φuri/ ‘to go crazy’ in (iii), verb stems ending with the central high vowel /i/ are nominalized, the nominalizer /+i/ is not realized. In contrast, as shown in the change from /abi+i/ ‘shout+Nominalizer’ to *abi+i* ‘shouting’ in (i), the nominalizer /+i/ is realized when preceded by stems ending with the front high vowel /i/. This is one of the reasons that /i/ and /ɨ/ are distinctive in Okinawan. Note that, as in *tabe # aruk+i* ‘trying out the food at restaurants’ and *taff+i # mi* ‘watching it standing’, the nominalizer /+i/ is not realized in Japanese when preceded by verb stems ending with front vowels.

Some relevant examples are seen in Yamato words such as *manziri* ‘without any sleep’, *nombiri* ‘leisurely’, *honnori* ‘with a faint streak of light’, *yanwari* ‘gently’, *bonyari* ‘dimly’ (cf. Kuroda 1965 (1979)) or *tombo* ‘dragonfly’, *ṣindoi* ‘tired’, and *kaygae* ‘thought’ (cf. Itô and Mester 1986: 69). A constraint ruling out the voiced obstruent geminate *ggw* (Itô and Mester 1995) motivates a rule stating that the first half of a voiced geminate becomes a homorganic nasal, as represented in (14) (cf. Archangeli and Pulleyblank 1994 and Paradis 1988 for an approach where constraints trigger rules):

(14) Voiced Consonant Cluster Nasalization

$$\left[ \begin{array}{c} \text{-cont} \\ \text{+voice} \end{array} \right] \rightarrow [+nasal] / \text{ \_\_\_\_ } \left[ \begin{array}{c} \text{-syll} \\ \text{+voice} \end{array} \right]$$

When the nasal *ŋ* is derived from the voiced variant *g* of the obstruent /k/ in the second member (*ŋgwa*) of the compounds in (13), it must be an obstruent nasal. In rule (6), the obstruent nasals /M/ and /N/ are the triggers of voicing, while rule (14) is a case of deriving an obstruent nasal. In section 5.1, we will see another case of rule (14) being applied (cf. (24c) and (24c’)), after the application of Non-Continuant Voicing (25).

#### 4. Sonorant Nasals in Okinawan

We have seen that stem-final *C'*, such as /M/ or /N/ in the *a*-examples of (5) and (7)–(9), triggers a voicing rule (6), so that the suffix-initial non-continuant /t/ is voiced under the influence of the preceding voiced nasal stop /M/ or /N/. In Okinawan, however, there is a type of nasal that does not trigger such voicing.

In (15b) below, the final sonorant /n/ (*C'*) of the Negative suffix /ran/ does not trigger any voicing though it is adjacent to /t/. The ill-formedness of (15c) suggests the unfeasibility of voicing by the nasal /n/. Note that in (15b), the suffix-final sonorant /n/ does not undergo Non-Identical Obstruent Deletion (10) either.

- (15) a. /yum+ta+n/ → yum+da+n (→ yu\_+da+n) ‘read+Past+Indic(ative)’  
       /sin+ta+n/ → sin+da+n (→ ṣi\_+ dʒa+n) ‘die+Past+Indic’  
       b. /yum+ran+ta+n/ → yum+\_an+ta+n ‘read+Neg+Past+Indic’  
       c. /yum+ran+ta+n/ → \*yum+\_an+da+n ‘read+Neg+Past+Indic’  
       d. /yum+ran+ta+n/ → \*yum+ran+ta+n ‘read+Neg+Past+Indic’

The ill-formedness of (15d) suggests that the suffix-initial sonorant /r/ must undergo deletion. Such deletion will be discussed later in this section.

Since the inauguration of generative phonology, the redundancy of voicing for sonorants was acknowledged and the feature [+voice] was omitted from the underlying representations of these segments (cf. Chomsky and Halle 1968; McCawley 1968, 88–93). In Itô and Mester’s (1986) analysis, the redundant feature [+voice] for sonorants is taken to be underspecified and filled in by post-cyclic default rules. In Okinawan and Japanese, it is necessary to distinguish obstruent nasals, like /M/ and /N/, from the sonorant nasal /n/ in the underlying representation. Otherwise,



the treatment of voicing redundancy for sonorants in McCawley (1968) and Itô and Mester (1986) cannot provide a principled account for why the distinctive [+voice] in the obstruent nasal /m/ or /n/ triggers voicing assimilation by rule (6) and undergoes deletion by rule (10) in Okinawan though the redundant [+voice] in the sonorant nasal /n/ does not.

In Okinawan, the noun *tʃu* ‘a human being’ has the cognate suffix *+nʃu* ‘a person from ~’, which attaches to nouns denoting places to form the nouns in (16):

- |      |             |                         |               |                       |
|------|-------------|-------------------------|---------------|-----------------------|
| (16) | umi+nʃu     | ‘a fisherman’           | agi+nʃu       | ‘a landman’           |
|      | ʃui+nʃu     | ‘a person from Shuri’   | NaaΦa+nʃu     | ‘a person from Naha’  |
|      | Tookyoo+nʃu | ‘a person from Tokyo’   | Oosaka+nʃu    | ‘a person from Osaka’ |
|      | Hawai+nʃu   | ‘a person from Hawai’i’ | NyuuYooku+nʃu | ‘a New Yorker’        |

The initial nasal of the suffix *+nʃu* in (16) must be a sonorant nasal, which circumvents voicing of the following obstruent *ʃ* by Non-Continuant Voicing (6).

There is a group of verb stems ending with the consonant cluster /nd/ in Okinawan. In (17), the final obstruent /d/ is palatalized, yielding *ɟʃ*, when followed by the initial /y/ of the non-Past form /+yɨ/ in (a) or by the nominalizer /+i/ in (b). However, stem-final /d/ in (d) does not trigger Non-Continuant Voicing (6) though followed by another non-continuant, i.e., /t/, leaving the form *+ta* unaffected, but allows the application of Non-Identical Obstruent Deletion (10), which derives the shortened form of *kan\_* from /kand/ before the suffix /+ta/. The non-applicability of Non-Continuant Voicing (6) is due to the presence of the nasal /n/, which constitutes a cluster of three consonants, /nd+t/.

- |      |         |                  |   |           |                     |
|------|---------|------------------|---|-----------|---------------------|
| (17) | /kand/: | a. /kand+yɨ+n/   | → | kandʃ+u+n | ‘put on (non-Past)’ |
|      |         | b. /kand+i/      | → | kandʃ+i   | ‘putting on’        |
|      |         | c. /kand+ran/    | → | kand+_an  | ‘do not put on’     |
|      |         | d. /kand+ta+n/ / | → | kan_+ta+n | ‘put on (Past)’     |
|      | /nind/: | a. /nind+yɨ+n/   | → | nindʃ+u+n | ‘sleep (non-Past)’  |
|      |         | b. /nind+i/      | → | nindʃ+i   | ‘sleeping’          |
|      |         | c. /nind+ran/    | → | nind+_an  | ‘do not sleep’      |
|      |         | d. /nind+ta+n/   | → | nin_+ta+n | ‘slept’             |
|      | /yand/: | a. /yand+yɨ+n/   | → | yandʃ+u+n | ‘tear’              |
|      |         | b. /yand+i/      | → | yandʃ+i   | ‘tearing’           |
|      |         | c. /yand+ran/    | → | yand+_an  | ‘do not tear’       |
|      |         | d. /yand+ta+n/   | → | yan_+ta+n | ‘tore’              |

In derived forms, such as *kan+ta+n* ‘put on (Past)’, *nin+ta+n* ‘slept’, and *yan+ta+n* ‘tore’, the pre-consonantal nasal which eventually occupies the stem-final position does not voice the suffix-initial non-continuant *t* immediately following. If it were an obstruent nasal, the condition for the application of Non-Continuant Voicing (6) would be satisfied. The non-applicability of this voicing rule (6) suggests that the pre-consonantal nasal /n/ in the verb stems /kand/, /nind/, and /yand/ in (17) must be a sonorant nasal. Incidentally, the deletion of the suffix-initial continuant /r/ in (c) involves the application of Sonorant Deletion (22), which

is to be discussed later in this section.

The pre-obstruent nasals boldfaced in the second member of each compound in (18) do not block *Rendaku*-voicing. Given the assumption that only [+voice] associated with obstruents blocks *Rendaku*, they must be sonorant nasals.

- (18) a. /kuti # kansui/ → kuf***ʃ***i#gansui ‘razor-sharp tongue’  
 mouth razor  
 b. /aka # kantaa/ → aka#gantaa ‘a girl with red short bob’  
 red bobbed hair  
 c. /wungi # kans+i/ → wund***ʒ***i#gan***ʃ***i ‘indebtedness to someone’  
 favor wearing

See fn. 8 for a discussion of the derivation of /i+i/ in (18c), where the stem-final /i/ is followed by the nominalizer /+i/.

As illustrated by pairs like [ya:] ‘a house’ vs. [ʔya:] ‘you’, [wa:] ‘I’ vs. [ʔwa:] ‘a pig’, and [nni] ‘the chest’ vs. [ʔnni] ‘a rice plant’, the glottal stop [ʔ] is distinctive pre-consonantly in Okinawan.<sup>9</sup> Interestingly, in word-initial position, pre-glottalized nasals are always followed by voiced consonants in Okinawan so that they must all be obstruent nasals, as shown in (19):

- (19) Obstruent Nasals  
 ʔmbusan ‘heavy’, ʔmbusun ‘to steam’, ʔmma ‘a horse’, ʔmmaga ‘a grand-child’,  
 ʔmmariyun ‘to be born’, ʔmmu ‘a sweet potato’, ʔnna***ʒ***i ‘an eel’,  
 ʔn***ʒ***asun ‘to take out’, ʔn***ʒ***išana ‘the very start’, ʔn***ʒ***iʃun ‘to move’

On the other hand, except in cases where voicing is involved as in (5), (7)–(9), and (13) and where [+voice] is underlyingly specified as in (19), nasals immediately preceding voiceless obstruents must be sonorant nasals, as in (20a), and those immediately preceding either voiced obstruents or another nasal must also be sonorants, as in (20b).

- (20) Sonorant Nasals  
 a. nsu ‘soybean paste’, nʃa ‘soil’, nʃu ‘three years’, nʃun ‘to peel’, ŋkeeyun ‘to meet’, ŋkaʃi ‘the old days’, mpana ‘nose (honorific)’  
 b. ndiyun ‘to get wet’, nndʒun ‘to see’, mba ‘no’, ndʒariyun ‘to get entangled’, ndʒasan ‘bitter’, nnu ‘a straw raincoat’, nna ‘empty’, nzoosan ‘lovely’

Just as in the case of the verb stems like /kand/, /nind/, and /yand/ in (17), pre-consonantal nasals in (20b) must be sonorant nasals, which themselves have no

<sup>9</sup> In Okinawan, the occurrence of the glottal stop [ʔ] is predictable word-initially when words start with vowels, while it is distinctive before /y/, /w/, /m/, and /n/. However, the present analysis of two types of nasal eliminates the contrast between [mba] ‘no’ and [ʔmba] ‘a sheet of dried soybean casein’ and the contrast between [nni] ‘the chest’ and [ʔnni] ‘a rice plant’, where the former starts with the sonorant nasal /n/ and the latter with the obstruent nasal /N/. Hence, the occurrence of the glottal stop [ʔ] is predictable in the environments; #\_V, #\_M/, and #\_N/.

voicing effect.

Although, in Okinawan, the suffix-initial non-continuant /t/ undergoes the voicing rule (6), the suffix-initial sonorants /r/, /m/, /n/, and /y/ undergo deletion, as shown in (21):

- (21) a. /kam+ran+mi/ → kam+\_an+\_i 'eat+Neg+yes-no Interrogative'  
 b. /kak+ran+n/ → kak+\_an+\_ 'write+Neg+Indic'  
 c. /kak+ran+n+ndi/ → kak+\_an+\_+\_di 'write+Neg+Indic+Complementizer'  
 d. /kam+yi+n/ → kam+\_i+n → kam+\_u+n 'eat+non-Past+Indic'

The derivation involving deletion of suffix-initial sonorants, /r/ and /n/, in (21b) provides an account for why the Indicative /+n/ does not surface in the negative form *kak+an* 'do not write'. (21c) illustrates both the application of deletion of suffix-initial /r/ and the double application of deletion of suffix-initial /n/. In (21d), deletion of the suffix-initial sonorant /y/ induces a change of the central high vowel phoneme /i/, which becomes [u] when preceded by a stem-final consonant, and [i] elsewhere.

In Okinawan, there are no suffixes starting with the fricative /s/.<sup>10</sup> As a result, suffix-initial consonants, like /r/, /m/, /n/, and /y/, are all sonorants, which are deleted when preceded by morpheme-final consonants, as shown below.

## (22) Sonorant Deletion

$$\begin{pmatrix} \text{-syll} \\ \text{+son} \end{pmatrix} \rightarrow \varphi \quad / \quad \text{[-syll]} + \text{\_\_\_\_}$$

Under the present analysis of two types of nasal, rule (22) does not apply to obstruent nasals, but to sonorant nasals like /m/ and /n/. Owing to the presence of a morpheme boundary (+), rule (22) does not apply to /nn/ in (20b) either.

Whether the voicing assimilation rule (6) or the deletion rule (22) applies depends on the suffix-initial consonant, i.e., on whether it is a non-continuant or a sonorant. The analysis proposed captures the mutual exclusiveness with respect to the application of the two rules and to the two types of C<sup>2</sup>s affected. We will see the same generalization made in rules (6) and (22) applicable to the genetically related language, Japanese.

## 5. Voicing and Deletion in Japanese

In the verb conjugations of Tokyo Japanese, both voiced stops and obstruent nasals as C<sup>1</sup> trigger voicing. On the other hand, sonorants as C<sup>i</sup> undergo gemination when followed by the stop /t/. In section 5.1, we will discuss such phonological behavior of C<sup>1</sup> when followed by the stop /t/. In section 5.2, deletion of suffix-initial continuants that occur post-consonantly as C<sup>2</sup>s will be discussed.

<sup>10</sup>In Okinawan, the causative morpheme is of the form /+ras/ (cf. Miyara 2000), which is equivalent to the Old Japanese causative /+ras/.

### 5.1. Obstruent Voicing in Japanese

In Japanese, the non-nasal sonorants /r/ and /w/ (as  $C'$ ) do not trigger progressive voicing assimilation to the following /t/ ( $C^i$ ), but assimilate totally to the following /t/ in a regressive manner.<sup>11</sup>

- (23) /kar+ta/ → kat+ta 'reap+Past'  
 /kaw+ta/ → kat+ta 'buy+Past'

Itô and Mester (1986) attributes the failure of voicing in (23) to the redundancy of the [+voice] feature for sonorants. That is, the feature [+voice] for sonorants is taken to be underspecified, i.e., not present in the underlying representation, and is assigned by post-cyclic default rules.

On the other hand, [+voice] must be underlyingly specified for voiced stops like /b/ and /g/. We have already seen cases in which  $C'$ 's in (1a), (5), and (7)–(9) function as triggers to voice the  $C^i$  /t/. If the Japanese stem-final nasals in (24a) and (24b) are taken to be the obstruent nasals /M/ and /N/, the distinctive feature [+voice] in /M/ and /N/ causes progressive voicing of the immediately following /t/.

- (24) a. /yom+ta/ → yom+da → yon+da → yonda 'read+Past'  
 b. /sin+ta/ → sin+da → jinda 'die+Past'  
 c. /yob+ta/ → yob+da → yom+da → yon+da → yonda 'call+Past'  
 c'. /yob+ta/ → yob+da → yod+da → yon+da → yonda 'call+Past'  
 d. /kag+ta/ → kag+da → kagi+da → kai+da → kaida 'smell+Past'

In (24), one of the two neighboring non-continuants,  $C'$ , causes the other ( $C^i$ ) to progressively assimilate in voicing, as represented in (25) (which is essentially the same as (6)):

<sup>11</sup>There are cases in which this type of total assimilation process takes place in a Miyako Ryukyuan spoken in Irabu (cf. Shimoji 2009). In this language, the Present tense form of the copula has two variants, *a+m* 'is (realis)' and *a+r* 'is (unmarked)', depending on which mood is expressed, so the Past tense forms result in *a+ta+m* 'was (past, realis)' and *a+ta+r* 'was (past, unmarked)'. When, as in (i), the Past suffix /+ta/ is associated with the Negative morpheme /+ran/, the suffix-final /n/ completely agrees with the following /t/.

- (i) /a+ran+ta+r/ → a+rat+ta+r 'was not'  
 COP+NEG+PST+MD

Likewise, in this language, the negative existential form is *nyaan*, whose final /n/ becomes the same as the following /t/ in (ii).

- (ii) /nyaan+ta+r/ → nyaat+ta+r 'There was not ...'  
 NEG.EXS+PST+MD

If the morphological analysis shown above is correct, the final consonant /n/ of the Negative and the negative existential in the Irabu language turns out to be a sonorant nasal. For a different analysis of (i) and (ii), see Shimoji (2009).

## (25) Non-Continuant Voicing

$$[-\text{cont}] \rightarrow [\alpha\text{voi}] / \left[ \begin{array}{c} -\text{cont} \\ \alpha\text{voi} \end{array} \right] \text{ \_\_\_\_\_\_ }$$

In (24), /m/, /n/, /b/, and /g/ in stem-final position form the natural class [-continuant, +voiced] (voiced stops) and all trigger the voicing of the suffix-initial /t/. In (24c), the subsequent change of *b+d* to *M+d* (or *d+d* to *N+d* in (24c'), cf. McCawley 1968: 96–97, 125) is handled by Voiced Consonant Cluster Voicing (14).<sup>12</sup>

Voicing assimilation applies only to the non-continuant /t/, and not to obstruents in general in Japanese. As shown in (26), such voicing does not apply to another obstruent, /s/.

- (26) a. /yom+sase+ta/ → \*yom+zase+ta 'read+Caus+Past'  
 b. /sin+sase+ta/ → \*sin+zase+ta 'die+Caus+Past'  
 c. /yob+sase+ta/ → \*yob+zase+ta 'call+Caus+Past'  
 d. /kag+sase+ta/ → \*kag+zase+ta 'smell+Caus+Past'

The non-convergent derivations in (26) could be avoided by ordering rules so that deletion of the continuant /s/ takes place before voicing, but we will not pursue this possibility here.

Rice (1993) proposed two types of voicing: a laryngeal type of voice ([voice]) and spontaneous voice (SV). Based on the SV analysis, she proposes that not only sonorants, but also “sonorant obstruents” in Japanese, are specified by SV. What she calls sonorant obstruents are the stem-final /b/ and /g/ that trigger voicing in

<sup>12</sup>One of the referees raised the question of how the group of verbs in (i) should be treated. They are taken here as vowel-final stems; /sinzi/, /ronzi/, /kinzi/, and so forth. On the other hand, those in (ii) must be suppletive forms, because they only have the non-Past form and disallow other inflectional endings (e.g., \*meiz+anai, \*meiz+are+ru, \*meiz+ase+ru, etc.). The original forms must be represented as in (iii) and their adnominal forms would be the same as in (ii).

- |       |                                |                             |                     |                |
|-------|--------------------------------|-----------------------------|---------------------|----------------|
| (i)   | sinzi+ru 'believe'             | ronzi+ru 'argue'            | kinzi+ru 'prohibit' | enzi+ru 'play' |
|       | anzi+ru 'worry'                | kanzi+ru 'feei'             | meizi+ru 'order'    |                |
| (ii)  | sinzuru 'believe'              | ronzuru 'argue'             | kinzuru 'prohibit'  | enzuru 'play'  |
|       | anzuru 'worry'                 | kanzuru 'feei'              | meizuru 'order'     |                |
| (iii) | sinz+u (←/sinz+ru/) 'believe'  | ronz+u (←/ronz+ru/) 'argue' |                     |                |
|       | kinz+u (←/kinz+ru/) 'prohibit' | enz+u (←/sinz+ru/) 'play'   |                     |                |
|       | anz+u (←/sinz+ru/) 'worry'     | kanz+u (←/sinz+ru/) 'feei'  |                     |                |
|       | meiz+u (←/sinz+ru/) 'order'    |                             |                     |                |

The forms in (i) are not taken as cases in which Sino-Japanese morphemes, such as /sin/ (信), /ron/ (論), /kin/ (禁), /an/ (案), /kan/ (感), and /mei/ (命), are immediately followed by the verb-stem /s/. If the morpheme-final nasal /n/ is a sonorant, it will not voice the following /s/ since the condition of Non-Continuant Voicing in (25) is not satisfied. Generally, the verb stem /s/ never undergoes Rendaku-voicing, as in *ie#de suru* 'run away', *boo+kan suru* 'stand by and watch', and *sin+rai suru* 'trust'. Hence, there is no good reason for voicing the verb stem /s/.

(24c) and (24d) and the voiced obstruent *d* (*C*<sup>i</sup> in (24a–d)) that received voicing from the stem-final nasal sonorants *m* and *n*. On the other hand, *Rendaku* involves [+voice]. In (27b), the feature [+voice] in the boldfaced voiced obstruent *z* appearing in the second morpheme of the compound serves to block *Rendaku*, while the presence of the sonorant *m* specified with SV in (27a) does not (cf. Itô and Mester (1986) for a detailed discussion of *Rendaku*-blocking).

- (27) a. /nyuudoo#kumo/ → nyuudoo#**g**umo ‘cumulonimbus’  
 b. /kita#kaze/ → kita#**k**aze ‘a north(erly) wind’  
                   → \*kita#**g**aze

The SV approach is based on the assumption that nasals do not show voicing contrasts when followed by obstruents. However, in fact they do in Okinawan, falsifying the prediction of the SV approach. That is, post-nasal voicing is expected only with obstruent nasals, but it does not take place with sonorant nasals in (15b), (16), (17d), and (20a).

The theory of markedness suggests that [+voice] is marked for obstruents while it is unmarked for sonorants (Rice 1993: 312). In the analysis proposed here, in (27), /m/ in the noun /kumo/ ‘a cloud’ must be a sonorant nasal, because this nasal does not block the application of *Rendaku*. The obstruent nasals in (24a) and (24b) are non-continuants with the feature [+voice], which serves as the trigger for voicing.

According to Rice’s analysis, the post-nasal voicing which has applied in the *nd* in (24a)–(24c) involves SV; (24c’) is repeated here as (28a) and a related Okinawan example (5a) as (28b). On the other hand, in the case of the Okinawan compound in (13a), repeated here as (28c), the *Rendaku*-voicing of /#kkw/ to #ŋgw involves the specification [+voice].

- (28) a. /yob+ta/ → yob+da → yod+da → yon+da → yonda ‘call+Past’  
 b. /tub+ta+n/ → tub+da+n → tu\_+da+n ‘fly+Past+Indic’  
 c. /wikiga#kkwa/ → wikiga#ggwa  
                   → wikiga#ŋgwa ‘male#child (boy)’

The two types of post-nasal voicing derived from voiced obstruent clusters in (28a) and (28c) are treated differently in spite of the fact that they both involve the voicing of voiceless obstruents and the derivation of homorganic nasals from a sequence of voiced obstruents. Technically there is no problem in Rice’s analysis, but it seems to miss an important generalization from the standpoint of economy.

Although, in the examples above, the distribution of obstruent nasals is limited to the final position of verb stems in Japanese, some Yamato morphemes like /yon/ ‘four’ in (29) allow the presence of a sonorant nasal /n/ in final position. This morpheme can be taken as a hybrid of the Yamato morpheme /yo/ ‘four’ and the morpheme-final /n/, when the final /n/ is treated as one of the characteristics of the phonological shape of Sino-Japanese morphemes. There is no post-nasal voicing in (29):

- (29) /yon/:   yoŋ+kai ‘the fourth floor’  
               yoŋ+ken ‘four houses’  
               yon+too ‘four heads’  
               yon+hai ‘four cups’

The numeral /yo/ is used in such Yamato words as *yo+mo* ‘all directions’ and *yo-sumi* ‘four corners’ and also in a larger Sino-Japanese word *yo-jigen* ‘four dimensions’, while /yon/ is mostly accompanied by Sino-Japanese morphemes.

Likewise, the final consonants of Sino-Japanese morphemes, like /han/ (反), /kan/ (関), and /sin/ (心), will be sonorant nasals, because they never trigger voicing assimilation in following non-continuants, as in (30):

- (30) a. han+tai ‘opposition’   ham+puku ‘repetition’  
           haŋ+koo ‘resistance’   han+sei ‘reflection’  
       b. kan+setsu ‘joint’   kaŋ+kei ‘relation’  
       c. jim+pai ‘anxiety’   ʃiŋ+ki ‘feeling’

On the other hand, as the second member of Sino-Japanese words, some other Sino-Japanese morphemes allow alternations between voiced consonants and voiceless counterparts in morpheme-initial position. The Sino-Japanese morpheme /koku/ ‘country’ in (31a) allows both the voiced version, i.e., *goku*,<sup>13</sup> and the voiceless counterpart in (31b). The same is true when the Sino-Japanese morpheme /nan/ ‘south’ in (31a) is combined with other morphemes. In (31c), *zan* and *boku* are the voiced versions of /san/ ‘mountain’ and /hoku/ ‘north’ respectively. In (31d), /kai/ ‘sea’, /hoo/ ‘direction’, /kyoku/ ‘pole’, and /to/ ‘city’ are not affected.

- (31) a. naŋ+goku ‘the southern country’   teŋ+goku ‘heaven’  
           riŋ+goku ‘neighboring countries’   hoŋ+goku ‘one’s home country’  
       b. zen+koku ‘all over the country’   min+koku ‘the people’s country’  
       c. nan+zan ‘southern mountains’   nam+boku ‘the south and the north’  
       d. naŋ+kai ‘southern sea’   nam+poo ‘southerly direction’  
           naŋ+kyoku ‘the South Pole’   nan+to ‘southern city’

Considering that Sino-Japanese morphemes or words do not undergo *Rendaku* in principle (Itô and Mester 1986), the proper underlying representation should be /nan/ rather than /nan/. Voicing alternations of this kind as the second member of a Sino-Japanese word will then be taken to be morphologically conditioned.<sup>14</sup>

Along the same line of reasoning, the Sino-Japanese numeral in (32) will be underlyingly /san/ ‘three’. Just as sonorant nasals in Okinawan allow the occurrence of both voiced obstruents and voiceless obstruents in post-nasal position in (20), the sonorant nasal in /san/ allows the voiced obstruent *b* in (32a) and the

<sup>13</sup>I owe some of the examples in (31a) to one of the referees.

<sup>14</sup>Note that, as in *kita#guni* ‘the northern country’, *Rendaku* applies to the Yamato morpheme /kuni/ ‘a country’. Since this type of voicing is restricted to Yamato morphemes, it should not apply to the Sino-Japanese morpheme /koku/ ‘a country’ in (31b). However, it appears to apply to the same morpheme in (31a).

voiced obstruent *g* in (32b), but disallows voiced obstruents in (32c).

- (32) a. san+bon 'three pieces'  
       san+byaku 'three hundred'  
       san+bai 'three cups'  
       b. saŋ+gai ~ saŋ+kai 'the third floor'  
       saŋ+gen ~ saŋ+ken 'three houses'  
       c. saŋ+ken ~ \*saŋ+gen 'three matters'  
       san+too ~ \*san+doo 'three heads'

In (32a), classifiers like /hon/ 'piece', /hyaku/ 'hundred', and /hai/ 'cup' become *bon*, *byaku*, and *bai* respectively. In (32c), the voiced versions of /ken/ 'matter' and /too/ 'head' are disallowed. The numeral /san/ allows free variation in the case of such classifiers as /kai/ 'floor' and /ken/ 'house' in (32b). For a related discussion of post-nasal voicing in Japanese, see Itô, Mester, and Padgett (1995) and Itô and Mester (2003).

Japanese has sonorant nasal/voiceless obstruent clusters as are seen in (29), (30), and (31d). In principle, selection of the voiced versions as the second member of many Sino-Japanese words is morphologically conditioned.

## 5.2. Continuant Consonant Deletion in Japanese

As was illustrated in (23), continuants like /r/ and /w/ in  $C^f$  are totally assimilated to non-continuant /t/ as  $C^i$ . Such continuants exclude /s/ and thus must be sonorants, while, as in the derivation of *kafi+ta* from /kas+ta/ 'lent', the stem-final non-sonorant /s/ induces insertion of the vowel *i*. In (24), the non-continuant /t/ as  $C^i$  undergoes voicing post-consonantly. In contrast, continuants like /s/, /r/, and /y/ as  $C^i$  undergo deletion post-consonantly in Japanese.

All the suffix-initial continuants ( $C^i$ 's) in (33) and (34) undergo deletion in post-consonantal position; ( \_ ) indicates the deletion site of  $C^i$ .

- (33) a. /yom+yoo/ → yom+\_oo 'read+Tentative'  
       b. /yom+ru/ → yom+\_u 'read+non-Past'  
       c. /yom+rare+ta/ → yom+\_are+ta 'read+Pass+Past'  
       d. /yom+sase+ru/ → yom+\_ase+ru 'read+Caus+non-Past'  
       (34) a. /kak+yoo/ → kak+\_oo 'write+Tentative'  
       b. /kak+ru/ → kak+\_u 'write+non-Past'  
       c. /kak+rare+ta/ → kak+\_are+ta 'write+Pass+Past'  
       d. /kak+sase+ru/ → kak+\_ase+ru 'write+Caus+non-Past'

Such a post-consonantal deletion rule is formulated as the following:

- (35) Continuant Consonant Deletion

$$\left[ \begin{array}{c} \text{-syll} \\ \text{+cont} \end{array} \right] \rightarrow \varphi / [-\text{syll}] + \text{\_\_\_\_\_\_}$$

The morpheme boundary (+) in (35) is intended to preclude the application of this rule to such examples as *boniyari* 'dimly', *yanwari* 'gently' and *gijjiri* 'tightly'. Itô's



(1986) Coda Condition may trigger rule (35), which must apply only to Yamato words. The application of this rule to such Sino-Japanese words as the adverbial *issai* 'entirely' and the noun *issetsu* 'a(nother) view' raises a problem, because they consist of (/iti/ or) /it/ and /sai/ or /setu/.<sup>15</sup>

Under the theory of underspecification, employed by Itô and Mester (1986), the distinctive voicing [+voice] is present in the underlying representation only for obstruents, and the redundant voicing of sonorants is filled in by postcyclic default rules. Accordingly, the distinctive voicing feature of the stem-final obstruent /b/ in (36) spreads onto the suffix-initial /t/ by Voicing Spread.

- (36) a. /tob+ta/ → tob+da → tod+da → ton+da 'fly+Past'  
 b. /tog+ta/ → tog+da → togi+da → toi+da 'sharpen+Past'

In their analysis, however, the redundant voicing of the stem-final sonorants /m/ and /n/ in (24a) and (24b) blocks the application of voicing. Instead, like /r/ and /w/ in (23), the nasal sonorants /m/ and /n/ as *C'* should undergo gemination, yielding the incorrect outputs in (37):

- (37) a. /sin+ta/ → \*sit+ta 'die+Past'  
 b. /kam+ta/ → \*kat+ta 'bite+Past'

Itô and Mester (1986) acknowledge this problem, and present some alternatives in an Appendix. For their recent rethinking of the underspecification paradox of the feature [voice] in Japanese nasals, see Itô, Mester, and Padgett (1995), Itô and Mester (2003). See also Kingston and Solnit (1989), McCarthy and Taub (1992), and Prince and Smolensky (2004) for a discussion of the inadequacy of underspecification. The proposal using obstruent nasals in (24a) and (24b) does not face this problem.

Whether the voicing assimilation rule (25) or the deletion rule (35) applies depends on whether the suffix-initial consonant is non-continuant or continuant. The analysis with obstruent nasals, /M/ and /N/, proposed here has the linguistically significant consequence that there is a mutual exclusiveness with respect to the application of the two rules and with respect to the two types of *C'*s affected. Also, when the present phonological analysis is employed, essentially the same generalizations made in rules (25) and (35) can be applied to the two genetically related languages, Japanese and Okinawan.

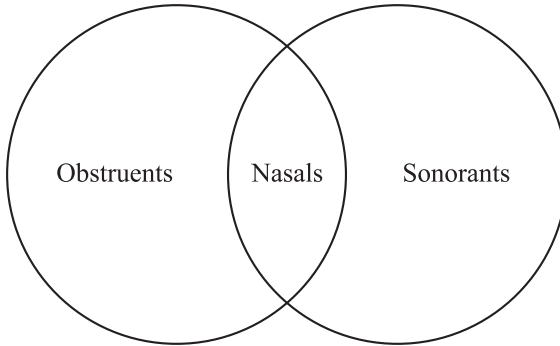
## 6. On the Underlying Representations of Two Types of Nasal

We now consider the underlying representations of obstruent nasals and sonorant nasals.

Based on the discussion of the preceding sections, the relationship among obstruents, sonorants, and nasals will be represented as in the following diagram:

<sup>15</sup>I owe to one of the referees the observation that rule (35) should be only applicable to Yamato words. However, such a limited application should not directly lead to the inadequacy of the rule. In Japanese, there are several rules that hold only for particular morpheme classes (Itô and Mester 1995); *Rendaku*-voicing is one such rule.

(38)



In (38), nasals are taken as the intersection of obstruents and sonorants. Nasals in (38) are further divided into obstruent nasals and sonorant nasals. Steriade (1995: 159) states that “many languages allow nasal vowels, but no other nasalized continuants”, and proposes that [+nasal] must be licensed by the presence of [–continuant]. On the other hand, the feature [–continuant] becomes significant in characterizing voiced stops and nasal consonants as triggers of voicing in Okinawan and Japanese. Thus, “sonorant obstruents” (Rice 1993) will constitute the natural class [–continuant, +voice], and obstruent nasals in the present analysis will constitute a subset of the natural class [–continuant, +voice], which triggers the application of Non-Continuant Voicing (6) (or (25)). Voiced Consonant Cluster Nasalization (14) will then apply to the output of rule (6), and this yields the nasal consonant [+nasal, –continuant, +voice], as indicated in (39):

(39)  $\left[ \begin{array}{c} \text{–continuant} \\ \text{+voice} \end{array} \right]$   $\left[ \begin{array}{c} \text{–syllabic} \\ \text{+voice} \end{array} \right]$   
 $\downarrow$   
 [+nasal]

In (39), the features [+nasal, –continuant, +voice] represent obstruent nasals. Of these three features, [+voice] is more closely connected to [–continuant] than it is to [+nasal], because it is the features [–continuant, +voice] that trigger voicing in rules (6) and (25). It appears that the features [–continuant, +voice] are needed for the lexical representation of obstruent nasals. On the other hand, the universal tendency of sonorants to be voiced suggests that sonorant nasals may lack the underlying specification for [voice]. Clarification follows immediately, but we assume that obstruent nasals and sonorant nasals differ in whether or not the feature [–continuant] is underlyingly specified, as in the following table:

(40)

	Obstruent nasals	Sonorant nasals
[nasal]	+	+
[continuant]	–	
[voice]		

The analysis of the underlying representations in (40) is supported by the fact that the feature specification of the obstruent nasal *M* in (41) with [+voice] constitutes a violation of Lyman's Law, according to which "morphemes contain at most one voiced obstruent" (Itô and Mester 1995: 819).<sup>16</sup>

- (41) /ogam/ 'to pray' /hagem/ 'to work hard' /idom/ 'to challenge'  
 /yodom/ 'to stagnate' /kizam/ 'to mince' /sizum/ 'to sink'  
 /sibom/ 'to wither' /kubom/ 'to become hollow'

As was discussed in Itô and Mester (1995: 819), there is "a constraint against single [p]." Not only Yamato and Sino-Japanese morphemes, but also Native morphemes in Okinawan, observe the constraint: /h/ appears only as *mp* and *pp* when juxtaposed with another consonant (cf. *m+pana* 'nose (honorific)' in (20); *ham+puku* 'repetition', *sim+pai* 'anxiety' in (30); *šip+pai* 'failure', *zep+pan* 'out of print', etc. in Japanese). The post-consonantal position results only when the phonological shape of the preceding Sino-Japanese morpheme is either CVC or CVN (where N=nasal). That is, out of the two possible phonological shapes of the Sino-Japanese morpheme written 失, it is /sit/ (e.g., *šip+pai* 'failure', *šit+tai* 'blunder', *šik+kaku* 'disqualification', *šis+saku* 'error'), not /situ/ (e.g., *šitsu+rei* 'rudeness'), that gives rise to two consecutive consonants. The other case is seen when the phonological shape of Sino-Japanese morphemes contains the sonorant nasal /n/, as in /sin/ (信) (e.g., *šin+rai* 'trust', *šin+pukui* 'respect', *šin+koō* 'belief'). Likewise, obstruent nasals are formed when Yamato morphemes of the shape C...VN or C...VC are combined with another morpheme (e.g., /+ta/ and /+te/ in Japanese) that contain non-continuant /t/ in initial position. They are all cases in which a morpheme-initial consonant is preceded by a morpheme with the phonological shape C...VN or C...VC.

Based on the underlying representations in (40), I propose that it is necessary to adjust consonant clusters by the phonotactic constraint in (42) before lexical rules are applied, and that (42) is applicable to Sino-Japanese words as well as Yamato or Okinawan Native words.

(42) Consonant Cluster (C<sub>1</sub>C<sub>2</sub>) Constraint

- C<sub>1</sub> is either (i) an obstruent or (ii) a sonorant; in case (i), C<sub>1</sub>=C<sub>2</sub> when C<sub>2</sub>=[-voice] (but *hh*→*pp*) and C<sub>1</sub>=[+nasal, -continuant] acquires [+voice] when C<sub>2</sub>=[+voice]; otherwise, C<sub>1</sub>=[+nasal] in case (ii) (but /nh/→*mp*).

By C<sub>1</sub>=C<sub>2</sub> when C<sub>2</sub>=[-voice] in (i), voiceless obstruent geminates are formed in the environment /C...VC<sub>1</sub>+C<sub>2</sub>/, as in *šip+pai* 'failure', *šit+tai* 'blunder', *šik+kaku* 'disqualification', and *šis+saku* 'error'. By C<sub>1</sub>=[+nasal, -continuant, +voice] when C<sub>2</sub>=[+voice] in (i), obstruent nasals are formed in the environment /C...VC<sub>1</sub>+C<sub>2</sub>/. In fact, the rule of Voiced Consonant Cluster Nasalization in (14) is a re-statement of the obstruent nasal formation in (42i) for the sake of convergent derivations. By

<sup>16</sup>The examples in (41) were given as potential counter-examples to Lyman's law by an anonymous referee.

$C_1$ =[+nasal] in (ii), sonorant nasals are formed in the environment /C...VC<sub>1</sub>+C<sub>2</sub>/. Accordingly, [voice] for sonorant nasals in (40) or (42ii) becomes [+voice] by the universal process of sonorant voicing, while the feature [+voice] for obstruent nasals is provided by (42i).

Such a phonotactic constraint as the one in (42) is independently needed to derive *pp* from C<sub>1</sub>C<sub>2</sub> in (i) when C<sub>2</sub>=/h/ and *mp* from C<sub>1</sub>C<sub>2</sub> in (ii) when C<sub>2</sub>=/h/. Okinawan shares constraint (42) with Japanese. Naturally, this constraint never applies when verb stems with the obstruent /M/ in final position are nominalized by the suffix /+i/, as in (43):

- (43) a. /hito # koM+i/ → hito # gom+i ‘a crowd’  
           people being-crowded  
       b. /isi # tuM+i/ → isi # dzum+i ‘being built of stone’  
           stone piling-up

As shown in (40), the obstruent nasal /M/ lacks the feature [+voice] in the underlying representation so that it will not block the application of *Rendaku*. In fact, it does not in (43).

Obstruent nasals allow only voiced consonants (cf. (13), (19), and (24a–c)) to follow. In principle, sonorant nasals allow both voiced and voiceless consonants in the post-nasal position. That is, these post-nasal consonants are either voiced or voiceless in Okinawan Native morphemes (cf. (15b); (16); (17a–c) and (17d); (18); (20a) and (20b)) and in some Sino-Japanese words (cf. (31a) and (31b); (32b)), while they are voiceless in some other Sino-Japanese words (cf. (29); (30); (31d)).

## 7. Conclusion

Based on the analysis of obstruent nasals /M/ and /N/ with the distinctive features [+nasal, –continuant] and sonorant nasals /m/ and /n/ with distinctive [+nasal] only, it is claimed that there are Native morphemes with /M/ and /N/ and those with /m/ and /n/ in Okinawan and also in Japanese. The two types of nasal observe the phonotactic constraint on consonant clusters formulated in (42). In Okinawan, obstruent nasals /M/ and /N/ occur in final position in verb stems (in the *a*- and *c*-examples of (5) and (7)–(9)), in initial position in the second member of compounds (in (13a–c)), and after the glottal stop in initial position in verbs, adjectives, and nouns (in (19)). Sonorant nasals /n/ and /m/ appear elsewhere, that is, in final position in the Negative /+ran/, in initial position in the suffix +*nfu* ‘a person from ~’, in final position in some verb-stems (in (17)), in medial position in nouns (in (18)), and in initial position in many types of words (in (20)). In Yamato morphemes, the obstruent nasals /M/ and /N/ occur in final position in verb stems (in (24a), (24b) and (41)) and in medial position in *nombiri* ‘leisurely’, *tombo* ‘dragonfly’, *ſindo* ‘tired’, *kaygae* ‘thought’, etc.; the sonorant nasal /n/ appears in the numeral /yon/ ‘four’. In Sino-Japanese morphemes, the final nasal consonant is in principle the sonorant nasal /n/. In the formation of Sino-Japanese words, there are cases in which voicing of the initial consonant of the second member is morphologically conditioned. In Okinawan, it was argued that obstruent nasals trigger

Non-Continuant Voicing (6), undergo Non-Identical Obstruent Deletion (10), are derived by Voiced Consonant Cluster Nasalization (14), and are pre-glottalized word-initially, while sonorant nasals undergo none of these processes. In Japanese, obstruent nasals trigger Non-Continuant Voicing (25), which gives rise to a subsequent application of Voiced Consonant Cluster Nasalization (14) (cf. (24c) and (24c')).

The phonological analysis proposed here has the following characteristics:

- (i) The recognition of /M/ and /N/ as obstruent nasals makes the change of  $C^f+C^i$  in (5), (7)–(9), and (24) more natural than the previous treatment by McCawley (1968: 96–97, 125) in the sense that one of the two neighboring non-continuants ( $C^f$ ) causes the other ( $C^i$ ) to progressively assimilate in voicing, as represented by rule (6) or (25).
- (ii) The treatment of /M/ and /N/ as obstruent nasals makes more natural the derivation of *b* to *N* before *d* in (24c) because Voiced Consonant Cluster Nasalization (14) takes place between the same type of segment (i.e., voiced non-continuants) in (24).
- (iii) Only when the obstruent nasals (/M/ and /N/) and the sonorant nasal (/n/) are distinguished in the underlying representation does the underspecification of voicing for sonorants (McCawley 1968 and Itô and Mester 1986) provide a principled account for why [–continuant, +voice] in /M/ or /N/ triggers voicing assimilation (25) though the redundant [+voice] in sonorant /n/ does not.
- (iv) The two genealogically related languages, Japanese and Okinawan, are characterized as follows: they share Non-Continuant Voicing (6) or (25) and Voiced Consonant Cluster Nasalization (14); on the other hand, they differ from each other in that Okinawan selects Non-Identical Obstruent Deletion (10) and Sonorant Deletion (22) and Japanese chooses Consonant Gemination (observed in (23)) and Continuant Consonant Deletion (35). This analysis attains the generalization that the applications of rule (25) and rule (35) in Japanese are mutually exclusive with respect to the continuancy vs. non-continuancy of suffix-initial consonants.
- (v) Only Yamato words allow the occurrence of obstruent nasals in Japanese. This distributional characteristic, in conjunction with the application of Non-Continuant Voicing (25), provides an answer to the question of why only Yamato words rule out nasal/voiceless obstruent clusters like \**nt*, \**mp*, \**nk* (cf. Itô and Mester 1995).

Accordingly, the distinction between /M/ and /N/ as obstruent nasals and /m/ and /n/ as sonorant nasals plays a significant role in the phonological systems of Okinawan and Japanese.

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## [要 旨]

### 沖縄語の鼻音二型

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本稿では、沖縄語や日本語の音韻現象を扱うにあたって、阻害性鼻音 'obstruent nasals' と鳴音性鼻音 'sonorant nasals' とを区別する必要性を論じている。前者の基底形は [+鼻音, -継続性] で、後者は [+鼻音] のみで表示され、音韻的にまず区別される。同一系統関係にある両言語においては、h 音が別の子音と重なる際には \*hh ではなく、pp か mp のみが許容されどか、有声子音の前では同一調音点をもつ鼻音しか許容されないという、子音結合上の制約がある。この種の制約による調整を経て、阻害性鼻音は [+鼻音, -継続性, +有声] と再表示され音韻規則の適用を受けるが、鳴音性鼻の有声性という普遍性から導かれるという立場が展開されている。沖縄語においては、阻害性鼻音は後続子音の有声化の引き金となったり、それ自体が消去されたり、有声阻害音結合から阻害性鼻音を派生する規則の適用を受けるが、鳴音性鼻音は有声化、消去、有声阻害音結合からの派生のいずれとも関わらない。日本語でも、大和系形態素の末尾 (例、動詞語根 yom) や、その他の大和系形態素の中腹 (例、tombo) で阻害性鼻音が生起し、有声化の引き金となったり (例、/yom+ta/ から yon+da 「読んだ」)、有声阻害音結合から規則的に派生されたりする (例、/yob+ta/ から yob+da を経て yon+da 「呼んだ」)。一方、漢語系形態素の末尾 (例、han+tai 「反対」) では鳴音性鼻音が生起し、原則として後続子音の有声化には関わらない。この鼻音二型の区別がなされてはじめて、沖縄語や日本語の音韻特性の説明において有意義な一般化が果たされると論じている。