

Dialectal Variations on Syllable-final Nasal Mergers in Taiwan Mandarin^{*}

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This paper reports a dialectal split in syllable-final nasal mergers between northern and southern Taiwan Mandarin: both /in/ → [iŋ] and /əŋ/ → [ən] are found in northerners' speech, while an additional /iŋ/ → [in] is reported among southerners. The former two mergers are treated as innovations while the latter is due to negative Min transfer. Rule connotation seems to be a combined result of origin, analogy, and speaker confidence. /iŋ/ → [in] is stigmatized due to Min transfer, /əŋ/ → [ən] has acquired a slight negative tang by analogy, and /in/ → [iŋ] is deemed as fairly positive. Regardless of rules, northerners, being speakers of the standard dialect, are generally more receptive to merged forms than southerners. A positive correlation is found between rule connotation and development. /in/ → [iŋ] is the closest to complete phonologization, followed by /əŋ/ → [ən], and /iŋ/ → [in], which is the least developed. Rule interaction is found in speakers that have both rules involving /i/. Those who have only one rule show higher merging rates than those who have both rules. Conflict of social connotation and increased cognitive loading are posited to be the cause.

Key words: syllable-final nasal merger, dialectal variation, rule perception, rule development

1. Introduction

Mandarin, the official language of Taiwan and China, allows two syllable-final nasals, /n/ and /ŋ/. Both can occur with the five vowels in the system, /i/, /ə/, /a/, /u/, and /y/, but only VN sequences containing the former three vowels (i.e. /in/, /iŋ/, /ən/, /əŋ/,

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/an/, and /aŋ/) result in monophthongal realizations of the vowel for both nasals (Duanmu 2000).¹

Previous studies show that there is a tendency for the two nasals to be neutralized after these vowels in Taiwan Mandarin, but researchers disagree upon the direction of sound changes, their robustness, and their cause, as is shown below.

A number of studies claim that /iŋ/ and /əŋ/ tend to be realized as [in] and [ən], respectively, but /aŋ/ remains relatively stable (Hung 2006, Kubler 1985, Tse 1992, J. H.-T. Yang 2007, Yueh 1992). The processes are found to vary from those at the burgeoning stage (Tse 1992), to mergers-in-progress (Hung 2006, Yueh 1992), to changes almost complete (J. H.-T. Yang 2007). Different reasons have been given to account for these findings. Yueh (1992) believes that the effects imposed by location, gender, and age are minimal, while Hung (2006) claims that formal styles and contexts are influential in inhibiting the mergers. Kubler (1985) associates the cause of the mergers with the influence of Min, as it is a powerful substrate language in Taiwan. The majority of the population is ethnically Min, and thus almost all people have at least some passive knowledge of the language (S.-X. Chen 1979, Y.-D. Chen 1989, S. Huang 1993). Tse (1992) and Yueh (1992), on the other hand, claim that this neutralization is an innovation favored by the younger generation. Therefore, it cannot be due to negative transfer from Min, as most of the younger generation acquired Mandarin as their first language, and both Mandarin monolingual and Mandarin-Min bilingual speakers showed a similar trend.² The rules could be best characterized as frontness assimilation, as both /i/ and /ə/, as well as /n/, are produced in the front half of the vocal tract.

In contrast, Ing (1985) finds that instead of merging [ŋ] with [n], speakers seem to show high fluidity for the two nasals, i.e. /n/ and /ŋ/ are realized one for the other. /in/, /ən/, and /an/ tend to be realized as [iŋ], [əŋ], and [aŋ],³ respectively, while /iŋ/, /əŋ/, and /aŋ/ tend to be realized as [in], [ən], and [an], respectively. Similar to Kubler (1985),

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¹ /un/ and /uŋ/ are realized as [wən] and [(w)oŋ], respectively, and /yn/ and /yŋ/ are realized as [yn] and [joŋ], respectively.

² Although the majority of the population in Taiwan is ethnically Min, due to a Mandarin-only policy imposed by the government in 1956 (S. Huang 1993), most people born after 1950 (including Tse's (1992) and Yueh's (1992) subjects) acquired Mandarin as (one of) their first language(s). The ban was later lifted in 1987.

³ [ɑ] is an allophone of /a/ before the velar nasal (Y.-H. Lin 1989).

Ing also claims that the mergers are due to influences of Min and various non-standard Mandarin varieties.⁴

A third group of researchers finds nasal mergers only in /in/ and /əŋ/ sequences (C.-y. Chen 1991b, Hsu 2006, Hsu & Tse 2007, C. C. Lin 2002). /in/ tends to be realized as [iŋ], and /əŋ/ tends to be realized as [ən]. No mergers occur in sequences involving /a/. C.-y. Chen (1991b) reports the merging process to be more advanced for /in/ → [iŋ] than for /əŋ/ → [ən] while Hsu (Hsu 2006, Hsu & Tse 2007) claims the opposite. Her older speakers showed lower merging rates for /in/ → [iŋ] than for /əŋ/ → [ən], while no such difference was found for her younger speakers. This is true regardless of gender and language background. Therefore, Hsu argues that /əŋ/ → [ən] is the leading merger instead. Results from comparable groups, matched by birth year (Chen's 1951-62 vs. Hsu's 1951-60) or by age (Chen's 1938-49 vs. Hsu's 1951-60; Chen's 1965-68 vs. Hsu's 1981-90), are incongruent with each other (Figure 1).

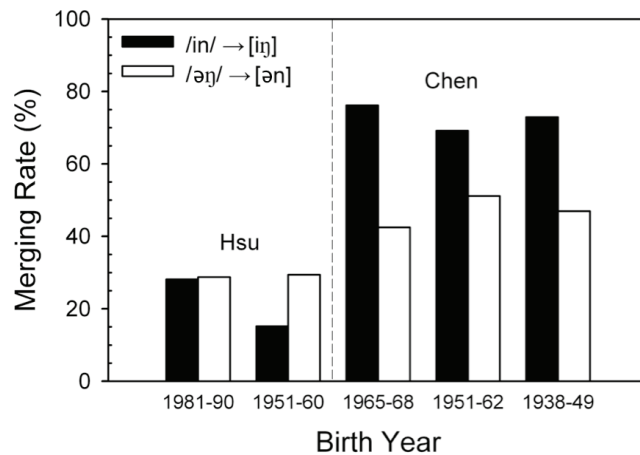


Figure 1: Application rates of the two mergers in C.-y. Chen (1991b) and Hsu (2006). The two sets of bars on the left are from Hsu, while the three sets of bars on the right are from Chen. Original groupings in Chen are combined here to facilitate comparisons. Hsu's 1951-60 subjects are comparable to Chen's 1951-62 subjects in birth year, and to Chen's 1938-49 subjects in age. Hsu's 1981-90 subjects are comparable to Chen's 1965-68 in age.

⁴ Mandarin can generally be subcategorized into eight major dialects (Wen 2000). The standard dialect in Taiwan is the variety spoken around the Taipei area, while the standard dialect in China is the variety spoken around the Beijing area. Due to a large influx of Chinese immigrants between 1945 and 1949, different varieties of Mandarin and other non-Mandarin Chinese languages were brought into Taiwan.

Both diachronic and synchronic reasons were given to explain these mergers. C.-y. Chen (1991a) surmises that the fluidity between [n] and [ŋ] might have a historical origin. Several /iŋ/ sequences in modern Mandarin were originally pronounced as /in/ (e.g. *qīngjiā* ‘in-laws’), and some /ən/ sequences were originally pronounced as /əŋ/ in Middle Chinese (e.g. *zhēnjiē* ‘chaste’).⁵ In other words, Taiwan Mandarin speakers are essentially reliving the diachronic merger rule synchronically. C. C. Lin (2002), on the other hand, deems the mergers as a synchronic innovation. Since both [ŋ] and [i] can be regarded as [+high], and both [n] and [ə] as [–high], he characterizes the mergers as an [αhigh] assimilation.

The above contradictory observations do not seem to be easily reconcilable. Ing’s (1985) study is the most different, proposing the fluidity of the two nasals /n/ and /ŋ/ after the three vowels /i, ə, a/. The two remaining camps agree on the merging direction after /ə/, but disagree on the merging direction after /i/. One possibility that might explain such discrepancies lies in dialectal variations, as subjects from different populations were recruited for these studies. C. C. Lin (2002) and Hsu (Hsu 2006, Hsu & Tse 2007) studied only native Taipei speakers; Yueh (1992) investigated Taipei and Tainan residents; Hung (2006) looked at Kaohsiung residents, while C.-y. Chen (1991a, 1991b), Tse (1992) and J. H.-T. Yang (2007) studied speakers who were affiliated with universities, whose language backgrounds could be heterogeneous. Finally, Kubler (1985) and Ing (1985) focused mainly on L2 Mandarin speakers whose L1 is Min or other non-standard Mandarin varieties. In view of the foregoing discussion, the first aim of the study is to investigate whether dialectal variations can resolve the incongruence in merger types and merging directions.

Even though no dialectal differences were found in Yueh (1992), there are at least two reasons why the speech of Taipei and non-Taipei speakers might potentially be different. First of all, although most speakers in Taiwan are Mandarin-Min bilinguals (S. Huang 1993), the official language Mandarin is used more frequently in the capital (Taipei) than in any other areas in Taiwan (Ang 1997), as it is the political, economic, and cultural center of the country. Taipei also has the largest Mainlander population (who mainly uses Mandarin), compared to any other places in the country (W.-s. Yang 2004).⁶ Of the nearly three million Mainlanders in Taiwan, about 20% of them are Taipei residents, constituting 22% of the city population. As a result, Mandarin-Min bilinguals in Taipei tend to use Min less frequently than Mandarin, and are oftentimes less fluent as well (Ang 1997, Y.-H. Huang & Fon 2008). Secondly, the three major dialects of Min in Taiwan, Chiong, Chôan, and Chiong-Chôan Mix, are unevenly

⁵ Pinyin is used for Mandarin romanization throughout the text.

⁶ “Mainlander” here refers to *Waishengren*, or immigrants from various parts of China who moved to Taiwan immediately after World War II.

distributed (Ang 2010).⁷ Chôan speakers mainly reside in Taipei and the west central coastal strip, while Chiong speakers are dominant in the west central non-coastal areas.⁸ Speakers in the southwestern part of Taiwan predominantly speak a variety of Min that is a more balanced mixture of Chiong and Chôan (Ang 2005, Li 2007). Table 1 shows the allowable VN sequences relevant to this study in the three Min dialects. All dialects allow /in/, /an/ and /aŋ/, and disallow /ən/. Chôan permits /iŋ/ but not /əŋ/, while Chiong and Mix permit /əŋ/ but not /iŋ/. However, bare /əŋ/ is not allowed. The sequence is always preceded by /j/. If application of the mergers is to a large extent determined by the influence from Min (Ing 1985, Kubler 1985), then differences in language composition between Taipei and non-Taipei areas would predict a split in nasal merger application among speakers.

Table 1: A summary of allowable VN sequences relevant to this study in Chôan, Chiong, and Mix dialects of Min.

	Chôan			Chiong/Mix		
	/i/	/ə/	/a/	/i/	/ə/	/a/
/n/	/in/	—	/an/	/in/	—	/an/
/ŋ/	/iŋ/	—	/aŋ/	—	/jəŋ/	/aŋ/

Besides merging directions, previous studies also disagree on merging rates. Taking the most widely agreed upon merger /əŋ/ → [ən] as an example, one finds rates are about 17–31% for minimal pairs (Tse 1992, Yueh 1992), 42% for isolated syllables (Yueh 1992), 28–46% for words (C.-y. Chen 1991b, Tse 1992, Yueh 1992), 29% for sentences (Hsu 2006), 30% for tongue twisters (Yueh 1992), 38% for passages (Yueh 1992), and 95% for riddle guessing (J. H.-T. Yang 2007). We may raise two possible causes for such discrepancies. One has to do with time difference. The mergers might have indeed occurred at a relatively early stage in 1992, but have gradually matured within a 15-year span. The other possibility might be related to methodology, as different approaches might have created contexts with different shades of formality and thus different degrees of facilitation for merger application. In either case, the wide range of application rates suggests that the mergers might still be in a volatile state, and the disparate results might actually reflect various degrees of formality and pronunciation consciousness. In view of this, the second aim of the study is to determine the robustness of the rules, and examine whether the merging process is fully phonologized.

⁷ Church Romanization is used for Min.

⁸ Min speakers mainly reside in the west half of Taiwan. Of the two dialects, Chiong is more dominant than Chôan in Taiwan. However, most speakers show various degrees of Chiong-Chôan mixture due to frequent travels within the island (Ang 1985).

Janson (1983) proposes that a discrete sound change undergoes five stages in order to reach complete phonologization (Table 2). The first stage entails the starting point of sound change, at which speakers regard the old form as both the production and the perception norm. The second stage starts when the perceptual norm shifts and includes both the old and the new forms, while the production norm remains the same. During the third stage, the production norm shifts so that it also includes the new form, as in the perceptual system. At the fourth stage, only the new form is produced as the production norm, but the perceptual system still contains dual norms. Finally, at the last stage, the sound change is completed and only the new form is treated as the single norm for both production and perception. Phonologization of a rule is reached when the rule is always applied. Therefore, if the mergers are robust and the merging process is close to complete, then one should find the merging patterns to be relatively stable with little variability across different contexts. Speakers should show single norms in their production, and merged forms should take precedence over non-merged ones. On the other hand, if the mergers are still in progress, then one should find a large context effect. Application rates should be much higher in an informal register, in which speakers are less aware of their pronunciation, and speakers should display dual norms in production instead. Both merged and non-merged forms should have about equal chance of realization. Since the development of sound changes usually undergoes an extended period of time, and Janson's (1983) original model does not provide quantitative criteria for each stage, it is empirically rather difficult to determine the exact stage a sound change is in unless it is at one of the unambiguous extremes (i.e. Stage 1 or Stage 5). Therefore, this study employs merging rates as the quantitative criteria for the different stages. As there are in total five stages, merging rates in percentages are also conveniently divided into five equal intervals to serve as operational definitions for the limits of each stage (Table 2).

Table 2: An illustration of Janson's (1983) model for discrete sound changes. The percentages indicate defining ranges of merging rates (see text). Light grey: the norm is the old form; dark grey: the norm includes both the old and the new forms; black: the norm is the new form.

	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
Production	0–20%	20–40%	40–60%	60–80%	80–100%
Perception					

As shown above, previous studies also disagree upon the cause for the mergers. Some argue that they are due to negative transfer from Min or other non-standard Mandarin varieties (Ing 1985, Kubler 1985), others claim that the mergers are neutral

innovations by young speakers due to assimilation (C. C. Lin 2002, Tse 1992, Yueh 1992), and still others believe that they are a recurring trend from the past (C.-y. Chen 1986, 1991a). In view of this, the third aim of the study is to look into possible causes for the mergers. Although it is difficult to verify the historical claim based on empirical data, it is possible to differentiate the first two causes based on cross-linguistic comparisons, along with judgment tests and differential sensitivities to standard pronunciation between males and females (Labov 1990, Maclagan et al. 1999, Trudgill 2000). If the nasal mergers are indeed caused by negative transfer from Min or other non-standard Mandarin varieties, one should be able to find corresponding cross-linguistic phonotactic conflicts in languages concerned. In addition, speakers should judge merged forms as less standard, and educated females should be less willing to apply the mergers than educated males. On the other hand, if the mergers are neutral innovations of assimilation, then corresponding cross-linguistic phonotactic conflicts should not be easily established. Also, educated speakers should be more receptive to such forms, and gender differences should be mitigated or even reversed, with females being more likely to apply the mergers than males.

In this study, two experiments were conducted. The first was a production task on the syllable-final nasal mergers in speakers of two Min dialectal groups in order to examine whether there was a geographical split regarding merger application, and how stable the mergers were in general. The second experiment was a judgment task in which subjects were asked to rate different renditions of nasal-ending words with regard to the degree of standardness in order to better understand the possible causes for the occurrences of the merger.

2. Experiment 1

2.1 Method

2.1.1 Subjects

Twenty-two native speakers of Taiwan Mandarin, 13 female and 9 male, participated in this study. Half of them were from Taipei (the northern group), and half of them were from southwestern Taiwan (the southern group). All speakers were university students and college graduates, and their ages ranged from 19 to 27 ($M = 21.36$, $SD = 2.66$). Both groups stayed in their hometowns for approximately 20.64 years ($SD = 2.87$), and the southern group only stayed in Taipei for less than eight months. No group difference was found for both age and length of stay in hometown. All speakers were Mandarin-Min bilinguals and acquired both languages as their L1. The northern group spoke a variety of Min resembling the Chôan dialect, while the southern group used a variety

that belongs to the Chiong or the Mix dialect. They were asked to self-rate their Min proficiency on a Likert scale of 1 to 5, with 1 being ‘absolutely no knowledge of the language’, and 5 being ‘native-like proficiency’. The northerners had an average of 3.09, while the southerners had an average of 4.27 [$t(20) = -2.47, p < .05$]. Subjects were paid for their effort.

2.1.2 Stimuli

Twelve minimal pairs of /n/- and /ŋ/-ending syllables were used as stimuli, including four /in/-/iŋ/ pairs (e.g. *xin* ‘heart’ vs. *xing* ‘star’), four /ən/-/əŋ/ pairs (e.g. *shen* ‘body’ vs. *sheng* ‘to give birth’), and four /an/-/aŋ/ pairs (e.g. *fan* ‘to flip’ vs. *fang* ‘square’). Syllables were presented in Chinese characters and in *zhuyin* symbols, a local phonetic system used to facilitate character pronunciation. In addition, syllables were embedded in carrier sentences written in Chinese characters, and were placed in sentence-final positions to avoid anticipatory coarticulation on the nasals (e.g. *Wang laoshi feichang you aixin*, ‘Mr. Wang is very kind-hearted.’). The last words of the carrier sentences were carefully chosen so that they contained no other nasal-ending syllables except for the target stimuli. An additional set of 48 non-nasal-ending syllables and 72 sentences in which the last words contained no nasal-ending syllables were also included as fillers. In total, 4 (syllables) × 2 (nasals) × 3 (vowels) × 3 (conditions: *zhuyin*, character, sentence) = 72 stimuli and 48 (filler syllables) + 72 (filler sentences) = 120 fillers were included in the study. The full list of stimuli and embedded carrier sentences is given in Appendix 1.

2.1.3 Equipment

Recordings were done using a SONY PCM-M1 Digital Audio Recorder with Maxell R-64 DA 60 min DAT tapes and a SHURE SM10A head-mounted microphone.

2.1.4 Procedure

Subjects were recorded in a quiet room. They were asked to read stimuli printed on index cards in a natural fashion. The stimuli were blocked by condition and each session contained an additional fourth block of a pronunciation check (see below). Subjects were allowed to rest between blocks if necessary. For the reading tasks, the order of presentation within each block and the order of the blocks were randomized for each subject. The pronunciation check was always the last block. The check was a paper-and-pencil test consisting of 36 multiple-choice questions, including 24 target syllables and 12 non-nasal-ending fillers printed in Chinese characters in a semi-randomized

order. For each syllable, subjects were required to circle the dictionary pronunciation of the character, represented by the *zhuyin* symbols, from four available choices. The check was to ensure that subjects knew the underlying pronunciation of the stimuli, since most Chinese characters are not very transparent in this regard. After the recording, subjects were asked to fill out a questionnaire regarding their language backgrounds. An average session lasted about 20 min.

2.1.5 Labeling

Target syllables were hand-labeled accordingly based on acoustic and perceptual cues using Praat 5.1 (Boersma & Weenink 2007). An example is shown in Figure 2.

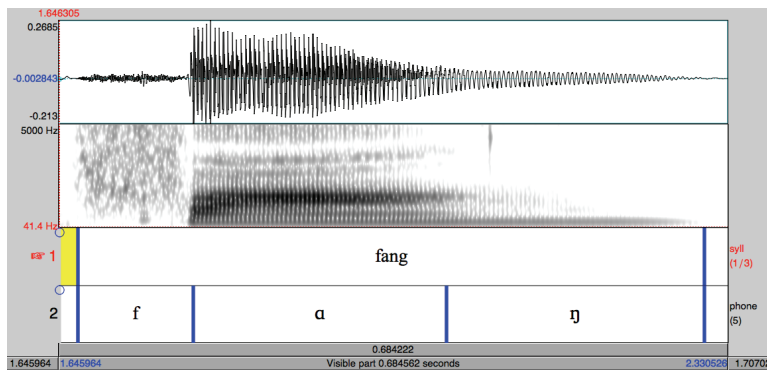


Figure 2: An example of *fang* ‘square’ being pronounced as [fɑŋ]. The first tier labels the underlying form using Pinyin romanization and the second tier labels the actual pronunciation using IPA.

2.2 Results and discussion

Of the 72 (stimuli) \times 22 (subjects) = 1584 target syllables collected, nine syllable-final nasals (< 1%) were deleted, and no trace of place information was left behind. Since what was of interest in this study was the merging process of syllable-final nasals, these tokens were excluded from further analyses. Accuracy for the pronunciation check was fairly high (> 98%). Only six tokens showed misidentified dictionary pronunciations. These were also excluded from further analyses since we were unsure what the underlying forms were for these stimuli for the subjects.

There were 324 instances of mergers found in total. Except for one /an/ \rightarrow [aŋ] and two /ən/ \rightarrow [əŋ], all of the others occurred with /in/, /ɛŋ/, and /iŋ/. Among the three, the first two were the most common ($N = 159$ and 137, respectively), accounting for over

90%, while there were only a few instances of the latter ($N = 25$). All northerners showed evidence of realizing /in/ as [in], while only seven southerners did [$\chi^2(1) = 2.75, p = .097$] (Figure 3).⁹ Two males and two females did not show any sign of this merger. On the other hand, for /ən/ sequences, all except for two northerners, one male and one female, and one southern female, showed instances of merging, indicating this rule is fairly prevalent among both groups of speakers [$\chi^2(1) = 0, \text{ns.}$] (Figure 4). As for /in/ sequences, except for one, all instances occurred in southerners, and only seven southern speakers showed signs of merging [$\chi^2(1) = 4.91, p < .05$] (Figure 5). The four southerners who did not show any sign of this merger were all female. The following analyses on merging rates focused only on these three sequences and only on speakers that showed evidence of the mergers.

The first merging rule examined is /in/ → [in]. As shown in Figure 6, there was a marked contrast between northerners and southerners in terms of rule application. For northerners, their merging rates were fairly high (80–90%) regardless of gender and condition (Figure 6a). However, the overall merging rates were somewhat lower for southerners, and there was a gender split (Figure 6b). Females were more like their northern counterparts showing high merging rates (60–70%) across conditions, while male merging rates were only comparable in the sentence condition (62%). In *zhuyin* and character conditions, the merging rates were relatively low (25%). Different presentation conditions did influence merging rates, but except for southern males, the influence was relatively minor. For northerners and southern females, the differences were usually within 5–10%. However, for southern males, there was a big increase of close to 40% from *zhuyin* and character conditions to the sentence condition.

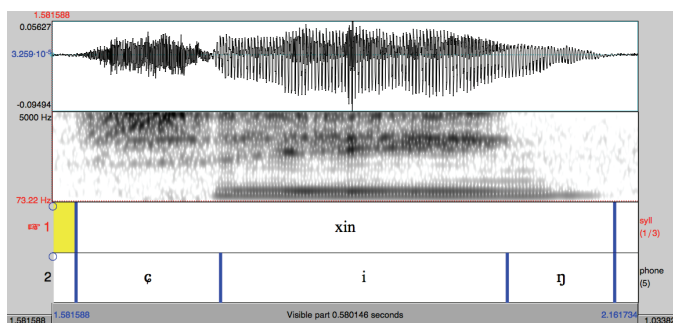


Figure 3: An example of /in/ → [in] in *xin* ‘heart’.

⁹ Yates’ (1934) correction for continuity was used since expected counts in some of the cells were less than five. Correction was used throughout the paper when necessary.

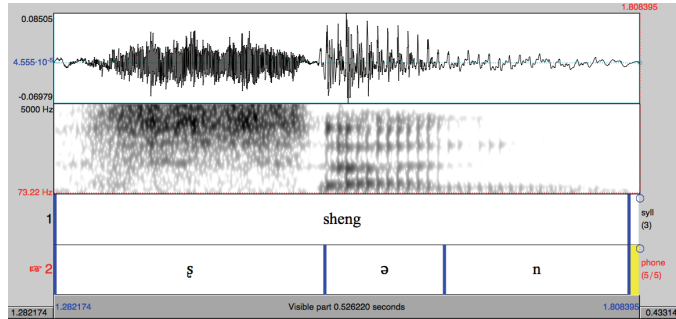


Figure 4: An example of /əŋ/ → [ən] in *sheng* ‘to live’.

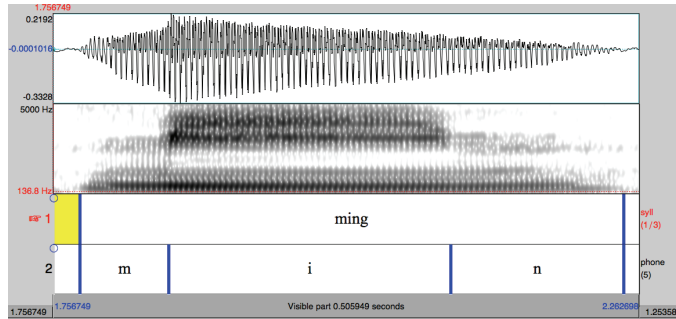


Figure 5: An example of /iŋ/ → [in] in *ming* ‘name’.

Since the dependent variable, merging or not merging, was binary, a forward stepwise logistic regression was performed to predict the probability of the merger occurrences of /in/ → [in] from dialect, gender, and condition on speakers that had the merger. Results showed that the overall model fit test was significant [$\chi^2(3) = 29.57$, $p < .0001$]. Among the factors, the main effect of dialect and the three-way interaction were (near-)significant predictors of merger occurrences (Table 3). None of the other factors was related to the occurrences of the merger. The interaction effect was the stronger of the two. Switching from northerners and southern females in all three conditions or southern males in the sentence condition to southern males in *zhuyin* and character conditions would decrease the odds of merging by a factor of .19. In addition, switching from northerners to southerners would generally decrease the odds of merging by a factor of .31. By including the two predictors, the model could correctly classify 77% of the cases. The logistic regression equation for the model is shown in (1).

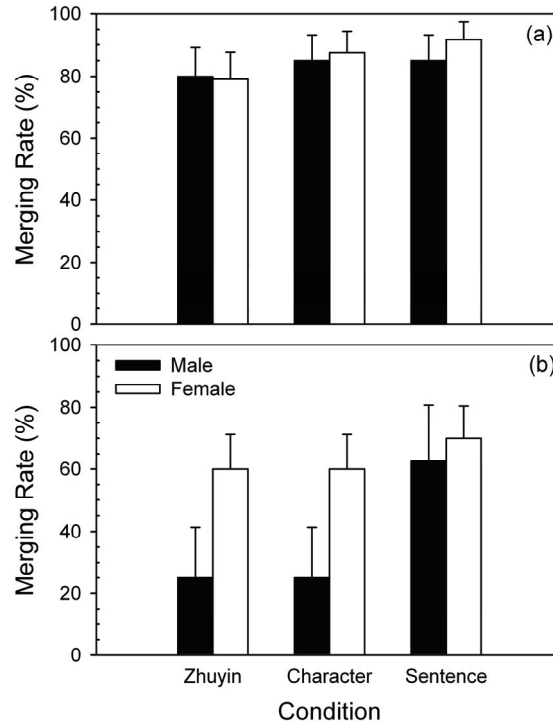


Figure 6: Average merging rates of /in/ → [iŋ] in (a) northerners and (b) southerners. Error bars represent standard error.

Table 3: Summary of the stepwise logistic regression analysis for variables predicting the merger /in/ → [iŋ] for speakers that had the merger.

Variable	B	SE	Wald χ^2	Exp(<u>B</u>)
Dialect	-1.18	.35	$\chi^2(1) = 11.40, p < .001$.31
Dialect × gender × condition			$\chi^2(2) = 6.79, p < .05$	
Dialect × gender × <i>zhuyin</i>	-1.64	.85	$\chi^2(1) = 3.69, p = .05$.19
Dialect × gender × character	-1.64	.85	$\chi^2(1) = 3.69, p = .05$.19
Constant	1.72	.24	$\chi^2(1) = 50.36, p < .0001$	5.60

Note: Nagelkerke $R^2 = .19$, correct classification = 77%. References: dialect = north; gender = female; condition = sentence.

$$(1) \text{ Logit}(p) = 1.72 - 1.18 G - 1.64 [D \text{ by } G \text{ by } C_1] - 1.64 [D \text{ by } G \text{ by } C_2]$$

where

- p is the probability of /in/ → [in]
- D is the dialect group of subjects
- G is the gender of subjects
- C_1 is the *zhuyin* condition
- C_2 is the character condition

The second merger examined is /iŋ/ → [in]. Since there was only one instance in the northern group showing this merger, the following analyses included only southerners. As shown in Figure 7, the overall merging rates were fairly low. There was a gender difference regarding the presentation conditions. For male speakers, the merging rates hovered around 35–45%, regardless of conditions, while female speakers had low merging rates in non-sentence conditions (0–20%), and higher rates in the sentence condition (45%). Merging rates in the sentence condition were more comparable between the two genders. However, a logistic regression with gender and condition as predictors showed that both main and interaction effects were not significant.

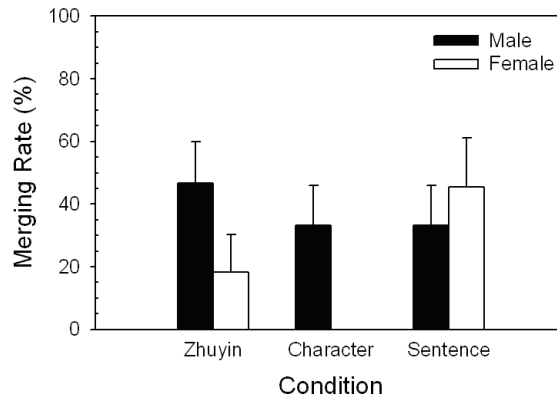


Figure 7: Merging rates of /iŋ/ → [in] in southern speakers. Error bars represent standard error.

The third merger examined is /əŋ/ → [ən]. As shown in Figure 8, there was a large difference between northerners and southerners. For northerners and southern males, merging rates for *zhuyin* and character conditions were comparable, around 55–75%, but southern females showed very low merging rates of only about 20–25%. For the sentence condition, there was a strong group difference. Northerners showed almost complete merging (95–100%), while southerners only merged around 65–75% of the time, regardless of gender. The influence of presentation conditions was dependent on

dialect and gender. For southern males, the difference was fairly minor ($\approx 7\%$). For others, the increase from *zhuyin* and character conditions to the sentence condition was as large as 20–40%.

A forward stepwise logistic regression was performed to predict the probability of the nasal merger occurrences of $/\text{əŋ}/ \rightarrow [\text{ən}]$ from dialect, gender, and condition on speakers that had the merger. Results showed that the overall model fit test was significant [$\chi^2(4) = 50.03, p < .0001$]. Among the factors, the main effects of dialect, condition, and the two-way interaction of dialect and gender were successful predictors of merger occurrences (Table 4). None of the other factors was significant. Dialect was the strongest predictor. Switching from northerners to southerners would decrease the odds of merging by a factor of .15. Condition was the second strongest predictor, but the difference was only found between *zhuyin* and sentence. Switching from the former to the latter would increase the odds by a factor of 5.34. As for the interaction effect, being a southern male would increase the odds of merging by a factor of 4.40. By including the three predictors, the model could correctly classify 73% of the cases. The logistic regression equation for the model is shown in (2).

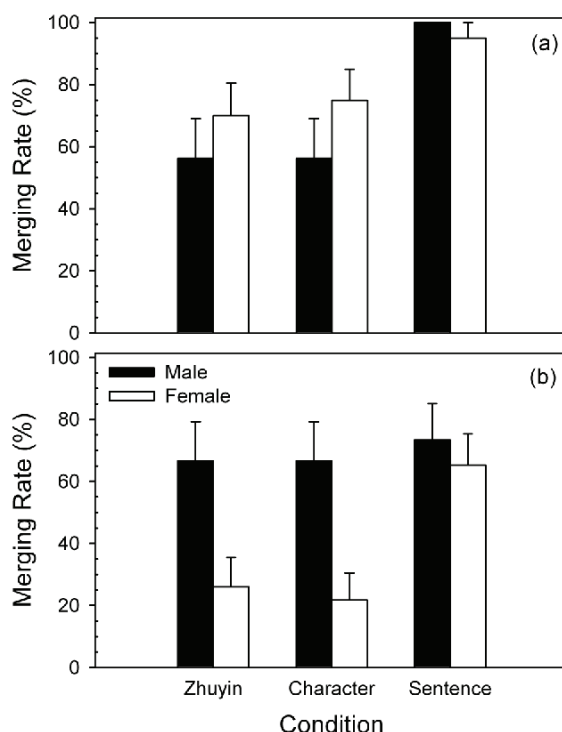


Figure 8: Merging rates of $/\text{əŋ}/ \rightarrow [\text{ən}]$ in (a) northerners and (b) southerners. Error bars represent standard error.

Table 4: Summary of the stepwise logistic regression analysis for variables predicting the merger /əŋ/ → [ən] for speakers that had the merger.

Variable	B	SE	Wald χ^2	Exp(B)
Dialect	-1.87	.37	$\chi^2(1) = 25.85, p < .0001$.15
Condition			$\chi^2(2) = 19.19, p < .0001$	
Character	5.43e-016	.36	$\chi^2(1) = 2.32e030, ns.$	1.00
Sentence	1.68	.42	$\chi^2(1) = 15.77, p < .0001$	5.34
Dialect × gender	1.48	.44	$\chi^2(1) = 11.41, p < .001$	4.40
Constant	.75	.30	$\chi^2(1) = 6.32, p < .05$	2.12

Note: Nagelkerke $R^2 = .28$, correct classification = 73%. References: dialect = north; gender = female; condition = *zhuyin*.

$$(2) \text{ Logit}(p) = .75 - 1.87 D + 1.68 C_2 + 1.48 [D \text{ by } G]$$

where

- p is the probability of /əŋ/ → [ən]
- D is the dialect group of subjects
- G is the gender of subjects
- C_2 is the sentence condition

It is interesting to find that mergers of both directions regarding /i/ exist in southern speakers. In fact, of the seven southerners that had /in/ → [iŋ], four also had the /iŋ/ → [in] merger, two males and two females. The remaining three that did not have the /iŋ/ → [in] merger were all female speakers. Since gender was already found to be an important factor in southern speakers regarding the /in/ → [iŋ] rule (Figure 6), only female speakers were included in the following analyses. Figure 9 shows the merging rates of /in/ → [iŋ] in southern females with regards to the existence of /iŋ/ → [in]. There was a strong contrast between those with the /iŋ/ → [in] rule and those without. For those that had both mergers, the merging rates for /in/ → [iŋ] were fairly low, only around 12–25%. On the other hand, for speakers that only had the /in/ → [iŋ] rule, the merging rates were very high, around 84–100%.

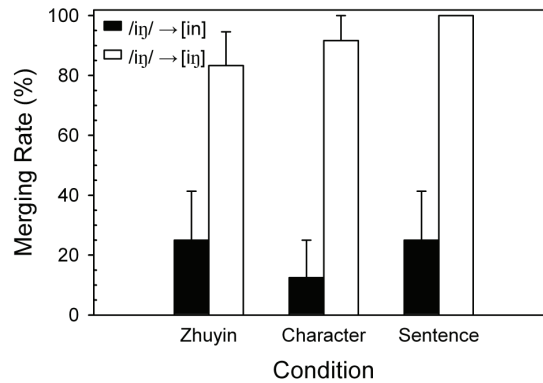


Figure 9: Merging rates of /in/ → [iŋ] in southern female speakers with regards to the existence of /iŋ/ → [iŋ]. Error bars represent standard error.

A forward stepwise logistic regression was performed to predict the probability of the nasal merger occurrences of /in/ → [iŋ] in southern female speakers that had the merger from the existence of /iŋ/ → [iŋ]. Results showed that the overall model fit test was significant [$\chi^2(1) = 33.64, p < .0001$]. The main effect of /iŋ/ → [iŋ] existence was a successful predictor of merger occurrences of /in/ → [iŋ] (Table 5). Switching from /iŋ/ → [iŋ] to /iŋ/ → [iŋ] would increase the odds of merging /in/ with [iŋ] by a factor of 41.80. By including the predictor, the model could correctly classify 87% of the cases. The logistic regression equation is shown in (3).

Since having the /iŋ/ → [iŋ] merger was found to affect the merging rate of /in/ → [iŋ], one would like to see if the opposite were also true. That is, whether having the merger of /in/ → [iŋ] would also affect the merging rate of /iŋ/ → [iŋ]. Of the seven southerners that had /iŋ/ → [iŋ], four of them also had /in/ → [iŋ], two males and two females. The ones that only had /iŋ/ → [iŋ] were two males and one female. Figure 10 shows how the existence of /in/ → [iŋ] affected the merging rates of /iŋ/ → [iŋ]. For speakers who had both mergers, the merging rates for the latter were merely 10–20%. On the other hand, for those who only had /iŋ/ → [iŋ] but not /in/ → [iŋ], the merging rates increased to around 30–60%.

Table 5: Summary of the stepwise logistic regression analysis for predicting the merger /in/ → [in] in southern females that had the merger from the existence of /in/ → [in].

Variable	B	SE	Wald χ^2	Exp(B)
/in/ → [in] merger	3.73	.79	$\chi^2(1) = 22.61, p < .0001$	41.80
Constant	-1.34	.50	$\chi^2(1) = 7.05, p < .01$.26

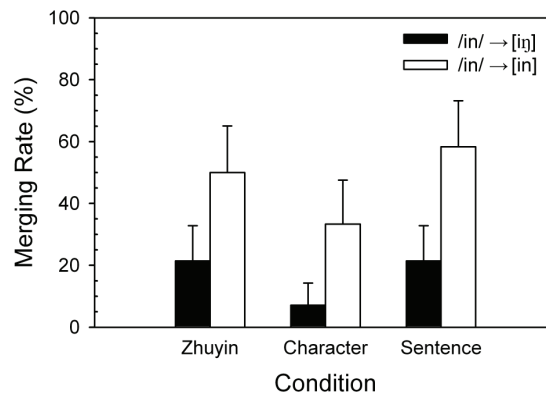
Note: Nagelkerke $R^2 = .59$, correct classification = 87%. Reference: /in/ → [in] merger = existent.

$$(3) \text{ Logit } (p) = -1.34 + 3.73 M$$

where

p is the probability of /in/ → [in]

M is the existence of /in/ → [in]

**Figure 10:** Merging rates of /in/ → [in] in southern speakers with regards to the existence of /in/ → [in]. Error bars represent standard error.

A forward stepwise logistic regression was performed to predict the probability of /in/ → [in] occurrences on speakers that had the merger from the existence of /in/ → [in]. Results showed that the overall model fit test was significant [$\chi^2(1) = 8.65, p < .01$]. The main effect of /in/ → [in] existence was a successful predictor of merger occurrences of /in/ → [in] (Table 6). Switching from /in/ → [in] to /in/ → [in] would increase the odds of merging /in/ with [in] by a factor of 4.47. By including the predictor, the model could correctly classify 69% of the cases. The logistic regression equation for the model is shown in (4).

Table 6: Summary of the stepwise logistic regression analysis for predicting the merger /iŋ/ → [in] for speakers that had the merger from the existence of /in/ → [iŋ].

Variable	B	SE	Wald χ^2	Exp(B)
/in/ → [iŋ] merger	1.50	.53	$\chi^2(1) = 7.93, p < .01$	4.47
Constant	-1.61	.41	$\chi^2(1) = 15.11, p < .001$.20

Note: Nagelkerke $R^2 = .15$, correct classification = 69%. Reference: /in/ → [iŋ] merger = existent.

$$(4) \text{ Logit } (p) = -1.61 + 1.50 M$$

where

- p is the probability of /iŋ/ → [in]
 M is the existence of /in/ → [iŋ]

In this experiment, three robust mergers were found, /in/ → [iŋ], /iŋ/ → [in], and /əŋ/ → [ən]. There were no consistent mergers involving /ən/, /an/, or /aŋ/, unlike what was claimed in Ing (1985). In addition, contrary to Yueh (1992), a split was found between Taipei and non-Taipei speakers. Northerners only have /in/ → [iŋ] and /əŋ/ → [ən], while southerners have all three mergers. This is consistent with C. C. Lin's (2002) and Hsu's (Hsu 2006, Hsu & Tse 2007) results regarding native Taipei speakers. In Experiment 2, listeners' perception of these mergers was investigated through a judgment test.

3. Experiment 2

3.1 Method

3.1.1 Subjects

Twenty-four native speakers of Taiwan Mandarin, 16 female and 8 male, participated in this study. Half were from Taipei, constituting the northern group, and half were from southwestern Taiwan, constituting the southern group. All subjects were university students and college graduates, and none had participated in the first experiment. Northerners had an age range between 20 and 25 ($M = 22.00$, $SD = 1.65$), while southerners had an age range between 18 and 19 ($M = 18.33$, $SD = .49$) [$t(12.94) = -7.37, p = .0001$].¹⁰ Southerners were somewhat younger than northerners because only freshmen were included to avoid extended exposure to nonnative dialects. Northerners and southerners stayed in their hometown for approximately 21.75 years ($SD = 1.96$)

¹⁰ Levene's test for equality of variances was violated. Therefore, the adjusted df was used accordingly. Adjusted df 's were used when necessary throughout the text.

and 18.16 years ($SD = .49$), respectively [$t(12.38) = -6.15, p < .0001$]. Subjects were paid for their effort.

3.1.2 Stimuli

Eighteen syllables of /in/, /iŋ/ and /əŋ/ sequences were used as stimuli. They were embedded in disyllabic words and were always placed in the second position. The first syllable did not contain any of the target sequences. Two versions of each word were read by the first author, a trained phonetician, once with the relevant merger rule applied, and once without. The stimuli were carefully chosen so that both renditions have no other homophonous counterparts in the lexicon. For example, *anjing* ‘quiet’ was read once with an [iŋ] ending, and once with an [in] ending. Both readings could only uniquely refer to the word *anjing* since *anjin* does not exist in the lexicon. The stimulus list was randomized and repeated three times. In total, there were 6 (tokens) \times 3 (sequences) \times 2 (renditions) \times 3 (repetitions) = 108 syllables. For a complete list of the stimuli, please see Appendix 2.

The recordings were first checked by four additional trained phoneticians, one of whom being the third author, to make sure that place distinctions of the final nasals were obvious to the ear. Afterwards, auditorily the clearest token of each rendition was chosen for every stimulus word, and the portion containing the first syllable and the onset of the second syllable (if there was one) for the two renditions was replaced by a corresponding fragment from another /ŋ/-rendition of the same word. This was to ensure that any signal up to the beginning of the second vowel was identical for both pronunciations. The final product sounded fairly natural, and could not be reliably distinguished from the original by a trained ear. All pairs were then adjusted for their loudness using Audition 1.5 so that they were reasonably similar auditorily. Stimulus word duration was also adjusted using Praat 5.1 (Boersma & Weenink 2007) so that all except for two pairs had a total duration of 750 ms. The pairs for *xuesheng* ‘student’ and *yanjing* ‘eye’ were adjusted to 800 ms since the shorter version sounded awkwardly rushed.

3.1.3 Equipment

Recordings of the stimuli were done using a KORG MR-1000 Digital Audio Recorder and a Sennheiser HMD 25-1 head-mounted microphone. Presentation of the stimuli was done by PowerPoint on a BenQ Joybook S73G laptop and a pair of SONY MDR-7502 headphones.

3.1.4 Procedure

Subjects were seated in a sound-treated room. They were played the sound files one by one, and were asked to choose from three occupations one that best suited the pronunciation on an answer sheet after listening to each file. The three occupations were a news anchor, a post office front desk clerk, and a braised pork rice food stand owner. The stimulus list was repeated three times, each block with a different semi-randomized order. A manual check was performed to ensure that no renditions of the same word occurred contiguously. Two block orders were prepared and subjects were assigned to either order according to their order of appearance. A practice trial was placed before the actual experiment to make sure that subjects understood the procedure. Subjects were allowed to rest between blocks if necessary.

After the judgment task, subjects were asked to rate using a Likert scale on how necessary it is for people of these three occupations to speak standard Mandarin, with '1' being 'very unnecessary' and '5' being 'very necessary'. Finally, a pronunciation check was conducted as in Experiment 1 to ensure that subjects knew the underlying pronunciation of the stimuli. The check was a paper-and-pencil test consisting of the 18 stimulus words printed in Chinese characters, with the target syllables underlined. The words were in a randomized order and each target syllable was given two pronunciation choices printed in *zhuyin* symbols, one ending in [n] and the other ending in [ŋ]. Subjects were requested to circle the dictionary pronunciation of the target syllables. In addition, subjects were asked to fill out a questionnaire regarding their language backgrounds and language use. An average session lasted about 20 min.

3.1.5 Measurements

Likert scale ratings on the need for standard Mandarin usages for the three occupations were used as the dependent variable. For example, if a subject chose "post office desk clerk" to be the occupation suitable for a particular rendition of *anjing* 'quiet', and also judged the necessity for an office clerk to adopt standard Mandarin is '3' on the Likert scale, then the standard level of the pronunciation for the stimulus would be assigned a '3'.

3.2 Results and discussion

In the Likert scale rating task, all except for one subject rated news anchors as an occupation that requires the highest level of standard Mandarin ($M = 4.88$), and food stand owners as one that requires the lowest level ($M = 2.38$). Office clerks were rated as somewhere in-between ($M = 3.50$). A two-way mixed ANOVA with group being the

between-subject variable and occupation being the within-subjects variable showed that there was a significant main effect of occupation [$F(1.76, 38.61) = 151.60, p < .0001, \eta^2 = .87$].¹¹ No other effect was significant (Figure 11). Post hoc pairwise comparisons showed that ratings were the highest for news anchors and lowest for food stand owners ($p < .0001$), indicating that most subjects agreed with the level of formal speech required for each occupation assumed in this study. The subject that rated differently was excluded from further analyses since she misinterpreted standardness as clarity. Accuracy for the pronunciation check was fairly high ($> 93\%$). The error tokens were excluded from further analyses to ensure that subjects made judgments based on correct underlying forms.

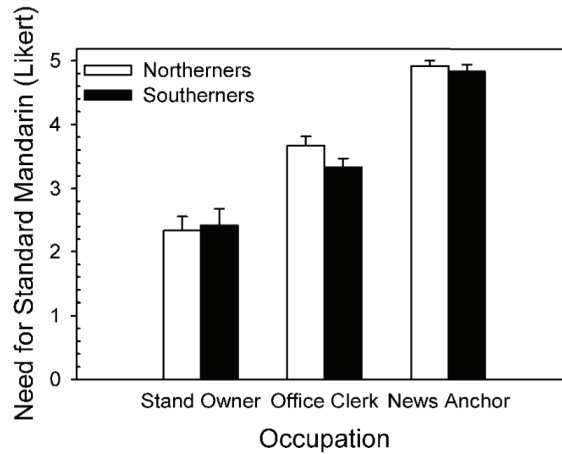


Figure 11: Mean Likert scale ratings of the three occupations regarding their need for standard Mandarin. Error bars represent standard error.

In order to investigate whether there were differential connotations with regards to merger application, a three-way mixed ANOVA on standardness rating was performed. The between-subjects variable included group, and the within-subjects variables included merger and rendition. Results showed that the main effects of group and rendition were significant [group: $F(1, 337) = 15.29, p < .001, \eta^2 = .04$; rendition: $F(1, 337) = 74.85, p < .0001, \eta^2 = .18$]. Two-way interactions involving rendition were also significant [group \times rendition: $F(1, 337) = 24.16, p < .0001, \eta^2 = .07$; merger \times rendition: $F(2, 674) = 35.77, p < .0001, \eta^2 = .10$]. Finally, the three-way interaction was also significant [$F(2, 674) = 3.72, p < .05, \eta^2 = .01$].

¹¹ Mauchly's test showed that the sphericity assumption was violated. Therefore, Huynh-Feldt adjusted df 's were used accordingly.

Regarding the three-way interaction, three post hoc ANOVAs regarding the different mergers were performed. The first was a two-way mixed ANOVA on standardness rating of pronunciations regarding /in/. The between-subjects variable was group, and the within-subjects variable was rendition. As shown in Figure 12a, results indicated that only the main effect of group was significant [$F(1, 397) = 15.09, p < .001, \eta^2 = .04$]. Post hoc pairwise comparisons showed that ratings by northerners were significantly higher than those by southerners ($p < .001$).¹² No other significant effect was found.

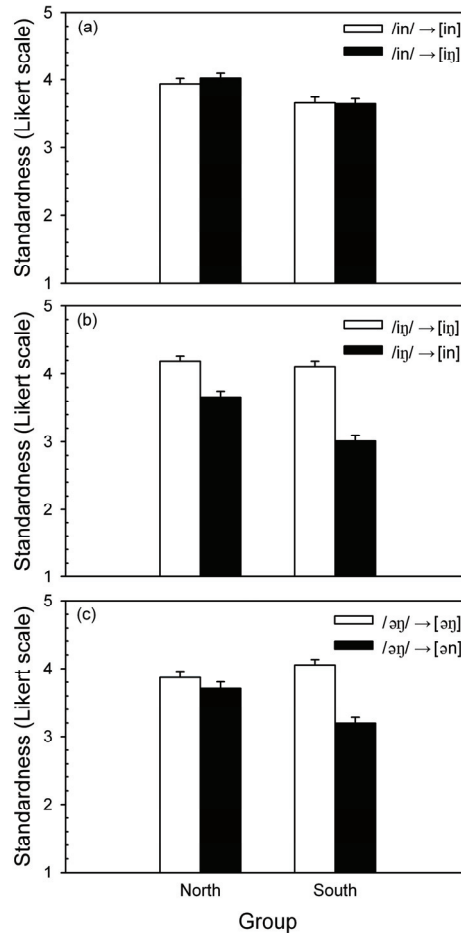


Figure 12: Average standardness rating scores on pronunciations of (a) /in/, (b) /iŋ/, and (c) /əŋ/. Error bars represent standard error.

¹² Bonferroni's adjustments for pairwise comparisons were employed throughout the paper.

The second set of post hoc analyses was a similar two-way mixed ANOVA on standardness rating of /iŋ/ pronunciations. As shown in Figure 12b, results indicated that both of the main effects were significant [group: $F(1, 388) = 16.59, p < .0001, \eta^2 = .04$; rendition: $F(1, 388) = 123.02, p < .0001, \eta^2 = .24$]. The two-way interaction was also significant [$F(1, 388) = 14.90, p < .001, \eta^2 = .04$]. Post hoc pairwise comparisons showed that the [iŋ] pronunciation was rated higher than [in], regardless of groups ($p < .0001$). Post hoc independent t tests indicated that there was no difference between listener groups for the [iŋ] rendition. However, significant differences existed for the [in] rendition. Northerners gave higher ratings for [in] than southerners [$t(388) = 5.30, p < .0001$].

The third set of post hoc analyses was an analogous two-way mixed ANOVA on standardness rating of /əŋ/ pronunciations. As shown in Figure 12c, results indicated that both effects involving rendition were significant [rendition: $F(1, 367) = 39.99, p < .0001, \eta^2 = .10$; group \times rendition: $F(1, 367) = 18.68, p < .0001, \eta^2 = .05$]. The main effect of group was also near significant [$F(1, 367) = 3.02, p = .08, \eta^2 = .01$]. Post hoc paired t tests showed that there was no significant difference between the two renditions for northern listeners, but southerners rated [əŋ] to be higher than [ən] [$t(182) = 7.81, p < .0001$]. In addition, post hoc independent t tests also showed that there was no difference in rating between the two groups of listeners for [əŋ], but northerners significantly rated [ən] higher than southerners [$t(367) = 3.98, p < .0001$].

In order to compare across merger rules, two other sets of post hoc ANOVAs were performed. The first was a two-way mixed ANOVA regarding the non-merged forms, with group being the between-subjects variable, and merger being the within-subjects variable. Results showed that only the main effect of merger was significant [$F(2, 674) = 13.28, p < .0001, \eta^2 = .04$]. No other effect was significant. Post hoc analyses showed that the /in/ \rightarrow [in] rule was rated the lowest ($p < .0001$ with /iŋ/ \rightarrow [iŋ]; $p < .01$ with /əŋ/ \rightarrow [əŋ]). No difference was found between the other two.

A similar two-way mixed ANOVA was performed regarding the merged forms. Results showed that both of the main effects were significant [merger: $F(2, 674) = 21.86, p < .0001, \eta^2 = .06$; group: $F(1, 337) = 35.31, p < .0001, \eta^2 = .09$]. The interaction effect was not significant. Post hoc analyses regarding the merger effect showed that /in/ \rightarrow [iŋ] was rated the highest, and /iŋ/ \rightarrow [in] the lowest, regardless of groups. /əŋ/ \rightarrow [ən] was somewhere in-between (/in/ \rightarrow [iŋ] vs. /iŋ/ \rightarrow [in], $p < .0001$; /in/ \rightarrow [iŋ] vs. /əŋ/ \rightarrow [ən], $p < .001$; /əŋ/ \rightarrow [ən] vs. /iŋ/ \rightarrow [in], $p < .05$). As for the group effect, a post hoc independent t test indicated that northerners always gave higher ratings than southerners, regardless of merged forms ($p < .0001$).

Generally speaking, both groups of listeners considered /in/ \rightarrow [iŋ] to be fairly standard, and /iŋ/ \rightarrow [in] rather non-standard. Listeners from different dialectal areas

tended to have different opinions regarding the /əŋ/ → [ən] merger. Northerners found it relatively standard, while southerners regarded it as somewhat non-standard. In addition, although non-merged forms generally received high ratings, /in/ → [in] was considered as less standard than the other two (north: $M = 3.94$; south: $M = 3.65$). In terms of dialectal areas, northerners were inclined to assign higher rating scores to rules than southerners, especially for the merged renditions. This might be related to the differential linguistic statuses between the two dialects.

4. General discussion

This study has observed three syllable-final nasal mergers in Taiwan Mandarin, /in/ → [iŋ], /iŋ/ → [in], and /əŋ/ → [ən]. Among the three, the /əŋ/ → [ən] merger is adopted by the majority of speakers from both northern and southern dialects, and appears to be fairly robust and stable. This is consistent with most of the previous studies, as nearly all of them have reported finding this merger (C.-y. Chen 1991a, 1991b, Hsu 2006, Hsu & Tse 2007, Hung 2006, Kubler 1985, C. C. Lin 2002, Tse 1992, J. H.-T. Yang 2007, Yueh 1992).

Although C.-y. Chen's (1991a) historical account is rather difficult to prove in real time, it is interesting to note that the merger is also found in Mainland (J. H.-T. Yang 2007) and Singapore Mandarin (C.-y. Chen 1986, 1991a). As both varieties share a common ancestry with Taiwan Mandarin, the historical account seems to be a possibility. However, it is rather difficult to imagine how a diachronic tendency would motivate a synchronic application seamlessly so as to create a predominant trend. Besides, there is a strong contrast in the merging rates between Taiwan and China [J. H.-T. Yang (2007): 96% vs. 38%], while rates between Taiwan and Singapore are more comparable [C.-y. Chen (1986, 1991b): 45% vs. 57%]. It is thus suspected that differential influences from common local substrates in the three locations might be a potential cause. As over 70% of the population in Taiwan (S.-X. Chen 1979, Y.-D. Chen 1989, S. Huang 1993) and approximately 62% of the Chinese population in Singapore are ethnically Min (Leow 2001), while only less than 4% of the total population in China are (Zhang 1989, Zhu 2002), it is suspected that Min might be the potential cause for the occurrence of this merger, as Kubler (1985) suggests.

In fact, Min is not only currently the most predominant non-official language in Taiwan, but had also acted as the *lingua franca* for a fairly long period of time before the government imposed a Mandarin-only policy in 1956 (S. Huang 1993). This implies that during the transitional stage from Min- to Mandarin-dominant language use, the speech community of Taiwan had probably undergone a process of “group second

language acquisition” of Mandarin (Winford 2003). It is thus quite likely that Min played an influential role in shaping Mandarin phonology in Taiwan.

However, the fact that neither [ən] nor bare [əŋ] are permissible in Min renders Kubler’s claim unjustifiable. Some other factors might have contributed to the occurrence of this merger. As both sequences were non-native to Min, yet the merger is from [əŋ] to [ən], not vice versa, it is likely that Min speakers find bare [əŋ] to be more intolerable and perhaps also harder to produce than [ən]. One piece of supporting evidence lies in how Min L2 speakers of Mandarin produce /əŋ/ sequences. Regardless of dialects, it is fairly common to observe native Min speakers over 60 years old to produce /əŋ/ as [ŋ], which is a legal rhyme in Min. For elderly speakers from the Chiong or the Mix dialect, /əŋ/ is also often produced as [jəŋ]. Bare [əŋ] sequences are hardly if ever heard. On the other hand, native Min speakers often have relatively little difficulty in producing /ən/ as is, even though it is also non-native to Min phonology.

Another piece of evidence lies in the vowel labialization rule of Taiwan Mandarin (J. H.-T. Yang 2007). In Mandarin, /əŋ/ and /oŋ/ are distinctive after nonlabial consonants (e.g. *deng* ‘to wait’ vs. *dong* ‘to understand’), while only /əŋ/ is allowed after labial ones (e.g. *feng* ‘wind’, but no **fong*). However, perhaps due to the challenge of producing bare [əŋ], there is a robust rule of realizing /əŋ/ as [oŋ] after labial consonants in Taiwan Mandarin. The rule has been active since the early days of Mandarin acquisition in Taiwan speech community and is currently still widely accepted in Taiwan Mandarin. In fact, the vowel labialization rule and the /əŋ/ → [ən] merger are in competition after labial consonants. It is rather common to observe applications of either rule among Min speakers, yet producing a sequence of [+labial] + /əŋ/ is rarely found.

Therefore, it is likely that the prevalence of the /əŋ/ → [ən] merger is an integration of phonological and sociolinguistic factors. Phonologically, for reasons yet unclear, first generation Mandarin learners in Taiwan found bare [əŋ] sequences to be either more intolerable or difficult to produce than [ən], motivating the change from the former to the latter. Sociolinguistically, the “Mandarin-only” policy and the ban of Min usage (S. Huang 1993) compelled native Min speakers to master Mandarin within a very short period of time, encouraging ingenuous accommodations for incongruities between L1 and L2. Furthermore, unlike some Taiwan Mandarin features that stemmed from language contact, the [ən] realization of /əŋ/ has not been severely stigmatized, even though it is a nonstandard form. In fact, northerners, who are often considered as more Mandarin-friendly than their southern counterparts (Ang 1997), deem the merged form as more standard than the southerners do. Such a lenient attitude toward this merger in the speech community of Taiwan may have further supported its diffusion. In other words, it is the unique sociolinguistic environment in Taiwan that created and

fostered the /əŋ/ → [ən] merger, which surfaced as an assimilation rule (C. C. Lin 2002, Tse 1992, Yueh 1992) that has resemblance to mergers in Middle Chinese (C.-y. Chen 1991a).

Compared to /əŋ/ → [ən], the post-/i/ nasal merger appears to be relatively unstable, and previous research disagrees upon the direction of change. This study finds the pattern to be dialect-dependent. Both directions exist in the south, but only /in/ → [iŋ] exists in the north. It is interesting to note that there seems to be a rough correlation between the choice of claim and the time of study, with the /iŋ/ → [in] merger appearing earlier in literature than /in/ → [iŋ]. If publication year could act as a delayed estimate of time of occurrence, then /iŋ/ → [in] is likely to be an older merger than /in/ → [iŋ]. As recent reports regarding both directions are still found, it is suspected that post-/i/ nasals are yet highly volatile in Taiwan Mandarin and the two mergers are in competition with each other, especially in the south. For northern speakers, not much gender effect is found in rule application (i.e. /in/ → [iŋ]), and the merged form is regarded as at least as standard-sounding as the non-merged one. On the other hand, the rules are gender-sensitive in southern speakers. Females favor the /in/ → [iŋ] rule while males prefer the /iŋ/ → [in] rule. In addition, the application of /iŋ/ → [in] appears to be rather erratic and unsystematic, and cannot be easily accounted for by gender or presentation contexts. Therefore, although the two mergers may still be in competition at present, based on the above observations, a higher chance of survival is predicted for the /in/ → [iŋ] merger in the long run.

Previous studies made different proposals for the cause of the two post-/i/ nasal mergers. For /in/ → [iŋ], however, the historical account (C.-y. Chen 1991a) is unlikely, as the rule is not found in Mainland Mandarin. Instead, a similar trend found in Singapore Mandarin (C.-y. Chen 1986, 1991a) suggests Min influence. However, as [in] is allowed in Min, negative transfer seems implausible. That leads to the conclusion that the merger is possibly a genuine innovation in Taiwan Mandarin, which surfaced phonologically as an assimilation rule. That it is a relatively new rule with positive connotations also makes this an attractive cause.

As for the /iŋ/ → [in] merger, it is said to be either due to Min influence (Kubler 1985) or to an innovation of frontness assimilation (Tse 1992, Yueh 1992). As this merger only exists in the south, and southern dialects of Min allow [in] but not [iŋ], it is fairly likely that the merger is due to negative transfer from Min. This would also explain why northerners do not show consistent signs of adopting this rule, as the Chôan dialect allows both [in] and [iŋ], and thus the merger could not have occurred if it is indeed Min transfer. Furthermore, the account corroborates nicely with the negative connotation and the early appearance of the merger in literature, since negative transfer predicts that the merger is highly marked, and should likely have occurred during the

time when most people were monolingual Min speakers and had to learn Mandarin as L2 within a very short time span.

The three merging rules examined in Taiwan Mandarin all display certain degrees of regional discrepancy in merging rates. /əŋ/ → [ən] is fairly robust in the north, and merging rates are condition-dependent. Gender has only a minor influence on non-sentence conditions, with females taking the lead. If merging rates in non-sentence conditions are operationally used as a conservative criterion for determining the developmental progress in the production of the merger, then females are at a mid-to-late Stage 4 of a single norm system, while males are at a late Stage 3 of a dual norm system in Janson's (1983) sound change model, with [ən] taking the lead.

The merger is also fairly popular among southerners, but the sentential merging rates are considerably lower than those in the north. Gender differences are large in non-sentence conditions, with males being more than twice as likely to apply the rule as females. Condition only imposes a strong effect in female speakers. Like the north, the merger is probably at different stages for the two genders (Janson 1983). For females, there is only a single production norm of [əŋ] for /əŋ/, and [ən] is considered as an innovation that only occurs occasionally, implying an early Stage 2. On the other hand, males seem to have already reached a mid Stage 4, with [ən] gradually becoming the single norm.

Compared with /əŋ/ → [ən], /in/ → [iŋ] is even more robust in the north. Merging rates are fairly high regardless of gender and condition. The production of the merger could be considered as at an early Stage 5 in Janson's (1983) model. Although results of the judgment task show that both forms are still considered as equally standard, it can be predicted that the percept of [in] should be gradually waning due to the predominance of [iŋ] realization.

Meanwhile, the merger is common, but not as popular among southerners. The application rates are much lower than those of northerners. Large gender differences exist in non-sentential conditions, with females being more inclined to apply than males. Major context effects were found in male, but not female speakers. This suggests that production of the rule is probably also at different stages for male and female southerners (Janson 1983). For males, the merger is considered to be optional, implying an early Stage 2, while females seem to have gradually shifted to the new norm, indicating an early Stage 4. Both [in] and [iŋ] are regarded as acceptable phonetic forms, with the latter slightly taking the lead.

The minor merger examined in our study, /iŋ/ → [in], exists mainly in southerners. It is a relatively common rule, but the application rates are generally low. There is a non-significant gender effect, with males being more than twice as likely as females tend to apply the rule in the non-sentence condition. A non-significant trend for

presentation conditions was also found in female speakers. This suggests that production of the rule is probably at different stages for the two genders. Females are likely to be at a late Stage 1 (Janson 1983), at which only a single norm of [iŋ] exists, and [in] only occurs occasionally. On the other hand, males start to have dual norms, implying an early Stage 3. Both [in] and [iŋ] are considered as possible realizations for /iŋ/, although the latter is the preferred form. However, since the results of the judgment task indicate that southerners regard this rule as rather nonstandard due to its Min origin, it is of doubt whether this rule will eventually survive all five stages in Janson's (1983) model.

On the other hand, northerners rarely apply the merger in their production, although they should be fairly familiar with the rule due to large constant influxes of southern population into Taipei. As this rule is deemed fairly negative, it is not surprising that they have not readily incorporated the rule into their system despite frequent contact. Therefore, even though northerners are likely to be at early Stage 1 in Janson's (1983) model, the negative percept of the rule makes it difficult to predict whether such a rule would survive long enough for it to undergo all five stages in the model and reach the end state. Longitudinal studies would be needed to see the final outcome of the merger.

Table 7 is a summary of the three mergers based on Janson's (1983) model. In the north, /in/ → [iŋ] is the most advanced in development, followed by /əŋ/ → [ən]. /iŋ/ → [in] is merely a perceptual rule, if it even exists. On the other hand, the developmental progress of the three rules is not as differentiated in the south. In general, /in/ → [iŋ] and /əŋ/ → [ən] are slightly more developed than /iŋ/ → [in], but it is rather difficult to discriminate the former two. If /iŋ/ → [in] is indeed an older rule than /in/ → [iŋ], this would imply that the development of sound changes is not only affected by real time, but is also influenced by other factors, such as connotation of the rule. A rule tends to develop at a quicker pace when it is positively perceived, but its progress will be thwarted when it is deemed negative. In this study, the correlation between progress and perception of the mergers is easily seen. /in/ → [iŋ] and /əŋ/ → [ən] are both more positively perceived in the north than in the south, and they are also at a more advanced stage in northern Taiwan. Similarly, northerners perceive /in/ → [iŋ] as the most positive, /iŋ/ → [in] the most negative, and /əŋ/ → [ən] to be somewhere in-between, which nicely mirrors their developmental trend.

Table 7: A summary of the three mergers based on Janson's (1983) model.

Mergers	North		South	
	Male	Female	Male	Female
/in/ → [iŋ]	Early Stage 5		Early Stage 2	Early Stage 4
/iŋ/ → [in]	Early Stage 1		Early Stage 3	Late Stage 1
/əŋ/ → [ən]	Late Stage 3	Mid/late Stage 4	Mid Stage 4	Early Stage 2

Interestingly, perception of a rule is not solely governed by its origin. A rule of non-negative origin does not naturally invite a strong positive attitude, as was the case with /in/ → [iŋ] and /əŋ/ → [ən] in the south. Even though these two mergers do not originate from Min transfer, southerners' evaluation of the rule is still not as positive as their northern counterparts. Similarly, a rule of negative origin does not necessarily imply strong negative perception, as is the case with /iŋ/ → [in] in the north. Even though the merger is likely due to negative transfer from Min, northerners perceive this rule as much more acceptable than southerners.

In other words, both merging rates and perception of the rules show regional differences. Regional linguistic discrepancy, be it production or perception, is often intuitively linked to dialectal variation, and Min is thus one obvious candidate in our study as the Min dialects prevailing in northern and non-northern Taiwan are phonologically and lexically distinct from each other. However, dialectal variation does not seem to be robustly supported in our study. Except for /iŋ/ → [in], no evidence indicates that the mergers are the direct outcome of Min transfer. It is thus suspected that other regional variations on language performance might be the cause.

Due to political and demographic factors, northern Taiwan, Taipei in particular, has been considered the center of Standard Taiwan Mandarin ever since Taipei became the capital in 1949. It is probably also the most Mandarin-friendly region in Taiwan (Hsu & Tse 2009). Despite the Min majority in the rest of the country, the political status in Taipei and its relatively large Mainlander population (W.-s. Yang 2004) make Mandarin more favorable than Min in the city. The long-term overall Mandarin-only policy has further accelerated the language shift toward Mandarin. This Mandarin-prone trend is also indicated in our study, as northerners in general tend to self-rate themselves as less proficient in Min than their southern counterparts even though they are all native speakers of Min.

As the leading role of Mandarin in Taiwan, northerners are inclined to exhibit more positive attitude and confidence toward their Mandarin. As a consequence, they are more willing to adopt new linguistic changes than southerners. This could explain why the two major mergers investigated in our study, /əŋ/ → [ən] and /in/ → [iŋ], are

both more developed and more positively perceived in the north, and the merging rates are incongruent between the two groups of speakers.

However, this does not easily explain why /iŋ/ → [in] is perceived as more acceptable in the north, as the rule is not even adopted by the speakers. It is suspected that there might be two possibilities underlying this regional difference. One is the power imbalance between standard and nonstandard dialect speakers. Southerners are well aware that they come from a dialectal area that is considered as non-standard. The mainstreaming pressure might thus make them less tolerant of nonstandard forms than their northern counterparts, who are essentially the creators of the mainstream, and are thus “licensed” to judge the acceptability of sound changes. The other possibility might lie in the degree of dialect exposure. Being native residents of an immigrant city should have provided northerners with ample opportunities in encountering dialects from various parts of the country, fostering their tolerance for nonstandard forms. On the other hand, the population composition of southern cities is less fluid. Most residents were born and raised in the area all their lives, and should have had relatively fewer experiences in encountering speakers from other dialects, except for perhaps the standard dialect spoken in mass media, which serves as a constant reminder of the nonstandard status of their own dialect and further intensifies the standard-nonstandard contrast. Therefore, they might be less tolerant to non-standard variants in pronunciation, even if those are from their own dialect. This could possibly explain why northerners judge the [in] realization of /iŋ/ as rather acceptable while southerners do not. It is likely that both factors are at work, and more studies are needed in order to understand the relationship among perception of sound change, dialect status, and resident mobility.

The differential attitude towards the two major mergers, /in/ → [iŋ] and /əŋ/ → [ən], is also interesting. Both northerners and southerners seem to prefer the former to the latter, as can be seen from the judgment task. Southern females even avoid practicing the latter, as is reflected by their merging rates. As mentioned above, although /əŋ/ → [ən] cannot possibly be due to Min transfer, its origin might be Min-related, and the rule might be a solution to the articulatorily difficult [əŋ] sequence for native Min speakers. This might have incurred a slightly negative percept towards the rule. Another possibility for this relatively negative connotation might be over-generalization from rule-rule association. As the /iŋ/ → [in] merger is a result of negative transfer from Min, and could be regarded as a marked trait of nonstandard Mandarin, speakers might have gradually associated all syllable-final /ŋ/ → [n] mergers with some degree of stigmata, regardless of the preceding vowel. Therefore, even though the /əŋ/ → [ən] rule is not due to Min transfer, it still has a slightly negative tinge compared with /iŋ/ → [iŋ]. In other words, of the three mergers found in this study, [iŋ] realizations are deemed as more prestigious than [n] realizations.

The strong contrast in the perception of the two post-/i/ mergers is intriguing, especially for the four speakers who practiced both rules. The two mergers are generally in a counteractive relationship. Speakers that had both rules were less likely to apply either, compared to those who had only one. The effect was especially strong for /in/ → [iŋ]. Even though it is fairly popular among southern females, merging rates decreased drastically when /iŋ/ → [in] was also adopted by the speakers. This probably also partially explains why southern male speakers were less likely to apply /in/ → [iŋ] than females, since they all had /iŋ/ → [in] as well. Similarly, the merging rates of /iŋ/ → [in] more than doubled when speakers did not also have the rule of /in/ → [iŋ], even though it is a fairly marked rule.

Potential factors for this counteractive relationship might be twofold. One possibility might lie in the conflict of attached social connotations. Based on the judgment task, southerners perceive [in] and [iŋ] as equally acceptable for /in/, but only consider the latter as adequate for /iŋ/. Therefore, when simultaneously adopting two rules carrying opposite connotations, one would possibly need to lower the application rates of both in order to mitigate the conflicting struggle between power and solidarity, at least within the same genre. As a consequence, speakers who have both rules tend to show lower merging rates compared to their single-rule counterparts. The other possibility might be cognitively related. By allowing both rules in the phonological system, one might have effectively doubled the number of homonyms in the lexicon, resulting in difficulties in resolving an incoming string of [in] or [iŋ], especially when both rules were not (yet) absolutely obligatory. Lowering merging rates might be a strategy employed by speakers to minimize confusability in word recognition in speech communication.

In general, southerners are more heterogeneous than their northern counterparts in merger application, and they vary from one end of the spectrum to the other. There are speakers who have only one merger rule of /iŋ/ → [in] ($N = 1$) or /əŋ/ → [ən] ($N = 1$), but there are also speakers who have two, either /in/ → [iŋ] and /əŋ/ → [ən] ($N = 2$), or /iŋ/ → [in] and /əŋ/ → [ən] ($N = 3$). Finally, there are speakers who have all three rules ($N = 4$). On the other hand, the variability of northerners is not as drastic. Most speakers have two rules, /in/ → [iŋ] and /əŋ/ → [ən] ($N = 8$). There are few speakers that only had one rule, /in/ → [iŋ] ($N = 2$), and only one speaker that had all three rules. If the sample in this study is representative, then one could conclude that most northerners have two mergers in their system, while southerners could have one, two, or three rules instead. It is rather difficult to explain away the variability in the south by speakers' hometown location, length of stay in Taipei, or Min proficiency. However, the discrepancy between northerners and southerners might at least partially explain why results in previous studies do not coincide with one another, especially when speakers were not restricted

to native residents of an area, and immigrants from other places might have thus been (unintentionally) included.

Regardless of the attached connotations, the mergers tend to show sensitivity to different registers, especially for /in/ → [iŋ] and /əŋ/ → [ən]. Speakers are more likely to apply the rule in relatively informal contexts in which they are presumably not as aware of their pronunciation than more formal ones. Interestingly, using the phonetic *zhuyin* system did not induce more careful speech than the Chinese characters. The difference lay grossly between monosyllabic representations and sentences. It is suspected that the sensitivity to formality is likely because the mergers have not yet reached Janson's (1983) Stage 5, whereby the sound change process is complete. However, the effect of formality is mitigated when the rule becomes more advanced in development, as was the case of /in/ → [iŋ] in the north. Speakers tend to apply the merger regardless of contextual differences. The only obvious exception to this trend is probably the /iŋ/ → [in] merger. No statistical significance was found among the three presentation conditions, although there did seem to be a trend in female production. This insensitivity might be due to its origin of negative Min transfer, which is very difficult to suppress, given the frequent usage of Min and the higher level of Min proficiency in the south. Further studies are needed in order to confirm the differential sensitivity to formality in stigmatized rules.

5. Conclusion

This study looks at syllable-final nasal mergers in Taiwan Mandarin. Three mergers, /in/ → [iŋ], /iŋ/ → [in], and /əŋ/ → [ən], are found to be commonly applied by speakers of the language. /iŋ/ → [in] is found only in southern speakers and is perceived as a negative rule possibly due to transfer from Min. On the other hand, /in/ → [iŋ] and /əŋ/ → [ən] are common to both northerners and southerners, and are likely genuine innovations of non-Min origin, although the latter could also be due to ease of articulation by early Min native speakers acquiring Mandarin within a very short time span through a group second language acquisition process. The developmental progress of the three mergers seems to be a combined result of rule connotation and speaker confidence, and is different among the rules and also between dialectal regions. /in/ → [iŋ] in the north is the most advanced in progress and has reached near complete phonologization while /iŋ/ → [in] is the least developed and will probably not follow through all the stages to become a complete merger. Interestingly, rule connotation does not seem to be solely determined by the cause of the merger, but is also correlated with the speaker confidence level. In general, northerners are more receptive to new rules than southerners, regardless of connotation polarity, even for rules they do not practice.

Connotation values also arise through analogy, as is the case with /iŋ/ → [in] and /əŋ/ → [ən]. The latter seems to have acquired a slightly negative tang because it has a similar phonological change as the former.

Therefore, if rules of similar connotation values should preferably be represented by a common phonological process in order to better reflect their status in the mental grammar, then one should probably employ different processes to capture the dialectal differences regarding the three mergers. For northerners, both /in/ → [iŋ] and /əŋ/ → [ən] could be best described by a prestigious [αhigh] assimilation. For southerners, /in/ → [iŋ] could still be represented by a similar [+high] assimilation, as the rule is deemed rather highly, while /iŋ/ → [in] and /əŋ/ → [ən] should probably be more suitably characterized by a stigmatized [–back] assimilation. In general, speakers' reactions towards positive rules are fairly similar. Female speakers tend to take the lead during rule development but gender differences are mitigated once the rule is more mature and close to complete. On the other hand, speakers' reactions towards negative rules are less homogeneous. Depending possibly on the origin of the rule and the cause of the negative connotation, males take the lead sometimes (/əŋ/ → [ən] and /iŋ/ → [in] in the south), but choose not to apply the rule at all in other cases (/iŋ/ → [in] in the north). Except for rules originated from negative transfer, all rules in progress are fairly sensitive to formality differences, but the sensitivity winds down once the development of the rule is close to complete. Rules due to negative transfer seem very difficult to suppress, even in careful speech, and formality thus does not seem to play as much of a role in rule application. Future studies would be required in order to understand how origin, connotation, and the development of rules interact with one another in determining the survival and vitality of rules.

Appendix 1

The following table shows the stimuli used in Experiment 1. Sentence-final underlined syllables were the target stimuli and the sentences were the carriers.

Sentence	Gloss
[i] set	
<i>Wang laoshi feichang you <u>aixin</u>.</i>	Mr. Wang is very kind-hearted.
<i>Wo-men yao qu kan <u>liuxing</u>.</i>	We are going to watch meteors.
<i>Xin lai de tongxue jiao <u>Xiaomin</u>.</i>	The new classmate is Xiaomin.
<i>Mingtian wo yao qu <u>baoming</u>.</i>	I am going to sign up tomorrow.
<i>Xiedai bu yao bang tai <u>jin</u>.</i>	Do not tie the shoelaces too tightly.
<i>Gege dai pengyou kan <u>yejing</u>.</i>	My brother took his friend to watch the night view.
<i>Xuexiao jiu zai wo jia <u>fujin</u>.</i>	The school is near my place.
<i>Ta-de mingzi jiao <u>Yijing</u>.</i>	Her name is Yijing.
[ə] set	
<i>Zhe-jian yifu bu tai <u>heshen</u>.</i>	The clothes do not fit well.
<i>Ta shi Li laoshi-de <u>xuesheng</u>.</i>	He is Mr. Li's student.
<i>You shi ge wennuan de <u>zaochen</u>.</i>	It's another warm morning.
<i>Wo-de hao pengyou jiao <u>Dacheng</u>.</i>	My good friend is called Dacheng.
<i>Wo mai-le yi-ge <u>baozhen</u>.</i>	I bought a pillow.
<i>Xiaohua changchang fuzhuang bu <u>zheng</u>.</i>	Xiaohua is often dressed untidily.
<i>Zhe shi ge keai de xiao <u>zhen</u>.</i>	This is a small lovely town.
<i>Banzhang yao fuze han <u>lizheng</u>.</i>	Squad leaders are responsible for calling attention.
[a] set	
<i>Baba-de dongxi bu yao <u>fan</u>.</i>	Don't rummage through Dad's stuff.
<i>Zhe shi ge haowan de <u>difang</u>.</i>	This is a fun place.
<i>Wo-men keyi tan-yi-<u>tan</u>.</i>	We can talk about it.
<i>Xingqitian yao shang jiaotang.</i>	We go to church on Sundays.
<i>Xiaohui lian zuochuan dou bu <u>gan</u>.</i>	Xiaohui does not even dare to ride a boat.
<i>Yufu ba chuan ting zai <u>yugang</u>.</i>	Fishermen anchored boats at the fishing harbor.
<i>Chuqu de men shi ling yi-<u>shan</u>.</i>	The exit is through another door.
<i>Shubao bu yao fang zai di-<u>shang</u>.</i>	Don't put the school bag on the floor.

Appendix 2

The following table shows the stimuli used in Experiment 2. Target syllables are underlined.

/iŋ/-syllable		/in/-syllable		/əŋ/-syllable	
<i>g<u>ex</u>ing</i>	‘pop singer’	<i>ai<u>x</u>in</i>	‘kind heart’	<i>xue<u>sh</u>eng</i>	‘student’
<i>an<u>j</u>ing</i>	‘quiet’	<i>fu<u>j</u>in</i>	‘nearby’	<i>li<u>zh</u>eng</i>	‘come to attention’
<i>yan<u>j</u>ing</i>	‘eye’	<i>huang<u>j</u>in</i>	‘gold’	<i>rou<u>g</u>eng</i>	‘meat broth’
<i>gao<u>x</u>ing</i>	‘happy’	<i>hui<u>x</u>in</i>	‘reply a letter’	<i>bang<u>ch</u>eng</i>	‘platform scale’
<i>lao<u>y</u>ing</i>	‘eagle’	<i>fa<u>y</u>in</i>	‘pronunciation’	<i>liu<u>ch</u>eng</i>	‘orange’
<i>nian<u>l</u>ing</i>	‘age’	<i>lai<u>b</u>in</i>	‘guest’	<i>tiao<u>sh</u>eng</i>	‘jump rope’

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台灣華語音節末鼻音合流之方言變異

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本文說明台灣華語音節末鼻音合流之方言變異：北部有 /in/ → [iŋ] 及 /əŋ/ → [ən]，南部則外加 /iŋ/ → [in]。前二者為新規則，後者則源於閩語負遷移。規則意涵似由起源、類比與說者信心度決定。/iŋ/ → [in] 因閩語負遷移而污名化，/əŋ/ → [ən] 則經類比而帶負面意涵，/in/ → [iŋ] 則相當正面。北部人為標準語代表，對合流語形接受度較南部人高。規則意涵與發展進程成正比。/in/ → [iŋ] 最接近完全音韻化，/əŋ/ → [ən] 次之，/iŋ/ → [in] 最慢。同時具 /in/ → [iŋ] 與 /iŋ/ → [in] 者之合流率較僅有單一規則者低。推測社會意涵衝突及認知負荷增加為主因。

關鍵詞：音節末鼻音合流，方言變異，規則感知，規則發展進程