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## Testing a Production Model of Taiwanese Tone Sandhi

James Myers\* and Jane Tsay  
National Chung Cheng University  
lngmyers@ccunix.ccu.edu.tw

### ABSTRACT

This three-year project has been studying the production of phonology and morphology in Taiwanese (Taiwan Southern Min), using both acoustic-phonetic and reaction-time experimental methods. Taiwanese tone sandhi and reduplication both have unique properties that are of great importance for models of language production, and since these processes interact, Taiwanese provides an ideal opportunity to test theories of language production that have been developed so far primarily with data from European languages. Since some of our experiments require experimentally manipulating lexical frequency effects, this project also involves a component wherein we compile a corpus of adult spoken Taiwanese. In Year 1 we concentrated on tone sandhi, the alternation between tone in juncture position (e.g. utterance-finally) and in context position (e.g. within a word). It has been hypothesized that the production of such alternations in fluent speech does not involve the changing of one tone into another, but rather the selection of lexical allomorphs appropriate to the environment (Hsieh 1976, Wang 1995, Tsay and Myers 1996). Building on recent work (Tsay 1998, Tsay, Charles-Luce and Guo 1999), we found support for this lexical allomorph hypothesis with acoustic experiments which confirmed that the lexical effect even applies across word boundaries and that it is not affected by pragmatic context.

Keywords: psycholinguistics, phonology, tone, Taiwanese, corpus

#### 1. Introduction.

The goal of our three-year research project *The Interaction of Tone and Morphology in the Production of Taiwanese* (NSC 89-2411-H-194-006, 89-2411-H-194-053) is to study the production of phonology and morphology in Taiwanese (Taiwan Southern Min) from a psycholinguistic perspective. In Year 1, the goal was to test a specific production model of Taiwanese tone sandhi (TTS); in Year 2 we have been looking at the processing of reduplication (chosen because of its interaction with TTS), and in Year 3 we will study how TTS and reduplication (in particular, triple reduplication) interact. This report briefly focuses on Year 1, first sketching out the theoretical and methodological background (section 2), then describing the methods and results of our experiments, which have relied on acoustic-phonetic methods, whose power to test psycholinguistic processing models have too often been neglected (section 3). Since some of the experiments of Years 2 and 3 require the manipulation of lexical frequency effects, we also describe the initial efforts we made in Year 1 to develop a corpus of adult spoken Taiwanese (section 4). We conclude with a brief discussion of work for Years 2 and 3 currently in progress (section 5).

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## 2. Background

### 2.1 The production of morphology, phonology and phonetics

Language use involves both comprehension and production, but far more work has been done on the former than the latter (for example, only two of the thirty-four chapters in the *Handbook of Psycholinguistics* [Gernsbacher 1994] are devoted to adult language production). Nevertheless, researchers have reached some consensus about what goes on during the lexical retrieval and pronunciation of words.

Word production begins with the retrieval of semantic and syntactic information (Levelt 1989, Bock and Levelt 1994). We will not say anything about these early stages except that evidence is quite strong that they are well under way before information about word form becomes available (Caramazza 1997, Peterson and Savoy 1998).

Traditionally, linguistics has described the form of a word under three headings: morphology, phonology, and phonetics. The English word *cats*, for instance, has the abstract morphological structure of CAT + PLURAL. The CAT morpheme is realized phonologically as /kaet/, an arbitrary fact that native speakers must memorize, but the phonological form of the PLURAL morpheme is predictable for speakers who know the rules of English: it must be /s/ in *cats*, /z/ in *dogs*, and /ɪz/ in *horses*. Phonetically, the form /kaet/ is pronounced with aspiration on the /k/, a fact that is not relevant for making lexical distinctions, since /k/ is always aspirated word initially (and is not in other positions, e.g. after /s/ as in *scat*). Linguists have assumed that these three aspects (morphology, phonology, phonetics) come into play in sequence during language processing.

While the question of the on-line interaction between morphology and phonology still remain quite unclear from lack of data (especially in production), much more research has been done on the question of the differences between phonology and phonetics. Scholars have long made a distinction between linguistic sounds as psychological objects and as physical objects, codified into the phonemic principle: a relatively small set of lexically distinctive sound categories in the mind (phonemes and tonemes) are systematically mapped (by allophonic rules) onto the wide variety of sounds physically present in speech. These two levels of representation have been given a variety of labels in the linguistic literature, including phonological vs. phonetic (as we have done above), (morpho)phonemic vs. allophonic, and lexical vs. postlexical (Kiparsky 1982). The idea has also found support in the psychological literature on speech production; Levelt (1989), for instance, calls the two levels segmental spellout and phonetic spellout, and explicitly states that they apply in temporally ordered stages. In our research we have adopted the terms lexical and postlexical, since they suggest the primary difference we are interested in. Namely, the lexical stage of phonological production involves the retrieval of the phonological representation of words stored in the mental lexicon, while the postlexical stage involves the modification of this representation in fluent speech without using lexical information (e.g. morphological structure).

Linguists have isolated a set of diagnostics that usually allow one to distinguish lexical and postlexical phonological patterns, some of which are listed below.

(1) Lexical rules vs. Postlexical rules (see e.g. Hargus and Kaisse 1993)

<u>LEXICAL</u>	<u>POSTLEXICAL</u>
word-bounded	not word-bounded
may refer to morphology	cannot refer to morphology
may have exceptions	automatic
semi-productive	fully productive
structure-preserving	need not be structure-preserving
categorical	may be phonetically gradient

For example, English speakers pronounce different vowels in morphologically related words such as "serene" and "serenity". This systematic pattern (also found in many other word pairs) is clearly lexical: it only occurs within words; it refers to morphological structure (the vowel only changes when specific suffixes are used); it has lexical exceptions (such as "obese"- "obesity"); it is at best semi-productive (e.g. Wang 1985 found that native speakers will not consistently apply it in nonsense words).

The last two properties in the above list deserve special focus. A phonological pattern is structure-preserving if it does not create sounds that are not lexically distinctive; that is, it only involves the distribution of phonemes (or tonemes), not the creation of allophones (Kiparsky 1982). The categorical/gradient distinction is similar, but weaker. A categorical pattern may be described with discrete elements, which may be lexically distinctive phonemes, but may also be allophones, as long as they are discrete. A gradient pattern is the opposite: it can only be described with nondiscrete, continuously varying physical parameters (as in the gesture-based model of Browman and Goldstein 1992). Since this vowel alternation is clearly structure-preserving (the phonologically derived vowel in "serenity" is the same as the nonderived vowel in "ten"), it is therefore also categorical. All of its properties, then, point to its being processed at the lexical stage of phonological production. This means that the vowels in "serene" and "serenity" are already different in the mental lexicon, in spite of their systematic relationship; all that happens on-line is the selection of the appropriate allomorph (i.e. form of the morpheme).

By contrast, flapping in English (as in "city" /sIti/ > [sIDi]) is often given as the prototypical example of a postlexical pattern. It is not word-bounded (as in "get it" /gEt It/ > [gEDIt]); it does not refer to morphology; it has no lexical exceptions; it is fully productive; it is not structure-preserving (the flap [D] is not distinctive in English); and it may be gradient. Thus flapping must be produced in the postlexical stage, when the phonological representations retrieved from the lexicon are modified during articulation.

There is also psycholinguistic evidence for these two stages (lexical vs. postlexical). First, during language change, which reflects acquisitional processes, lexical patterns diffuse through the lexicon on a word-by-word basis, whereas postlexical patterns affect all words in the lexicon at once, suggesting that their processing does not involve lexical access (see e.g. Kiparsky 1988). Second, the study of aphasia has shown a double dissociation between phonological errors produced at the lexical stage vs. at the postlexical stage. Thus some patients show phonemic paraphasia, which are disturbances in the planning of phonological representations without any problems in articulation, while others have intact lexical representations but disordered articulation (Caplan 1992). Third, the study of speech errors in non-aphasics suggests that errors that shift, insert or delete phonological

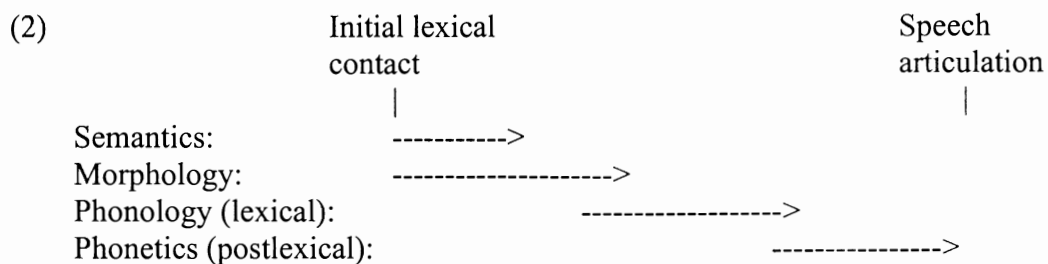
elements occur before the postlexical stage, because the elements that are affected are always categorical phonemic units, not gradient allophonic properties, and because the errors always trigger the application of appropriate postlexical processes (e.g. Mohanan 1982, Stemberger 1983, Shattuck-Hufnagel 1986, Levelt 1989). However, such errors also trigger allomorph selection for productive morphology (e.g. Myers 1993, Stemberger and Lewis 1986, Levelt 1989), showing that speech error evidence alone is not sufficient to demonstrate the existence of separate lexical and postlexical stages.

One final diagnostic for postlexical phonology should be mentioned, since it has been relevant to our experiments of Year 1. Apparently unlike lexical phonology, postlexical phonology can be "turned up and down" on-line in different speaking contexts. Thus when asked to give contrastive minimal pairs (e.g. "atom" vs. "Adam"), speakers suppress postlexical operations that normally neutralize distinctions (Labov 1994). Charles-Luce (1993, 1997) has found that such suppression of neutralization can be triggered both by linguistic factors (semantic context of a passage read aloud) and by social factors (namely whether or not a listener is present). This does not seem to be true of lexical phonology; an English speaker cannot pronounce the vowel in "serenity" more like that of "serene" in order to emphasize that the words are morphologically related. In other words, postlexical phonology interacts with pragmatics (the context of speaking), whereas lexical phonology does not.

These differences between lexical and postlexical phonology imply that their processing not only occurs at different stages, but that they are in fact processed in different ways. Presumably postlexical phonology involves mapping abstract mental representations onto articulatory gestures (e.g. Keating 1990, Zsiga 1995), but how is lexical phonology processed? Clearly patterns like "serene"- "serenity" are not simply stored in a passive memory, since then how could native speakers generalize them (or other more productive lexical patterns) to new cases at all?

The evidence suggested by a growing body of evidence is that the processing of lexical phonology involves selection of words and allomorphs from memory, with the sporadic generalization to novel cases handled by exemplar-driven analogy. For a long time the notion of analogy has not been taken seriously by linguists, but recent developments (including connectionism; see Myers 1998-2001, Tsay 1998-2001) have provided researchers with explicit models that can handle both linguistic and psycholinguistic evidence for analogical processing. In recent work (Myers 2000) we ourselves have built a new kind of explicit model of phonological analogy, founded on generative linguistic formalisms, that also makes testable quantitative predictions for psycholinguistics (see also Skousen 1989, Bybee 1994, 2000, Eddington 2000). One central goal of this project, then, has been to find out how well an allomorphy approach to lexical phonology is supported by psycholinguistic evidence from Taiwanese.

Summarizing, then, the production of lexical items seems to involve the following processes which operate in an essentially sequential fashion.



## 2.2 Methodologies for the study of processing stages in production

One reason for the relative paucity of research on language production noted above arises from the methodological difficulties involved. In this section, we briefly provide background on some of the methods this project has used or is using to study production in Taiwanese.

The most straightforward method is to collect naturally occurring speech errors (see Dell 1995 for a recent review) or to induce them experimentally (see Baars 1992), but both methods have their pitfalls (see e.g. Cutler 1982, Chen 1998) and we have not used them in the present project.

Experimental studies of normal word production attempt to control what speakers will say by the use of reading or picture-naming tasks. Reading tasks are rather problematic for use in languages with alphabetic writing systems such as English or Dutch, but may be less so in Sinitic languages, where there are far fewer cues to phonological form in the orthography. Picture-naming tasks (a recent review is Glaser 1992) avoid the problem of orthographic influence, though care must be taken to find words that can be pictured, and pretesting must be done to determine what names are typically given to each picture.

One form of such production tasks is often incorrectly dismissed by psycholinguists as merely "phonetics": the careful measurement of the physical properties of speech. However, such techniques have provided important evidence for processing models of word production. First, regarding models of morphological processing, Guy (1991) has used variations in the application of speech production rules (namely the optional deletion of final /t/ and /d/ in words like *lift*, *left* or *laughed*) to demonstrate a complex on-line interaction between phonology and morphology in English. Myers and Guy (1997) show that, as predicted, the phonology in this process shows lexical frequency effects only when it interacts with irregular inflection. Myers (1996) describes a controlled acoustic experiment studying this same process, suggesting that the lexical component of variable t/d deletion is categorical, while the postlexical component is gradient. Finally, Losiewicz (1992) argues for a lexically-driven production model of English inflection by showing that the phonetic duration of the regular past-tense suffix *-ed* is influenced by lexical frequency.

Such methods have been even more useful for testing models of phonological processing. For example, Peng (2000) used acoustic methods to determine that third-tone sandhi in Mandarin is postlexical, while Myers (1997) used similar methods to suggest that in Mandarin, the lexically idiosyncratic tone sandhi of the morpheme — "one" does not conform well with current models of lexical and postlexical processes in phonological production. Another recent example quite relevant to our own study of Taiwanese tone is Zsiga (1995), who investigated palatalization of /s/ in English. Generative phonologists have argued that palatalization in word pairs like "confess"-"confession" is lexical, since the process is word-bounded and sensitive to morphology, while in phrases such as "press your

point" palatalization is postlexical. If this is true, we then expect lexical palatalization to be categorical and structure-preserving, while postlexical palatalization should be gradient and allophonic. Support for this prediction in Zsiga's study included a comparison of noise frequency showing that the lexical palatal of "confession" was consistently lower in frequency than that of the postlexical palatal of "press your", which did not drop down into the lexical palatal range until the very end of the segment's articulation. Moreover, the articulation of the palatal in "confession" was essentially identical to that of the underived palatal in "fresh". In other words, lexical palatalization is categorical and structure-preserving and postlexical palatalization is gradient and allophonic, just as predicted. In Year 1 we have used (and in Year 3 will again use) methods similar to this to determine the role of lexical and postlexical processes involved in tone production in Taiwanese.

In spite of their usefulness, however, acoustic studies cannot tell us the actual time course of production. To do this, one must study reaction-time (RT) measures as an effect of various on-line manipulations. One example of such methods is Schriefers, Meyer and Levelt (1990), which describes a picture-word interference paradigm in the study of language production in Dutch. In this paradigm, subjects are shown pictures and asked to name them, while at the same time they hear auditorily presented spoken words. Two factors were experimentally varied: the linguistic relationship between the spoken words and the target picture names (semantically related, phonologically related, or unrelated), and the timing of the auditory relative to the visual stimuli (the stimulus onset asynchrony, or SOA, which was 150 msec before, simultaneous, or 150 msec after). It was found that the semantically related words only affected RT early in processing (i.e. when the SOA was -150 msec), while the phonologically related words only affected RT later in processing (i.e. when the SOA was 0 or +150 msec). This difference strongly suggests that semantics is processed before phonology in language production. In Year 3 of this project we hope to explore the possibility that similar techniques can also be used to probe the time-course of morphological and phonological processing. Though this has never been done, Andruski, Blumstein, and Burton (1994) were able to show that subphonemic variations in primes do affect lexical decision times in targets, but only with short SOA's, a finding consistent with hypotheses where postlexical representations are only activated at a later stage of processing.

### 2.3 Taiwanese tone sandhi

Taiwanese is a dialect in the Southern Min branch of the Chinese (Sinitic) family. For the most part, our research concerns the dialect spoken in the southern area of Taiwan including Chiayi, Tainan, and Kaohsiung counties.

Taiwanese has seven lexical tones: Yinping (陰平), Yangping (陽平), Yinshang (陰上), Yinqu (陰去), Yangqu (陽去), Yinru (陰入), and Yangru (陽入). Each of these tones has two alternative forms, one appearing in juncture position, the other in context position, a phenomenon called Taiwanese tone sandhi (TTS). Juncture tones are found utterance-finally and context tones are found word-internally (as within compounds or reduplicated forms). More generally, the juncture/context distinction involves syntactic structure: juncture tones appear at the right edge of an XP (see Chen 1987 and Lin 1994). Examples are shown below. For the sake of clarity and simplicity, throughout our discussion we use historical labels for the tone categories, given the various incompatible numbering systems currently in use in the literature. Phonetic tone values based on those described by R. Cheng (1968);

romanization is based on the system we have adopted for our corpus.

### (3) Taiwanese Tone Sandhi

Tone	Juncture Position	Context Position
Yinping	詩 si <sup>55</sup> "poetry"	詩文 si <sup>33</sup> -bun <sup>24</sup> "poetry & prose"
Yangping	時 si <sup>24</sup> "time"	時間 si <sup>33</sup> -kan <sup>55</sup> "time span; time"
Yinshang	死 si <sup>52</sup> "die"	死人 si <sup>55</sup> -lang <sup>24</sup> "dead people"
Yinqu	四 si <sup>21</sup> "four"	四點 si <sup>52</sup> -tiam <sup>52</sup> "four o'clock"
Yangqu	寺 si <sup>33</sup> "temple"	寺僧 si <sup>21</sup> -cing <sup>55</sup> "temple monk"
Yinru	色 sik <sup>2</sup> "color"	色彩 sik <sup>4</sup> -chai <sup>52</sup> "color"
	摺 cih <sup>2</sup> "fold"	摺衫 tsi <sup>52</sup> -sann <sup>55</sup> "fold clothes"
Yangru	熟 sik <sup>4</sup> "ripe"	熟茶 sik <sup>2</sup> -te <sup>24</sup> "baked tea"
	白 peh <sup>4</sup> "white"	白色 pe <sup>21</sup> -sik <sup>2</sup> "white color"

It has been hypothesized that the production of the tone sandhi alternations in actual speech does not involve changing one tone into another, but rather the selection of allomorphs (juncture or context) appropriate to the environment (e.g. Hsieh 1976, Wang 1995, Tsay and Myers 1996). For this reason we prefer the terms "juncture tone" vs. "context tone" rather than terms like "basic tone" vs. "derived tone", which imply a particular processing model which we believe is false.

There are a number of independent arguments for this conclusion. First, Taiwanese tone sandhi is phonetically unnatural in the sense that it is impossible to describe all of the alternations as a single process (raising, say, or the creation or loss of contours). In fact, even the most creative analyses cannot describe it with fewer than three rules or other mechanisms (Yip 1980, Tsay 1991, 1994). This alone does not prove that tone sandhi is lexicalized, but it is certainly consistent with it.

Second, Taiwanese tone sandhi is only semi-productive, which is typical of a process mediated by the lexicon. Experiments by Hsieh (1970, 1975, 1976) and Wang (1995) have shown that native speakers do not apply tone sandhi consistently. For example, Hsieh (1975) reports that when native speakers were asked to produce the context form of a morpheme given its juncture form, or vice versa, they did not apply tone sandhi correctly in all cases. This is more in accord with the hypothesis that the production of tone sandhi involves accessing forms from the lexicon than with the view that a general postlexical rule is applied to all lexical forms.

Third, Tsay (1997, 1998) has shown that lexical frequency is a factor in the processing of tone sandhi, at least in compounds. Specifically, for a morpheme whose context allomorph is more frequent than its juncture allomorph, compounds where this morpheme appeared in context position were responded to more quickly in a lexical decision task than compounds where this morpheme appeared in juncture position.

Finally, Taiwanese tone sandhi is categorical and, at least in some varieties, also structure-preserving. That is, the tone alternations in tone sandhi do not involve allophonic tones that vary gradually, but rather involve distinct tone categories, usually ones that also make lexical distinctions in the language. As can be seen from the above table, in the variety of tone sandhi that we are studying, all context tones are included in the set of possible juncture tones, and the juncture tones [55] and [24] neutralize as [33] in context position. These observations were confirmed in an acoustic-phonetic study reported in Tsay, Charles-Luce and Guo (1999): the pitch of



a juncture [55] is indeed identical to that of a context [55], and the neutralized context [33] tones are indeed the same. By contrast, this study found that otherwise identical juncture and context tones differed in duration, a gradient postlexical property. Admittedly, tone sandhi in some Taiwanese varieties may not be structure-preserving (e.g. in coastal dialects the context form of [51] is [35], which is never used as a juncture tone; see e.g. Yip 1980), but there is no reason to expect tone sandhi to be processed in dramatically different ways in these varieties. Perhaps future phonetic studies (outside of the current project) will confirm whether or not tone sandhi is phonetically categorical in these varieties, but in any event there does seem to be a clear contrast between the nature of Taiwanese tone sandhi and that of third-tone sandhi in Mandarin, which has been shown unambiguously to be gradient in production (Zee 1980, Peng 2000). Categoricality and structure preservation are classic diagnostics of lexicon-internal phonology as opposed to postlexical phonology (see above), and suggests that Taiwanese tone sandhi does indeed involve the selection of distinct allomorphs from the lexicon rather than the generation of tones in phonetic spellout.

Though the hypothesis of the lexical nature of tone sandhi presented by Tsay and Myers (1996) seems quite plausible, most of the evidence so far is circumstantial. Thus one of the goals of Year 1 (and also Year 3) is to test the hypothesis more thoroughly.

#### 2.4 Why a corpus?

During all three years of the project, the development of a corpus of spontaneous spoken Taiwanese is an important goal. The primary purpose for this is to calculate values for lexical frequency that are necessary for some of our experiments for Years 2 and 3, briefly described in section 5. Although the primary purpose of the corpus is to obtain frequency counts, it of course may also prove useful by itself for testing hypotheses about the production tone sandhi, compounding and reduplication. Moreover, the corpus will likely be of use to many outside researchers or other interested parties, and so we plan to make it publicly available as soon as possible.

### 3. Phonetic evidence for the lexical nature of Taiwanese Tone Sandhi

The Year 1 experiments tested two predictions made by the hypothesis that TTS production involves allomorph selection rather than on-line generation of sandhi tones: TTS should be categorical even when it applies across word-boundaries, and TTS should be unaffected by pragmatic context.

#### 3.1 Experiment 1: Context neutralization in word-final position

Motivation: As noted earlier, Tsay, Charles-Luce, and Guo (1999) found that Yinping and Yangping are indeed neutralized in context position as [33], suggesting that tone sandhi is a lexical process. However, since these context positions were always within words, a critic could charge that in such a case tone sandhi is of course lexical, since compounds are likely at least sometimes to be retrieved as wholes rather than always compounded on-line. Thus this experiment aimed to strengthen the argument by putting Yinping and Yangping into positions that produce context tones, and yet are word-final.

Subjects: 10 literate native speakers of Taiwanese, fluent and active users the language and approximately of the same age (average around 30 years) and social background (staff at National Chung Cheng University).

Materials: Similar to the materials of Tsay, Charles-Luce, and Guo (1999), subjects were presented with written sentences containing Yinping and Yangping tones that are neutralized as mid-level [33] in context position. However, here context position was formed word-finally, so that the context tone syllable is separated from the following syllable by various syntactic boundaries (e.g. *N-VP*, *Aux-VP*, *Adv-VP*, *Adj-NP*). For example, in the following sentence pair used in the experiment, (4a) shows a V-N string while (4b) shows a Adj-N string. While conceivably the string in (4b) could be a compound noun, this seems less likely for the string in (4a). Nevertheless, in both cases the first syllable has a context tone because it does not appear at the right edge of an XP. Materials consisted of six such sentence pairs (context Yinping vs. context Yangping), mixed with twelve additional filler sentences designed to hide the purposes of the experiment from the subjects; the full set of materials is given in Appendix 1. (Again the romanizations follow the conventions we have adopted for our corpus; digits indicating tone categories have been suppressed here for clarity.)

(4) Underlined syllables are neutralized to [33]

- a. 伊要捐土地起學校。  
i beh kuan thoo te khi hak hau  
3ps want donate land build school  
"S/he wants to donate land for building a school."
- b. 我要高椅子較好坐。  
gua beh kuan i a kha ho ce  
I want high chair more good sit  
"I want a high chair that is better for sitting."

Procedure: As in Tsay, Charles-Luce, and Guo (1999), subjects were asked to read the sentences aloud in Taiwanese, which were written in Chinese characters on a computer screen in front of them, one sentence at a time in pseudorandom order. The recordings occurred in a sound-proofed room, were made with a Sharp Mini-Disc Player, and analyzed with the Computerized Speech Lab (Kay Elemetrics).

Results and discussion: F0 was measured at two positions within the syllable. As expected, absolutely no significant effects were found by subject at either measuring point (beginning: 125 Hz vs. 126 Hz,  $t(9)=-0.12$ ,  $p=0.91$ ; end: 118 Hz vs. 119 Hz,  $t(9)=-0.10$ ,  $p=0.92$ ). Since context tones here were defined as phrase-internal but not word-internal, the apparently lexical nature of Taiwanese tone sandhi cannot be explained away by claiming that it merely describes a lexical pattern found across words stored in the lexicon. Instead, it appears that it is both lexical (as indicated by the complete tonal neutralization that it causes) and phrasal. This is consistent with the hypothesis of Tsay and Myers (1996), who suggested that speakers apply tone sandhi by selecting juncture vs. contexts allomorphs from memory and placing them in the correct environments in the syntactic structure. That is, while the generation of a particular tonal allomorph does not occur on-line, its selection does.

### 3.2 Experiment 2: Effect of listener presence on tone neutralization

Motivation: This experiment tests the prediction that tone sandhi, as a fundamentally lexical process, cannot be modified on-line by pragmatic context, unlike the results of Charles-Luce (1993, 1997) for postlexical processes.

Subjects: 30 literate native speakers of Taiwanese, fluent and active users the language and approximately of the same age (average around 20 years old) and social background (undergraduates at National Chung Cheng University).

Materials: Twenty written experimental sentences were given to subjects to read aloud in Taiwanese: five pairs containing sequences that involved the neutralization of context Yinping and juncture Yangqu (both realized as [33]), and five pairs containing sentences that involved the neutralization of Yinping and Yangping tones in context position (both realized as [33]). In the former case, disambiguation is possible through the postlexical process of syllable duration (juncture tones tend to be longer than context tones), but in the latter case, disambiguation would require varying pitch itself (which we hypothesize to be impossible, since the tone sandhi allomorphs are simply stored in the mental lexicon). Forty-eight additional pairs of sentences were included as experimentally irrelevant fillers to hide the purposes of the experiment from subjects in one of the conditions; the full set of materials is given in Appendix 2. Examples of these two types of neutralization are given below.

(5) Can be disambiguated by syllable duration  
(context Yinping or Yangping vs. juncture Yangqu, both neutralized as [33])

- a. 這是豬肉及碗。  
ce si ti bah kap uann  
this is pig-meat and bowl  
"This is pork and a bowl."
- b. 這是筷肉及碗。  
ce si ti bah kap uann  
this is chopsticks meat and bowl  
"These are chopsticks, meat, and a bowl."

(6) Cannot be disambiguated by syllable duration  
(context Yinping vs. context Yangping, both neutralized as [33])

- a. 他愛參加軍隊的活動。  
i ai cham ka kun tui e uah tang  
3sp love participate army poss. activity  
"He loves to participate in army activities."
- b. 他愛參加群隊的活動。  
i ai cham ka kun tui e uah tang  
3sp love participate group poss. activity  
"He loves to participate in group activities."

Procedure: Subjects were asked to read the sentences aloud in Taiwanese, which were written in Chinese characters on a computer screen in front of them, one sentence at a time. Subjects had to read each of these four types of sentences aloud in two different conditions: alone in a room, or in the presence of an attentive listener who was (ostensibly) trying to transcribe the subject's words. To emphasize the difference between these "listener absent" and "listener present" conditions, in the first condition the items were randomized with the fillers to make the contrasts less obvious to the speakers, while in the second condition the items were presented as minimal pairs without fillers to make the contrasts more obvious. Also, for all speakers the "listener absent" condition was carried out first, so the minimal pairs were not made obvious until the "listener present" condition. As in Experiment 1, the recordings occurred in a sound-proofed room, were made with a Sharp Mini-Disc Player, and analyzed with the Computerized Speech Lab (Kay Elemetrics).

Results and discussion: The acoustic measures of F0 (in three positions within the syllable) and syllable duration were made on the digitized recordings. Statistical analyses were conducted separately for the neutralization of tone across position (i.e. context Yinping/Yangping and juncture Yangqu) and for the neutralization of tone within one position (i.e. context Yinping and context Yangping). For each of these, and for each acoustic measure, we performed a two-way ANOVA by subject, with the two factors being Tone (i.e. the two neutralizing tone categories) and Listener Presence (i.e. with listener present or absent).

First, for the neutralization across position, we found no significant main effects for the Tone factor, with F0 measured at the beginning, middle, or endpoints, no main effects of Listener Presence, and no interactions (minimum  $p$ -value over 0.28). However, for the measure of syllable duration, we found a highly significant main effect of the Tone condition: juncture tones were significantly longer (214 msec) than context tones (177 msec) ( $F(1,116)=16.32, p<0.001$ ). There was no significant main effect of Listener Presence ( $p=0.15$ ) and no interaction ( $p=0.28$ ).

The lack of significant differences in F0, even with our relatively large number of subjects (for production studies), is consistent with the hypothesis that the allomorphs of Taiwanese tone sandhi are lexically distinct forms that are retrieved from memory rather than generated during speech production planning or articulation. However, as had been found in earlier studies, duration is an important factor distinguishing the articulation of juncture and context tones, presumably because syllable duration is under control during articulation. We had hoped to find further evidence for this control by finding an interaction for durations between the tone categories and the presence/absence of a listener, but the lack of such a finding does not argue against our basic hypotheses. The crucial finding is that it seems to be impossible for speakers to control F0 enough to distinguish context Yinping and juncture Yangqu by that variable alone.

For the neutralization within context position, we found no significant main effects for the Tone factor, with F0 measured at the beginning, middle, or endpoints, no main effects of Listener Presence, and no interactions (minimum  $p$ -value over 0.11). For the measure of syllable duration, we also found no significant main effect of Tone ( $p=0.71$ ) or of Listener Presence ( $p=0.81$ ). Interestingly, however, the interaction between Tone and Listener Presence very nearly reached statistical significance ( $F(1,116)=3.80, p=0.054$ ).

The lack of any effect for F0 confirms once again that neutralization of Yinping and Yangping within context position is indeed complete. It is also unsurprising that

speakers were not able to use duration to distinguish these tones, since both occur in the same prosodic position. What is most interesting, however, is the nearly significant interaction. The patterning of this interaction is highlighted in the following table.

(7) Interaction of tone and listener presence in the duration (msec) of Yinping and Yangping syllables in context position.

	Yinping	Yangping
Listener present	164	179
Listener absent	175	163

As can be seen, with a listener present, speakers produced Yinping with a shorter duration, but with a listener absent, they produced Yangping with a shorter duration. There is perhaps no particular reason why the pattern went this way rather than the reverse; what is important is that speakers were in fact affected by the presence or absence of a listener, but only in their articulation of duration. That is, they were struggling to do something that was in fact impossible: distinguish Yinping and Yangping syllables in context position. Neither F0 or duration can do the job reliably, but for different reasons. According to our hypothesis, F0 cannot be varied meaningfully at all, since Yinping and Yangping syllables are stored in the lexicon in identical forms. By contrast, duration normally is an acoustic cue that can be varied, as in the contrast between juncture and context tones that are the same in F0. Although the prosodic environments for our target words were identical, and so duration normally would be the same, our speakers thus seemed to feel that somehow they could use duration to distinguish between these otherwise identical forms. The difference in listener present and listener absent conditions shows that duration remained under their control, even in this setting where it was in fact useless. This provides strong support for our claim that the F0 contours of tone sandhi allomorphs, which are part of their lexical representations, are not under the control of speakers (whether conscious or semiconscious), in contrast to duration, which is part of the postlexical or phonetic realization of speech and hence is under speaker control.

In short, the results of Experiment 2 are consistent with those of Experiment 1, and with previous experiments (e.g. Tsay, Charles-Luce & Guo 1999), and together provide strong support for the allomorph selection hypothesis of Tsay and Myers (1996).

#### 4. A corpus of adult spoken Taiwanese

Methods: During all three years of the project, we are building a corpus of spontaneous spoken Taiwanese. Since the primary purpose for this is to calculate values for lexical frequencies that are necessary for some of our experiments in Years 2 and 3, this corpus involves an absolute minimum of analysis and tagging. The primary source is a set of local Taiwanese radio programs, which contain a large amount of spontaneous speech on a wide range of topics. The corpus is being put into a modified version of the CHILDES corpus analysis system (MacWhinney 1995, Sokolov and Snow 1994), since we already have much experience in using this (Tsay 1997-2000). See Appendix 3 for a small sample of this corpus.

The greatest difficulties in creating a corpus of Taiwanese are transcriptions and word segmentation. If there were a generally accepted transcription system for

Taiwanese (whether letter-based, character-based, or mixed) we would use it, but instead there are a number of competing systems, none of which is obviously superior to the others. From the requirement that our transcripts be readable by other researchers in Taiwan, the best system would primarily use Chinese characters, but unfortunately there are many Taiwanese words for which the 本字 (*benzi*, or "original characters") are unfamiliar or even nonexistent. As written Taiwanese becomes more popular, conventions are slowly arising for how characters should be used to represent Taiwanese morphemes, but these conventions are not always ideal. For example, the distinct Taiwanese morphemes *theh8* ("take"), *sal* ("take, grab"), and *gia2* ("take, hold") are often written with the same character 拿 (digits represent tone categories in the system adopted for our corpus). On the other hand, from the requirement that our transcripts be easily processed by computer and shared via the CHILDES system, they should be put into a purely romanized form, but unfortunately this makes it extremely difficult for the native Taiwanese speakers who do the transcribing, and there are also many words that are homophonous, which would require an arbitrary diacritic system of some sort. Since the use of characters is sometimes impossible, we have adopted a romanization system (specifically that published by the Ministry of Education in 1998; see 教育部國語推行委員會 (民 87) and Tsay 2000-2002 for further discussion).

The problem of word segmentation is directly related to that of transcription. If the words are not segmented, there is no point in building the corpus; we will not be able to extract word frequencies. Yet standard Chinese orthography does not mark word boundaries. Conventions have been developed for word segmentation in Mandarin (e.g. those of CKIP at Academia Sinica), but it isn't always clear that these conventions are the most appropriate ones, nor that they can be translated mechanically into Taiwanese, which has a somewhat different morphological system.

Together these problems have slowed down building of our corpus far below our expectations, but we have been working on a solution: the use of computer software to ensure reliability and validity in transcription and segmentation across transcribers. Essentially, the program (still in development) consists of two parts: a lexicon and a file-scanning algorithm. The lexicon consists of a list of words that are each identified in three ways: via an "official" orthography (i.e. either Chinese characters or romanization that we have decided to use as the standard written form for that word), via a phonemic transcription (romanization), and via a set of written forms that have been or are likely to be mistakenly used by transcribers instead of our "official" form; see Appendix 4 for a sample of the lexicon, and Appendix 5 for a sample of the corpus after analyzed by a program designed simply to search for matches in the lexicon and enter romanizations.

The purpose of the file-scanning algorithm is to scan through a transcribed file, much like a spell-checker, searching for strings that it does not recognize from its lexicon. When it finds one, it will notify the user of the problem, and offer a set of alternatives from the lexicon (unambiguously identified by their tripartite entries). If the user intends to use one of these, s/he should correct it in the transcript. If the user intends the item to represent a new lexical entry, the program enters it into a temporary lexicon whose contents can be discussed by the project participants at regular intervals, and then entered in some "standard" form into the main lexicon.

A more difficult situation is where the user enters a form identical to one in the lexicon, but actually intends it to represent another word (perhaps even a new word). This would be the case, for example, with the distinct verbs mentioned above that are

often transcribed identically as 拿. There is no sure way to guard against this problem, but the program's strategy is to use a heuristic: the lexicon records the number of times a given item has been encountered in the past. If an item has not been encountered very often, the program will be particularly vigilant, querying the user about it to make sure that it in fact represents the form that is already in the lexicon. If not, the user can change the way the new word is written, in which case it will be entered into the temporary lexicon for discussion by the project participants.

Progress to date: After one year of work, we have recorded over 70 hours of spontaneous adult Taiwanese from radio broadcasts. Of this, over 23 hours have been transcribed. The corpus currently has an estimated size of over 240,000 words (詞). It is expected that this size will grow at a much faster rate once the lexicon program is put into operation.

## 5. Work in progress

### 5.1 The processing of reduplication

The primary goal of Year 2 is to investigate the processing of morphology that affects TTS, the most important of which is triple reduplication. In this year we want to study this as a morphological process alone, isolated from its tonal properties. The methods used involve off-line judgment tasks and on-line production tasks.

Triple reduplication, which only affects monosyllabic adjectives, has the semantic function of making such adjectives more vivid than double reduplication (S. Cheng 1981; R. Cheng 1987; Yang 1991), as illustrated by the examples below. (Tone has been left off here to simplify the presentation.)

- (8) kim            金            "golden"  
 kim-kim        金金        "rather golden"  
 kim-kim-kim   金金金     "very very golden"

As Huang (1992) notes, the construction is morphological, not syntactic, because there are lexically-determined gaps, as illustrated below in (5a); (5b) illustrates Huang's suggestion that triple reduplication is not derived from double reduplication, but is instead an independent process (based on data from S. Cheng 1981).

- (9) a.    gau                            賢            "able"  
           \*gau-gau  
           \*gau-gau-gau
- b.    leng                            靈            "spiritually powerful"  
           \*leng-leng  
           leng-leng-leng

In spite of such gaps, the construction is quite consistent; of the 254 monosyllabic adjectives listed in S. Cheng (1981), Huang (1992) finds only three cases where an adjective may not undergo triple reduplication. Hence it seems plausible to hypothesize that triple reduplication (and reduplication generally in Taiwanese) is productive in processing terms, applying in the stage of "morphological

spellout" of Levelt (1989). A central goal of Year 2 is to test this hypothesis experimentally.

Two interesting findings have emerged so far in our on-going study of Taiwanese reduplication. The first is that it is exceedingly rare; in our growing corpus, we have found very few instances of vivid adjectival reduplication of any kind, and have so far come across only three tokens of triple reduplication (惓惓惓 "taciturn", 同同同 "identical", and ting-ting-ting "extremely hard"). Because of this, the corpus has proven to be useless for its primary purpose: to allow us to vary and control frequencies of reduplicated forms. The second finding comes from a study performed in response to this problem. A set of monosyllabic adjectives was selected and shown to three groups of native speakers; one group was asked to estimate the frequency of the monosyllabic adjectives, another was asked to estimate the frequency of the double-reduplicated form of these adjectives, the third was asked to estimate the frequency of the triple-reduplicated form. The frequency judgments were all highly correlated with each other. While this may be dismissed as an artifact of the method (the characters associated with the forms also varied in frequency, and this could have affected estimates for the reduplicated forms), we also found that when non-reduplicated frequencies were partialled out the correlation between double-reduplicated and triple-reduplicated frequencies remained just as high. This result already hints that in on-line processing of reduplication, speakers generate the forms rather than simply looking them up in memory. However, to be sure, we are currently running an on-line production experiment using a subset of our materials controlled for frequency effects as much as possible, and will report our results at a later date.

## 5.2 Tone sandhi and triple reduplication

In Year 3 we will investigate the production of tone in Taiwanese triple reduplication (henceforth abbreviated as TTR). In addition to the intrinsic interest of understanding an unusual aspect of Taiwanese morphophonology, we also hope to shed light on the important theoretical issue of the time course of morphological and phonological production in human language in general.

The tone patterns found in TTR are illustrated in the following table. The tone values for the initial syllables are based on the acoustic-phonetic data in Du (1988).

### (10) Tonal patterns in Taiwanese Triple Reduplication

<u>Tone</u>		<u>Tone pattern in TTR</u>
Yinping		34-33-55
Yangping		34-33-24
Yinshang		55-55-52
Yinqu		52-52-21
Yangqu		34-21-33
Yinru	-p/t/k	4-4-2
	-?	52-52-2
Yangru	-p/t/k	34-2-4
	-?	34-21-4

The most striking thing about the tonal patterns seen here is the appearance of the non-distinctive tone [34] on the first syllable in tone categories Yinping, Yangping,



Yangqu, and Yangru. This contrasts sharply with the tones on the second and third syllables; the second syllable appears to be identical to that of the "standard" context tone of tone sandhi, and the third is just the "standard" juncture tone. In other words, the process that gives rise to the tone on the first syllable is not structure-preserving. This is apparently true in all varieties of Taiwanese, not just the one that seem to violate structure-preservation in "standard" tone sandhi.

A second observation is that the tone on the first syllable appears to be derivable from a standard context tone by a single consistent process, namely the insertion of a high tone [H]. In the case of Yinping and Yangping, this will change a [33] tone into [34]. In the case of Yangqu, the change is from [21] to [34]. In the case of Yinshang and Yinqu, the inserted [H] would not surface because it is absorbed by the following high tone (i.e. [5]). This suggestion, which has also been made with some variations by Cheng (1973) and Yip (1980), results in the partial derivations shown below, where the inserted [H] is superscripted. (For clarity, we do not show derivations for the short tones, although they pose no special problems.)

(11) Yinping	Yangping	Yinshang	Yinqu	Yangqu
33-33-55	33-33-24	55-55-52	52-52-21	21-21-33
33 <sup>[H]</sup> -33-55	33 <sup>[H]</sup> -33-24	55 <sup>[H]</sup> -55-52	52 <sup>[H]</sup> -52-21	21 <sup>[H]</sup> -21-33
34-33-55	34-33-24	55-55-52	52-52-21	34-21-33

Notice that the existence of such a simple general rule here contrasts greatly with the situation found in standard tone sandhi, which cannot be expressed by any such rule in any variety of Taiwanese.

Du (1988:78) adds a third interesting observation, namely that the tones in the first syllable seem to be phonetically more variable than those found on the second or third syllables. That is, Du's speakers produced a Yinping tone on the first syllable in TTR as [23], [34] or [35]; Yangping as [23], [25], [34] or [35]; and Yinqu as [23], [25], [34], or [35]. By contrast, the first-syllable tones that did not differ from the second-syllable tones (i.e. had the "standard" context tone) showed no such variation.

These three properties (the violation of structure preservation, the existence of a consistent phonetically plausible rule, and variability) are all consistent with a single conclusion: the special tones seen on the first syllable in TTR are due to a postlexical process that applies after the lexical process of standard tone sandhi. There is one clear complication for this conclusion, however, and that is that this special tone change only occurs in a specific morphological environment, namely TTR. Like the fact that "lexical" tone sandhi is not word-bounded, this seems problematic, since according to the lexical/postlexical diagnostics, postlexical processes should not be sensitive to morphological structure. Again we must conclude that these diagnostics are tendencies rather than absolute. In this case, all other characteristics point to a postlexical process.

Thus our hypothesis about the tone pattern in TTR is that it involves ordered stages of different kinds of phonological/phonetic processes. Namely, there is first the lexical process of juncture/context allomorph selection, and then the first syllable undergoes a postlexical process where the tone is changed (by inserting H). We will call this the *Two-Stage Hypothesis*, where a lexical "allomorph/analogy" stage ("standard" tone sandhi) is followed by a postlexical stage (the special tone in TTR).

There are at least two logical alternative hypotheses which we will contrast with our own. According to the *Three-Stage Hypothesis*, speakers would first access one "basic" allomorph (i.e. the juncture form), then derive the other allomorph (i.e. the

context form), and finally derive the special tone on the first syllable. This is the hypothesis that linguists often implicitly assume when they call the context tone the "sandhi tone", i.e. the one that has been changed by rule from its original form as a juncture tone. Following the arguments in Tsay and Myers (1996) and those sketched above, we do not believe that the Three-Stage Hypothesis is correct (hence our complete avoidance of the misleading term "sandhi tone").

Finally, according to the *One-Stage Hypothesis*, speakers would simply retrieve allomorphs from the lexicon; there is only one kind of representation throughout processing. Though generative phonologists would not accept this as a possibility, some researchers (e.g. Bybee 1994, 2000) do seem to assume something like this.

To clarify the differences across the three hypotheses, take the example shown below in (12). In (12a) is the actual form that is uttered; (12b) contrasts the sequence of tonal patterns predicted by the three hypotheses, highlighting the changes in representations from stage to stage. The Two-Stage hypothesis is the one we hold at present. "YQ" stands for "Yangqu", an abstract representation of tone category; it is converted to the correct tone through lexical selection. Note the differences between our Two-Stage hypothesis, in which context-specific allomorphs are selected for each syllable, and the competing Three-Stage hypothesis, in which a single underlying representation is selected for each syllable.

(12) a. [tang<sup>34</sup>-tang<sup>21</sup>-tang<sup>33</sup>] 重重重 "very very heavy"

b.	<u>One-Stage</u>	<u>Two-Stage</u>	<u>Three-Stage</u>
Memory	34-21-33	YQ-YQ-YQ > 21-21-33	YQ-YQ-YQ > 33-33-33
...	34-21-33	21-21-33	<b>21-21-33</b>
Phonetics	34-21-33	<b>34-21-33</b>	<b>34-21-33</b>

Notice that our Two-Stage hypothesis assumes that triple-reduplicated forms are generated on-line, rather than being simply retrieved from memory; it is this assumption that we are currently testing in Year 2 (and which will help falsify the One-Stage hypothesis). Experimental methodologies of Year 3 include both acoustic phonetics (to test for predicted properties of tone contours in the first syllable of TTR forms) and on-line production (to examine the effect of interfering tones of various types, using a design similar to that of Schriefers, Meyer and Levelt 1990).

### 5.3 Concluding remarks

It is hoped that this project will make three important contributions. First, since virtually nothing is known about the on-line processing of Taiwanese, all that we learn will greatly improve our understanding of this language, as well as provide new challenges to psycholinguistic models based primarily on English. Second, the corpus of spoken Taiwanese that we are compiling should be of great use not only to psycholinguists, but also to linguists, researchers in natural language processing, educators, and anyone interested in Taiwanese as a living language. Third, Taiwanese has some unique properties that allow the study of crucial psycholinguistic questions that are difficult or impossible to study in languages like English. For example, in the TTR construction, both lexical and postlexical effects occur in the same initial syllable in the same phonetic parameter of F0, thus making subtle theoretical questions far easier to study than they would be in English.

APPENDICES

Appendix 1: Materials for Experiment 1.

Context Yinping	Context Yangping
伊要絲蕃薯葉仔	伊要辭頭路
伊買一支新茶壺	伊拿盤仔來盛茶米
伊要捐土地起學校	我要高椅仔較好坐
育孫仔真艱苦	搖樹仔真好玩
我被伊揍一下流鼻血	伊前一天去看醫生
伊下晡飛去台北	伊下晡賠四十萬

Fillers	
伊講駛車真難學	下星期我們就開學了
伊在灶腳煮菜	伊去菜市仔買豬肉
三月十八要選總統	這間店開到晚上十一點
我等下要去剪頭髮	這領衫是伊去買的
坐火車真趣味	今晚要去看電影
你爸剛才打電話來	新聞講明天會落雨

Appendix 2: Materials for Experiment 2.

Juncture Yangqu	Context Yinping/Yangping
這是林順春嬌及素華	這是林孫春嬌及素華 (Yinping)
這是被衫及鞋	這是皮衫及鞋 (Yangping)
這是被袋仔及鞋	這是皮袋仔及鞋 (Yangping)
這是阿姘嫂仔及阿兄	這是阿金嫂仔及阿兄 (Yinping)
這是筷肉及碗	這是豬肉及碗 (Yinping)

Context Yinping	Context Yangping
這台是丹小姐駛的車	這台是陳小姐駛的車
這個是布袋戲的秦假仙	這個是布袋戲的真假仙
他愛參加軍隊的活動	他愛參加群隊的活動
我要捐桌子及捐椅子	我要高桌子及高椅子
他竟然驚到昏去，真好笑	他竟然走到昏去，真好笑

Fillers	
他們今天去中山大學報到	他們今天去中正大學報到
他們昨天開車去台中	他們昨天開車去台東
他愛參加你家的活動	他愛參加我家的活動
他說要買椅子	他說要買旗子
這台是老小姐駛的車	這台是劉小姐駛的車
這是山貓及老鼠	這是狗貓及老鼠
這是王林美麗及志明	這是王曾美麗及志明
這是筆書包仔及書	這是尺書包仔及書
這是湯魚仔及飯	這是菜魚仔及飯
這個是布袋戲的小還真	這個是布袋戲的素還真
這是菜魚仔及飯	這是湯魚仔及飯
這是阿姑叔仔及阿伯	這是阿古叔仔及阿伯

Appendix 3: Extract from the corpus before computer segmentation/analysis (note: at the time this sample was taken, the corpus had not yet been updated to our current romanization system).

002:伊交一期的la0a0阮哥仔今仔日無無上班onn0 ?

001:hiau0la0 。

002:a0阮阿嫂仔? a0阮嫂仔去上班a0m0 ?

001:henn0 。

001:a0我攏我攏吃那那ne0 。

002:吃啥?

001:我攏吃吃粥la0 。

002:a0現在2無粥a0吃了a0 。

001:我ko1煮u0我a5不是未曉煮a0la0 。

002:hm0hm0現在敢有人賣芋槐?

001:無有時仔有來有時仔無來 。

002:來不是在自助餐賣?

Appendix 4: Sample of the lexicon designed to help with transcribing and analyzing the corpus (see note for Appendix 3).

Standard	Romanization	Confusable alternatives
安排	an1pai5	
安慰	an1lui7	
安怎樣	an2cuann2iunn7	怎麼樣
ang1	ang1	丈夫、先生、老公、男、尅
ang1a2boo2	ang1a2boo2	匡仔某、夫妻、尅仔某
紅	ang5	紅色
紅彩	ang5chai2	
紅kong3kong3	ang5kong3kong3	紅通通
calpool	calpool	男生、男孩、男人、查甫、諸夫
calpool 囡a2	calpoolgin2a2	男孩、男生、查甫囡仔
尾a0	bue2a0	尾仔、後來、最後、後面
尾a2	bue2a2	尾仔、尾巴

Appendix 5: Extract from the corpus after computer segmentation/analysis using the incomplete lexicon (see note for Appendix 3).

002:伊<i1> 交<kau1>一 期<ki2>的la0a0 阮<guan4/gun4>哥仔今仔日無無 上班  
<sioong5pan1>onn0 ?

001:hiau0la0。

002:a0 阮<guan4/gun4> 阿嫂<a0so4>仔? a0 阮<guan4/gun4>嫂仔去 上班  
<sioong5pan1>a0m0 ?

001:henn0。

001:a0 我<gua4> 攏<loong4> 我<gua4> 攏<loong4>吃 那<he1> 那<he1>ne0。

002:吃啥?

001: 我<gua4> 攏<loong4>吃吃粥la0。

002:a0 現<hen5>在2無粥a0吃 了<liau4>a0。

001: 我<gua4>ko1 煮<cu4/ci4>u0 我<gua4>a5 不<m5> 是<si5> 未曉  
<be5hiau4/bue5hiau4> 煮<cu4/ci4>a0la0。

002:hm0hm0 現<hen5>在敢 有人<u5lang2> 賣<be5> 芋槐<oo5huainn2> ?

001:無 有<u5> 時<si2>仔 有<u5> 來<lai2> 有<u5> 時<si2>仔無 來<lai2>。

002: 來<lai2> 不<m5> 是<si5>在自助餐 賣<be5> ?

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