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PROSODY AND THE ACQUISITION OF GRAMMATICAL MORPHEMES
IN CHINESE LANGUAGES

A DISSERTATION SUBMITTED TO THE GRADUATE DIVISION OF THE
UNIVERSITY OF HAWAII IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY
IN
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MAY 1996

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For those who have contributed to this study
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ABSTRACT

This study examines two issues concerning the acquisition of grammatical morphemes: (1) How is the acquisition of grammatical morphemes influenced by prosodic and phonological characteristics of the language being learned? and (2) What sorts of prosodic and phonological properties do grammatical morphemes have that might aid children in applying particular segmentation strategies? To address these issues, we compared the acquisition of grammatical morphemes in a pair of morphosyntactically similar but prosodically different languages, namely Taiwan Mandarin Chinese (TMC) and Taiwanese (TW). TMC is similar to stress-timed languages in the presence of a contrast between full-toned lexical syllables and neutral-toned functor syllables, while TW is more syllable-timed with fewer neutral-toned functor syllables occurring in phrase-final positions.

We analyzed the patterns of realization and omission of a highly frequent subset of grammatical morphemes in the spontaneous speech of three TMC children and three TW children, recorded between the ages 1;6 and 2;3. An imitation test was also conducted for both groups of children when their MLUs reached above 1.90. Results showed that TW children omitted significantly more functors than TMC children did under both conditions. For TW children, all 7 grammatical morphemes studied were susceptible to omission, regardless of pitch value, grammatical function, frequency in input, and/or position in which they occurred in an utterance. In contrast, neutral-toned grammatical morphemes that closely follow content words were frequently produced in TMC children’s speech. The results from the between-language comparisons suggest that speech
segmentation procedures differ for children learning either TMC or TW as their first language.

These findings suggest that rhythmic characteristics of languages can affect segmentation by providing different kinds of prosodic "handles" for the novice to grasp. Metrical feet may offer TMC children one kind of segmentation handle: neutral-toned grammatical morphemes that closely follow full-toned content words are in position to be "picked up" as parts of unopened packages. In TW, however, since there is no opposition between full- and neutral-toned syllables, all syllables contribute equally to linguistic rhythm, and the syllable more likely functions as a segmentation unit for TW children.
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<th>Description</th>
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<tr>
<td>ASP</td>
<td>aspect marker</td>
</tr>
<tr>
<td>BMC</td>
<td>Mandarin Chinese spoken in Beijing</td>
</tr>
<tr>
<td>CHAT</td>
<td><em>Codes for the Human Analysis of Transcripts</em></td>
</tr>
<tr>
<td>CL</td>
<td>classifier</td>
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<tr>
<td>DIM</td>
<td>diminutive marker</td>
</tr>
<tr>
<td>DUR</td>
<td>durative aspect marker</td>
</tr>
<tr>
<td>GEN</td>
<td>genitive marker</td>
</tr>
<tr>
<td>INTRJ.PAR</td>
<td>interjection particle</td>
</tr>
<tr>
<td>LOC</td>
<td>locative marker</td>
</tr>
<tr>
<td>M</td>
<td>mean</td>
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<tr>
<td>MLU</td>
<td>mean length of utterance</td>
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<td>NEG</td>
<td>negative marker</td>
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<tr>
<td>NOM</td>
<td>nominalizer</td>
</tr>
<tr>
<td>NP</td>
<td>noun phrase</td>
</tr>
<tr>
<td>OBJ.M</td>
<td>object marker</td>
</tr>
<tr>
<td>PL</td>
<td>plural marker</td>
</tr>
<tr>
<td>PROG</td>
<td>progressive aspect marker</td>
</tr>
<tr>
<td>Q.PAR</td>
<td>question particle</td>
</tr>
<tr>
<td>SF.PAR</td>
<td>sentence-final particle</td>
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<tr>
<td>SLI</td>
<td>specifically-language-impaired children</td>
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<tr>
<td>TG</td>
<td>tone group</td>
</tr>
<tr>
<td>TMC</td>
<td>Mandarin Chinese spoken in Taiwan</td>
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<tr>
<td>TW</td>
<td>the Min dialect spoken in Taiwan</td>
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</table>
LIST OF SYMBOLS

( ) noncompletion of a word
0word omitted word
- suffix marker
+ compound or rote form marker
? question
! exclamation
[!] stressing
# pause between words
+... trailing off
+, self-completion
++ other-completion
[*] error marking
= placed between error and target
err error coding
exp explanation
sit situation
CHAPTER 1
INTRODUCTION

1.0 Preliminaries

Cross-language studies have suggested that the prosodic features of parental speech addressed to young children may be language universal (Ferguson 1964; Kelkar 1964; Snow 1972; Remick 1976; Ruke-Dravina 1977; Fernald & Simon 1984; Grieser & Kuhl 1988; Fernald et al. 1989).\(^1\)\(^2\) Parents across cultures tend to use higher pitch, wider pitch range, shorter utterances, longer pauses, and much more verbal and prosodic repetition in speech to young children than in speech to adults (Fernald 1991:44).\(^3\) Acoustic studies of child-directed prosody by Garnica (1977), Stern et al. (1983), Fernald & Simon (1984), and Fernald et al. (1989) have further established a solid empirical basis for the claim that speech to young children differs in its prosodic structure from the speech typically addressed to adults.\(^4\) These findings suggest that the

\(^1\) In this thesis the term prosody refers to the interplay of changes in four acoustic properties: pitch, duration, rhythm, and intensity.

\(^2\) Studies have reported similar prosodic modifications in fathers' as well as mothers' speech (Papousek et al. 1987; Fernald et al. 1989).

\(^3\) The prosodic characteristics of parental speech described here have been referred to as the Universal Prosodic Features Hypothesis. Schieffelin's (1979) study done among the Kaluli of New Guinea, Heath's (1983) study done in the rural Black families in North Carolina, and Ratner & Pye's (1984) study done among Quiche-Mayan-speaking mothers in Guatemala are counterexamples to this. However, the use of research design and the interpretation of inadequate data in these studies have often been criticized.

\(^4\) A cross-language study by Fernald et al. (1989) compared prosodic modifications in maternal speech to young children in French, Italian, German, Japanese, British English, and American English, and found that Japanese mothers showed least extreme prosodic modifications. However, these culture-specific differences cannot rule out the fact that Japanese mothers still use higher pitch when speaking to young children.
distinctive prosodic patterns of parental speech provide prosodically salient auditory stimuli to engage and maintain young children’s attention, and thus may facilitate speech processing and language comprehension.

There is a growing body of evidence that indicates that infants start to show sensitivity to perceive and discriminate these prosodic features in parental speech at a very early stage. Infants are affected by what they have heard before birth, and at birth already prefer their mothers’ voices over those of strangers (DeCasper & Fifer 1980; DeCasper & Spence 1986). Mehler et al. (1988) demonstrated that four-day-olds are sensitive to prosodic features common to utterances in their mother’s native language. Morse (1972) reported that two-month-olds are able to discriminate two phonetically identical syllables ([ba]), differing only in pitch contour. Studies by Spring & Dale (1977) and Jusczyk & Thompson (1978) also indicated that two-month-old infants can discriminate bisyllabic utterances that differ only in stress pattern. A study by Kaplan & Kaplan (1971) found that eight month olds display ability to detect differences in intonational contour of simple English sentences. The latest evidence available suggests that infants begin learning about characteristic prosodic patterns of words before they begin learning about the typical phonetic and phonotactic differences in their native language (Jusczyk et al. 1992).5

5 Many tone language acquisition studies, including Mixtec (Pike 1949), Dangme (Apronti 1969), Gā (Kirk 1973), Mandarin Chinese (Clumeck 1976; Li & Thompson 1977), Cantonese (Tse 1977), Thai (Tuaycharoen 1977), have examined lexical tone languages. It is generally found that the acquisition of lexical tone in such languages takes place along with the acquisition of the lexical item itself, tone often being correctly realized prior to the well-
As they undergo the transition from babbling to first words, around their first birthday, and the transition from semantic to syntactic speech during their third year of life, young children must learn how to rapidly identify meaningful units contained within the speech stream. The prosodic characteristics that are distinctive to motherese may play a crucial role in the identification of constituent structure and in children's acquisition of that capacity (Read & Schreiber 1982:101). The importance of prosody in guiding young children to segment speech and to label syntactic categories has become a pivotal issue in the language learning literature (Peters 1983, 1985, 1995; Morgan et al. 1987; Jusczyk et al. 1989; Gerken et al. 1990; Gerken 1991, 1994a & b; Fernald 1991; Morgan 1992; Gerken & McIntosh 1994; Peters & Strömqvist 1996). This recent interest in the usefulness of prosody to young children who are learning language seems to point to the possibility that young children's speech perception and production are strongly influenced by the relative acoustic salience of particular morphemes and words in the speech stream. Slobin (1973, 1985) and Peters (1983, 1985) have proposed "operating principles" that bias young children to attend selectively to perceptually salient stretches of speech. Language is viewed as a system whose structures depend on combinations of content words and grammatical morphemes.\(^6\) In

\(^6\) Crosslinguistically, grammatical morphemes include both bound and free morphemes.
comparison with content words, grammatical morphemes are less readily identifiable as distinct acoustic entities because they are often bound, contracted, asyllabic, unstressed, and varying in form in different environments (Slobin 1985:1164).

Accordingly, the perceptually-based operating principles predict that young children acquiring various, divergent languages would more easily perceive content words than grammatical morphemes, which are likely to be acquired later. This hypothesis appears to be supported by evidence coming from children's early omission and subsequent production of grammatical morphemes across languages. Grammatical morphemes in the adult target are not particularly salient to young children and, as a result, are not likely to be extracted from the stream of speech, stored in a representation, and included in first productions.

This approach to language acquisition raises two related questions about the learnability of grammatical morphemes (Peters 1995:35):

I. How is the acquisition of grammatical morphemes influenced by prosodic and phonological characteristics of the language being learned?

II. What distinctive prosodic and phonological properties do grammatical morphemes have that might aid young children in perceiving them as a separate class?

One way to begin to address these questions is to compare the acquisition of grammatical morphemes in "minimal pair" sets of languages i.e., languages

which tend to have low phonological salience, a range of syntactic functions, and relatively low semantic content. The core members of the set are determiners, case markers, pronouns, copulas, tense/mood/aspect markers, and conjunctions. Morphologically, the core members are adpositions, clitics, and inflectional affixes (Peters & Menn 1993:742).
that are closely related in their morphological systems, but which differ prosodically. Traditional accounts of the interaction of prosody and grammatical morphemes have dealt with languages that are non-tonal and for the most part have an inflectional morphology. In this thesis, however, a pair of isolating tone languages, namely Mandarin Chinese and Taiwanese will be used as a testing ground for investigating the role of prosody in the acquisition of grammatical morphemes.

1.1 A Minimal-Pair Study

Cross-linguistic research on the interaction of prosody and grammatical morphemes has primarily focused on the languages which are non-tonal and have a complex inflectional morphology. The major aim of comparing the

---

7 This idea has been suggested by Plunkett & Strömqvist (1992) and Peters (1995).

8 The distinction between language (from Latin *lingua*, "tongue, language") and dialect (from Greek *dialettos*, "speech between persons, language") has never been clear for linguists, who do not use the term dialect with the negative social connotations it has in common parlance. In general, a language is understood to be a system of elements and rules conceived broadly enough to admit variant ways of using it. A dialect is understood as one of these variant ways. The problem is that we can alternatively view the variant ways of using a system as themselves constituting systems. No one has yet succeeded in establishing concrete rational criteria for this point of usage. In this thesis the criterion of mutual intelligibility proposed by Voegelin & Harris (1951) is adopted to draw boundaries between languages. Accordingly, it is misleading that all the varieties of Chinese have been subsumed under a single name. In fact, Chinese is not a single language but a family of languages made up of a group of mutually unintelligible languages (Bloomfield 1933:44). However, it is important to note that the criterion of mutual intelligibility for distinguishing between dialects and languages is not without its own set of problems, as noted by DeFrancis (1984). Thus, due in part to the political unity of China, and to the socio-psychological factors that also enter into the picture, rather than Chinese being viewed by Western linguists (e.g., Bloomfield 1933) as a language family consisting of a number of languages, it is viewed by the Chinese as a single language composed of several dialect groups (Chan 1985:6).

9 A recent study by Peters and Strömqvist (1996) delved into the role of tonal word accents in the acquisition of certain grammatical morphemes in Swedish. However, like other European languages, Swedish has been classified as an intonation language rather than a tone language. One reason for this is that in Swedish, the fundamental frequency (pitch) is used in
process in minimal pair sets of languages that are closely related in their morphosyntactic systems, but which differ in their prosody is to investigate the influence of prosody on the acquisition of grammatical morphemes (Peters 1995:12). In comparison with other languages, the Chinese languages have two noteworthy characteristics that may provide a particularly interesting test case for the interface of prosody and grammatical morphemes, namely their lack of inflection and their phonemic use of pitch.

The Chinese languages are well known for their impoverished system of grammatical morphology. There are virtually no inflectional devices that indicate number, gender, or case relations between nouns, or nouns and verbs. Like lexical morphemes, almost all the grammatical morphemes occur as separate words (i.e., free morphemes). As a result, a simple Chinese sentence sounds almost like a telegram in a richly inflected language (Li et al. 1992:3).

Every lexical morpheme in the Chinese languages is assigned a pitch or a pitch sequence called a tone. The number of lexically contrastive tones differs from one language to another. The tone system of Mandarin Chinese is relatively simple in comparison with that of the southern Chinese
language groups (Li & Thompson 1981:6).\textsuperscript{11} Aside from the varying number of full tones, the neutral tone is common for grammatical morphemes in many Chinese languages.\textsuperscript{12} It is generally admitted that the neutral tone in isolation is a low plateau, its tone range flattened to practically zero and its duration relatively short (Chao 1968; Tseng 1981; Shen 1990). There are two categories of neutral tone: syllables which are inherently toneless and those whose tone value is reduced (Shen 1989:38). Neutral-toned grammatical morphemes in Mandarin Chinese belong to the first category.

In addition to four lexical tones, Mandarin Chinese has a neutral tone.\textsuperscript{13} The neutral tone mainly occurs in suffixes and particles which serve grammatical functions. These neutral-toned syllables are shorter in length and less tonally distinctive than full-toned syllables. Full-toned syllables followed by neutral-toned syllables help to impart a stress-timed sort of rhythm to Mandarin utterances. In other words, the tonal domain is the same as the stress domain (i.e., foot) in Mandarin Chinese (Chao 1968; Yip 1980; Wright 1983; Duanmu 1990; Hsiao 1991). Neutral-toned functor syllables are unstressed and monomoraic. In contrast, full-toned lexical syllables are stressed and bimoraic (or sometimes trimoraic finally) in length (Chao 1968; Woo 1969; C. Cheng 1973; Duanmu 1990).\textsuperscript{14} Lexical syllables simultaneously

\textsuperscript{11} The southern Chinese language groups, including the Min, Hakka, and Yue languages, have lexical tones ranging from six to nine.

\textsuperscript{12} There are noneutral-toned grammatical morphemes in the Hakka and Yue language groups.

\textsuperscript{13} Because of the influence of the native language, Mandarin Chinese spoken in Taiwan differs considerably from Beijing Mandarin, especially in lexicon and phonology. It is Taiwan Mandarin that I will refer to throughout the whole thesis (hereafter simply TMC).

\textsuperscript{14} Lexical syllables refer to major grammatical categories such as nouns, verbs, and
have higher pitch, longer and fuller vowels, and greater loudness than functor syllables.\footnote{15} Hence, the interplay of changes in four acoustic properties: pitch, duration, rhythm, and intensity, coincides in TMC.\footnote{16}

Among the typologically homogeneous group of the Chinese languages, Mandarin Chinese and Taiwanese (hereafter simply TW) represent a typical example of internal differentiation. TW, one of the southern Min dialects, spoken by more than 80% of the total population, is the native language of Taiwan. It belongs to the larger Chinese dialectal family called Min-nan, South-Min, Southern Hukienese, or South Hokkien (Cheng 1968:19). There are seven distinctive lexical tones in TW. Besides full tones, TW also has a neutral tone. There are several environments where the neutral tone can occur and some turn out to be idiosyncratic. Normally the neutral tone in TW occurs on the second syllables of a few compounds, clause-/sentence-final particles, and clause-/sentence-final function words. That is to say, the occurrence of neutral-toned syllables coincides with the ends of certain noun phrases, a clause, or a sentence. It is apparent that the distribution of the neutral tone in TW could also play a functional role in signaling clause or sentence boundaries.\footnote{17}

In sharp contrast to TMC, grammatical morphemes in TW may carry any of the seven citation tones. Like lexical syllables, these functor syllables

\footnotesize{adjectives, while functor syllables are grammatical morphemes.}

\footnote{15} In Mandarin Chinese, many major grammatical morphemes contain schwa /ə/. This will be further discussed in Chapter 2.

\footnote{16} In so-called stress-timed languages, a combination of these features is responsible for the perceptual unit of prominence known as stress (Schane 1979:483).

\footnote{17} Most languages exhibit a gradual fall in pitch from the beginning to the end of an
also undergo sandhi changes. Although grammatical morphemes in TW are usually tonal, they tend to lose their distinct intrinsic fundamental frequency in phrase-final position. However, it should be noted that the environments for the occurrence of the neutral tone such as directional verb complements, resultative verb complements, the durative aspect marker leh, and the vocative markers -e & -a, are frequently the ones for the occurrence of tone spreading. As a result, the neutral tone of these function words is often replaced or displaced by the tone of preceding content words. This greatly reduces the possibility of function words undergoing tonal neutralization in phrase-final position.  

Unlike TMC, functor syllables in TW may carry salient tones. There is neither reduction of vowels in functor syllables nor lengthening of vowels in lexical syllables. Since prominence is imparted through intensity, pitch, duration, and/or vowel quality, functor syllables are not necessarily less prominent than lexical syllables in TW. It appears likely that TW is a language where syllable-based rhythm is predominant (Wright 1983; Tseng 1995). Here the prosodic characteristics such as pitch, duration, rhythm, and

\[ \text{utterance. (This need not apply to questions, however.)} \]

In many tone languages this results in successive tones becoming phonetically lower and lower in pitch until, at the end of the phrase, the high tone could be phonetically as low or even lower than the low tones at the beginning of the phrase. This is called "downdrift". The causes and origins of downdrift are not known, but it is obvious that the gradual pitch decrement in utterances serves a useful linguistic purpose in signaling clause and sentence boundaries (Ohala 1978:32).

18 I thank Dr. Robert Cheng for pointing out to me that in comparison with Taiwan Mandarin Chinese, Taiwanese has a greater inventory of neutral-toned syllables.

19 This assumption is concerned solely with the phonetic information carried by both lexical and functor syllables. The influence of semantic information on the native speaker's judgment of prominence is not relevant to the present discussion because it is not yet available to babies.

20 One piece of evidence Tseng (1995:73) uses to claim that TW has a syllable-based rhythm is the contraction process in TW. Contraction tends to occur when weak syllables are
intensity operate separately rather than in concert. These assumptions are consistent with the results of several acoustic and perceptual experiments revealing that there is no stress in TW as far as linguistic significance is concerned (Du 1988:225). Such discrepancies as are found to exist in the prosodic structures of TMC and TW can be used as a testing ground for investigating the effects of prosody on the acquisition of grammatical morphemes.

Previous research has centered on the early acquisition of tone as a

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involved. Weak syllables are often shorter in duration and lower in intensity. For example, in fast speech, bin³³ naµµ chai²¹ "tomorrow" and cha³³ hng⁵⁵ "yesterday, last night" are often produced as mia³³ chai²¹ and chang³³, respectively. After the application of contraction, each syllable becomes long enough to carry a beat, which is a characteristic of a syllable-timed language.

21 Typologically, languages have frequently been divided into three types of rhythm patterns: (a) stress-timed rhythm, where the temporal interval between stressed syllables is assumed to trend towards constancy; (b) syllable-timed rhythm, where the temporal interval occupied by a syllable is assumed to be roughly constant regardless of the segmental makeup of the syllable; and (c) mora-timed rhythm, where the number of moras is determined by counting the number of segments starting from the end of syllable up to and including the first vowel of the syllable, and the moras are approximately equal in duration. The first two types of rhythm patterns were originally proposed by Pike (1945), further developed by Abercrombie (1967), and adopted by many researchers. However, production experiments have failed to show constancy of these temporal intervals and, in fact, have shown considerable variation. These failures may be due to a constrained notion of what constitutes rhythmic organization; an additional confounding factor is the use of different terms by different researchers to refer to the components and domains of rhythmic organization (Fourakis & Monahan 1988:284). In any case, I think that it is not controversial to accept the claim made by Fourakis and Monahan (1988) that in a speech utterance there are some sequences of sounds, traditionally called syllables, that are more prominent than others in some respect. These syllables are referred to as stressed. A language is more or less stress-based, depending on how large a role stress plays in that language, especially with respect to four areas: syllable structure, lexical composition, processes of reduction and phonetic realization of stress. Languages such as English in which stress has important consequences in all these areas, and possibly others as well, can be called truly stress-based (Dauer 1983:59). The timing/rhythm difference between TMC and TW will be better understood if they can be fitted into the model proposed by Dauer (1983:60) that languages can be compared to each other along the dimension of having a more or less stress-based rhythm:

<table>
<thead>
<tr>
<th>Japanese</th>
<th>French</th>
<th>Spanish</th>
<th>Greek</th>
<th>Portuguese</th>
<th>English</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stress-based</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

10
special case of the early acquisition of prosodic features in general. The time and order of mastery of tones, the perception and production of tonal contrasts, and the stages of tone rules being acquired have been the focal issues. Mandarin Chinese and Cantonese are the languages on which the largest body of tone acquisition research has been done (Chao 1951; Clumeck 1977; Light 1977; Li & Thompson 1977; Tse 1978; Hashimoto 1980). There are no formal, published studies that report on the acquisition of tone in TW. Furthermore, the relationship between prosody and the acquisition of grammatical morphemes in Chinese languages has never been explored by any serious research.

Based on the differences in the prosodic structures of TMC and TW, we propose three hypotheses, each of which makes several predictions we wish to investigate through a comparative study:

**Hypothesis 1:** The timing/rhythm difference in TMC and TW affords different acquisition paths (i.e., a foot path vs. a syllable path) for children learning grammatical morphemes.

- The segmentation strategies employed by TMC- and TW-speaking children differ from the earliest stages of language production.

- There is a striking difference in the patterns of realization and omission of grammatical morphemes between the two groups of children.

- The degree to which grammatical morphemes are vulnerable to omission differs greatly between the two language groups.

**Hypothesis 2:** It is harder for young children to begin to produce the grammatical morphemes of TW that are full-toned than it is to produce the grammatical morphemes of TMC that are neutral-toned.

- There are significant differences between TMC- and TW-speaking children with regard to the omission of grammatical morphemes in their spontaneous and imitative speech.
• Grammatical morphemes in TW are least susceptible to omission when they are associated with phonological salience.

• Grammatical morphemes in TMC are most vulnerable to omission when they do not fit within the strong-weak metrical production templates.

**Hypothesis 3:** *Frequency of grammatical morphemes in caregivers’ speech will be reflected in the order of appearance of these morphemes in children’s productions.*

• There is a significant correlation between frequency of grammatical morphemes in input speech and their order of appearance in TMC- and TW-speaking children's productions.

• Other factors may interact with frequency of input in determining the order of appearance of grammatical morphemes in TMC- and TW-speaking children's productions.

Since our interest in the role of prosody has grown out of both theoretical considerations and empirical observations across languages, the present study will begin to build the empirical basis for our hypotheses by looking at longitudinal development in children learning either TMC or TW as their first language.

1.2 Outline of the Dissertation

This dissertation consists of six chapters. After this Introduction, Chapter 2: Prosodic Information For Grammatical Morphemes raises the possibility that contrastive studies of the acquisition of grammatical morphemes in a pair of morphosyntactically similar but prosodically different languages could shed new light on how children actually use prosody in the early stages of language acquisition. To explore such a possibility, we choose to focus on Taiwan Mandarin Chinese (TMC) and Taiwanese (TW), where the former is similar to stress-timed languages in the presence of a contrast between full-toned lexical syllables and neutral-toned functor syllables, while
the latter has fewer neutral-toned functor syllables occurring in phrase-final position, even though its lexicon and morphology are extremely close to those of Mandarin. In order to establish a perspective from which we can understand the evidence from children learning either TMC or TW as their first language, we provide ample background information for the interaction of prosody with grammatical morphemes in both languages.

Chapter 3: The Experiment proposes three hypotheses based on the differences that are found to exist in the prosodic structures of TMC and TW. To test the validity of these hypotheses, we utilize two sources of evidence — longitudinal language samples and controlled experiments. In particular, we depend more on longitudinal language data, which have been most widely used by researchers studying a variety of languages and provide us with the least problematic source of child language data since it is elicited in natural contexts. We analyze the patterns of realization and omission of a highly frequent subset of grammatical morphemes in the spontaneous speech of three TMC children and three TW children, recorded between the ages 1;6 and 2;3. An imitation test was also conducted for both groups of children when their MLUs, calculated from spontaneous utterances, reached above 1.90. In the last month of the data collection, a comprehension test was conducted for both groups of children.

Chapter 4: Results analyzes the data regarding realization and omission of a selected subset of grammatical morphemes from longitudinal language samples, imitation tests, and comprehension tests. Results obtained from longitudinal language samples and imitation tests indicate that the TW-speaking children omitted significantly more functors than the TMC-speaking children did. For the TW-speaking children, all 7 grammatical
morphemes studied were susceptible to omission, regardless of pitch value (full-toned vs. neutral-toned), grammatical function (semantic and syntactic complexity), frequency in input, and/or position in which they occurred in an utterance. In contrast, the proportions of functor omissions were very low for the TMC-speaking children. Results indicate that neither the TMC-speaking children nor the TW-speaking children performed significantly better in the comprehension tests of grammatical morphemes. Results indicate that there is a significant correlation between frequency of grammatical morphemes in input speech and their order of appearance in the TMC- and TW-speaking children's productions.

Chapter 5: Discussion examines evidence in support of the three hypotheses we investigated in this study. The evidence presented in this chapter suggests that rhythmic characteristics of languages can affect segmentation by providing different kinds of prosodic "handles" for the novice to grasp. Metrical feet may offer TMC-speaking children one kind of segmentation handle because neutral-toned grammatical morphemes that closely follow full-toned content words are in position to be "picked up" as parts of unopened packages. In TW, however, since there is no opposition between full- and neutral-toned syllables, all syllables contribute equally to linguistic rhythm, and the syllable more likely functions as a segmentation unit for TW-learning children. Specifically, lexical syllables which are more semantically salient than functor syllables have an advantage in perceptibility and therefore in processing. Finally, we propose to take a complex view of how these factors (i.e., semantic complexity, syntactic complexity, frequency in input, and perceptibility in speech) interact with each other and what other factors (e.g., children's production limitations) might become involved in
determining the order of appearance of grammatical morphemes in children’s productions.

Chapter 6: Conclusions and Future Directions summarizes the research findings, presents implications for the study of prosody in children’s speech, and proposes an agenda for future explorations. Three conclusions are reached. First, the timing/rhythm difference in TMC and TW affords different acquisition paths (i.e., a foot path vs. a syllable path) for children learning grammatical morphemes. The segmentation strategies characteristically employed by TMC children and TW children differ from the early stages of language production. The trochaic foot functions as a segmentation unit in TMC-speaking children’s speech, while the syllable acts as a segmentation unit in TW-speaking children’s speech. Second, it is more difficult for young children to produce the full-toned grammatical morphemes of TW, than it is to produce the neutral-toned grammatical morphemes of TMC. In order to understand the relative difficulty in learning grammatical morphemes, we may compare the differences in omission of these morphemes, between TMC- and TW-speaking children. Third, frequency of grammatical morphemes in caregivers’ speech will partially reflect the order of appearance of these morphemes in children’s productions. However, other factors may interact with frequency of input in determining the order of appearance of grammatical morphemes in children’s productions.
CHAPTER 2
PROSODIC INFORMATION FOR GRAMMATICAL MORPHEMES

2.0 Introduction

Research showing the richness of prosodic cues in caregiver speech to children, coupled with research showing children's sensitivity to these cues, suggests an important role for prosodic information in the identification and extraction of word-level units in the stream of speech. To identify the possible role of perceptual biases in the early phases of language acquisition, certain perceptual predispositions have been proposed. Children may, for example, be predisposed to attend to, extract and store particular salient syllables, or other salient elements, from a sequence of speech (Slobin 1973, 1985; Gleitman & Wanner 1982; Peters 1983, 1985; Echols 1987; Gleitman et al. 1988; Echols & Newport 1992; Echols 1993).

The notion that perceptual biases may assist in early language acquisition can be attributed to Slobin's (1973) description of such factors in the acquisition of grammatical inflections. A predisposition to extract the stressed syllable is also consistent with certain cross-linguistic differences in the timing of acquisition of particular grammatical inflections; Gleitman and Wanner (1982) note that semantically equivalent grammatical inflections are learned earlier for languages in which they are stressed. Further evidence supporting the importance of stress as a cue to the identification of grammatical morphemes comes from Feurer's (1980) case study of the acquisition of Mohawk, Pye's (1983) study of the acquisition of the verb in Quiche Mayan, and MacWhinney's (1985) study of the acquisition of Hungarian. The latest evidence provided by Peters (1995) and Peters &
Strömqvist (1996) suggests that perceptually salient prosodic patterns, including pitch contours, rhythm, and increased duration, may serve as "spotlights" on any grammatical morphemes that are regularly associated with these patterns.

One of the persistent problems faced in research on the role of prosody in the acquisition of grammatical morphemes is the difficulty of conveying to others how the acquisition of particular grammatical morphemes can be explained by reference to prosodic differences only. After all, it is hard to separate out the relative contributions of each type of complexity, namely some combination of syntactic and semantic complexity, frequency, and perceptibility in speech. The difficulty of learning grammatical morphemes has been explained by Brown (1973), and others after him, by referring to their semantic complexity. Recently, attempts have been made to relate the absence of grammatical morphemes in early productions to the acquisition of syntax (Radford 1990). However, little attention has been given by child language researchers to the possible influence of prosody on the acquisition of grammatical morphemes. To look seriously at the interrelations between prosody and grammatical morphemes, Peters (1995) suggests an approach to comparative research in the investigation of areas of morphology that are prosodically and phonologically influenced. The comparison technique could be useful for a pair of morphologically very similar languages in which prosodic and phonological characteristics such as stress patterns, timing (stress vs. syllable), rhythmicity (kinds of metrical feet, if any), vowel quantity (long/short contrasts, full/reduced contrasts), and pitch phenomena, might interact with morphology (Peters 1995:37).
Traditional accounts of the interaction of prosody and grammatical morphemes have dealt with languages that are non-tonal and for the most part have an inflectional morphology (mostly Indo-European languages). This is a weakness because the scope of the prosodic and phonological approach to grammatical morphology will depend on the presence of prosody/phonology-grammatical morpheme correlations across languages. In addition, the specific correlations cited with regard to non-tonal and richly inflected languages should not be considered generalizable to such isolating tone languages as Mandarin Chinese and Vietnamese. In other words, prosodic and phonological correlates to grammatical morphemes in other languages may take many different forms. In attempting to understand better the effect of prosody on the learning of grammatical morphemes, we need to compare data from more types of languages.

The issue of prosodic and phonological correlates of grammatical morphemes in language acquisition is particularly interesting when viewed from the perspective of Chinese languages. When any of the Chinese languages is compared to nearly any other language, the lack of inflection and the phonemic use of pitch are the two most obvious features to emerge. In languages of this type, where the presence of inflection is virtually nil and each syllable is characterized by a fixed pitch pattern, we need to ask how the prosodic and phonological properties interact with the morphological typology of these languages with respect to the perceptibility and segmentability of morphemes. Given that the Chinese languages have a set of function words, how might we expect their prosodic and phonological correlates to be manifested in these languages?
Among the typologically homogeneous group of Chinese languages, TMC and TW offer an excellent test case for looking into the role of prosody in the acquisition of morphemes. Although TMC and TW are closely related in their morphosyntactic systems, they differ interestingly in their prosody. TMC is similar to stress-timed languages in the presence of a contrast between full-toned lexical syllables and neutral-toned functor syllables, while TW is more syllable-timed with fewer neutral-toned functor syllables occurring in phrase-final position. By comparing this pair of maximally similar languages we might be able to tease out answers to such a question as how the acquisition of grammatical morphemes is influenced by prosodic and phonological characteristics of the language being learned as well as its morphological typology.

2.1 Tonotactic Background

As a preliminary testing ground for investigating the influence of prosody on the acquisition of grammatical morphemes, we have chosen to focus on TMC and TW. These languages vary greatly in the number of distinct tonal categories which they possess. The following is some of the tonotactic background.

2.1.1 TMC Tones

Mandarin originally refers to the dialect spoken in Beijing and its neighboring areas, which later became the standard language of Taiwan and Mainland China. Although during the earlier fifties, Taiwan adopted the policy of promoting a uniform language based on the Beijing dialect (hereafter simply BMC), the Mandarin spoken in Taiwan is strongly colored by the native language (i.e., TW). It differs greatly from BMC, especially in
lexicon and phonology.¹ The four citation tones in TMC are shown in Table 1.

Table 1. TMC citation tones²

<table>
<thead>
<tr>
<th>Tone Code</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tone Shape</td>
<td>H</td>
<td>MH</td>
<td>LH</td>
<td>HL</td>
</tr>
<tr>
<td>Pitch</td>
<td>55</td>
<td>35</td>
<td>214</td>
<td>51</td>
</tr>
<tr>
<td>Tonal Description</td>
<td>high-level</td>
<td>high-rising</td>
<td>low-dipping</td>
<td>high-falling</td>
</tr>
</tbody>
</table>

2.1.2 TW Tones

TW is a Chinese Southern Min dialect spoken in Taiwan and on neighboring islands.³ When this dialect is spoken elsewhere, it is called by various names, e.g., Amoy, Hokkian, Xiamen and so forth. In spite of slight differences, those regional variants are close enough to be considered a single dialect. Traditionally, TW is said to have eight tones.⁴ The sixth tone was lost in most Min dialects. Thus, there are seven distinctive citation tones in this dialect, as shown in Table 2:

¹ As far as pronunciation is concerned, the main differences between TMC and BMC include: (i) The retroflex initials zh-, ch-, and sh- have merged with the dental sibilants z-, c-, and s- in TMC. (ii) Syllables which in BMC have a labial initial and the final -eng are often pronounced in TMC with -ong. (iii) The distinction between the finals -in and -ing and between finals -en and -eng is not always maintained in TMC. (iv) The suffix -r is very rare in TMC. (v) The neutral tone in TMC occurs much less frequently than in BMC. However, it should be noted that there exist individual differences regarding the degree to which a TMC speaker is influenced by his/her native language (i.e., TW).

² The number represents the pitch register according to a scale of five levels, 1 being the lowest and 5 being the highest (Chao 1968:26). Thus, the 55 number means the pitch register of the syllable remains at level 5 throughout, whereas the 214 number indicates that the pitch register of the syllable begins at level 2, lowers to level 1, and then rises to level 4.

³ In this thesis the term Taiwanese means colloquial (vernacular) Taiwanese. Literary Taiwanese has a slightly different phonetic system.

⁴ I number the tones as if the sixth tone were present.
Table 2. TW citation tones\(^5, 6, 7\)

<table>
<thead>
<tr>
<th>Tone Code</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tone Shape</td>
<td>H</td>
<td>HL</td>
<td>L</td>
<td>M?</td>
<td>LM</td>
<td>M</td>
<td>H?</td>
</tr>
<tr>
<td>Pitch</td>
<td>55</td>
<td>53</td>
<td>11</td>
<td>3</td>
<td>13</td>
<td>33</td>
<td>5/33/3*</td>
</tr>
<tr>
<td>Tonal Description</td>
<td>high-level</td>
<td>high-falling</td>
<td>low</td>
<td>mid-abrupt</td>
<td>low-rising</td>
<td>mid</td>
<td>high-abrupt</td>
</tr>
</tbody>
</table>

* Dialectal variations

Of the seven tones, five are non-entering (long) tones and two are entering (short/abrupt) tones. Syllables ending in vowels and nasals have non-entering tones, and those ending in \(/p, t, k, ?/\) have entering tones. Non-entering tones are usually longer than entering tones. Although the checked sounds \(/p, t, k, ?/\) shorten their preceding vowels within a checked syllable, phonologically long segments (i.e., \([C:] & [V:]\)) are not needed since they are not distinctive in TW (Wang 1992:4).\(^8\) Moreover, final consonants in Chinese languages tended to undergo weakening and were then elided historically (for details, see Chen 1973).\(^9\) This diachronic deletion also occurs in modern Chinese languages, e.g., TW. Recent acoustic-phonetic research on TW has demonstrated that \(/p, t, k/\) often undergo lenition or deletion, and

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\(^5\) Here I adopt Tseng’s (1995:32) numerical notations of tones in TW.

\(^6\) Pitch level, slope of contour, and abruptness/glottalization are the three criteria for the description of tones in TW. Cheng & Cheng (1977) and Zhang (1983) utilize three sets of tone features: [high], [mid], and [low] indicate the relative pitch level; [level], [falling], and [rising] indicate the direction of pitch contour; [+abrupt] and [-abrupt] indicate the glottalization of tone.

\(^7\) The “?” symbol represents the checked sounds \(/p, t, k, ?/\).

\(^8\) Compared with TW, Cantonese is bimoraic and exhibits the distinctiveness between long and short vowels (Yip 1990).

\(^9\) Chen (1973) proposes two kinds of parallel successive stages of sound change in Chinese languages. Both display the weakening and deletion of stop \(/p, t, k, ?/\) and nasal \(/m, n, n/\) endings. These stages are roughly schematized below:
(i) checked sounds: \(p \rightarrow t \rightarrow k \rightarrow ? \rightarrow \bar{a}\) (ii) nasal endings: \(V_m \rightarrow V_n \rightarrow V_{\bar{n}} \rightarrow V_{\bar{n}} \rightarrow V\)
/ʔ/ at most times disappears when tone sandhi occurs (Wang 1991, 1992, 1993). This phenomenon exhibits synchronic processes of weakening in TW. Under such circumstances, the so-called checked tone/syllable is affected and probably no longer exists.

Basically each syllable can have two different tones depending on the environments in which it is found. When the syllable occurs alone, in the final position of a tonal group, or before a neutral tone, it carries one tone; when the syllable occurs in the non-final position in a tone group, it carries another tone. Cheng (1968) treats the former as the underlying tones and names them as basic or inherent tones and the latter derived or sandhi tones. The underlying principle governing these sandhi processes refers to a citation tone undergoing tone sandhi when followed by another citation tone. The following schemata give a brief idea of the sandhi processes between tones:

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10 In Wang's experiments, the sound change of these /p, t, k/ before /-a/ probably can become (i) spirants (/p, k/ -> [β, γ]), (ii) flap (only for /t/ -> [l]), (iii) voiced stop (/p, t, k/ -> [b, l, g]).

11 Du (1988) performed an acoustic analysis of TW tones, and concluded that there were six citation tones, five long tones and one short tone. It is not surprising for her to discover only one short tone because TW spoken in the central west coast of Taiwan and Singapore does not distinguish between tones 4 and 8. However, the results of her study also showed that each long citation tone had one sandhi form but the short citation tone had two sandhi forms.

12 In his 1970 experimental study, Hsieh made up some nonsense words and put them in the sandhi environments to see if the subjects made expected changes. He found that the subjects only made between 10-30% expected changes and that the majority of unexpected responses were due to the subjects not changing the tones. From these results he concluded that the tone sandhi rule did not have psychological reality, and the native speakers stored both the isolation tone and sandhi tone in the mental representation, contrary to the generative assumption that only the base form is represented. Following Hsieh's study, Wang (1995) conducted a longitudinal experiment to investigate the tone sandhi behaviors of Taiwanese speakers. He found the generative notion of RULE typically not able to handle the tone sandhi phenomenon in which the individual differences were great among tones. Instead, he proposed to adopt the notion of PATTERN. The phonological organization of the lexicon is based on the analogical connections established among items. When a sufficient number of such connections are established, a pattern is formed (Wang 1995:64).
(1) TW Sandhi Tones
   LM --------> M
   H --------> M
   M --------> L
   HL --------> HM
   H? --------> M?
   M? --------> H?

The rule in (2) is generalized from those in (1):

(2) Tone Sandhi Rule
   T \ ------------------------------------------\t / \________________________\T]_TG
   (T = Citation Tone, t = Sandhi Tone, TG = Tone Group)

Research on the syntax of TW tone sandhi conducted by Cheng (1968, 1973) and Chen (1987) has shown that the domain of the phonological phrase is chiefly determined by syntactic structure. Tone sandhi which applies within phonological phrases motivates tone groups. A tone group in TW is derived by demarcating the right end of every XP, except when XP functions as an adjunct phrase. X is a categorical variable ranging over A, N, V, P, etc., and XP represents the maximal projection of X in standard X-bar theory (Chen 1987:117).

2.2 Closed-Class Morphology

One of the major cuts in the lexicon divides so-called open-class items from closed-class items. The open classes include meaning-bearing or "content" words, particularly nouns, verbs, and adjectives. The closed classes include function words, inflectional and derivational morphology. The distinction between the two types of words has played an important role in recent psycholinguistics (Garrett 1978, 1980; Bradley 1978; Bradley et al. 1979;
Friederici & Schoenle 1980; Swinney et al. 1980; Segui et al. 1982). Support for a lexicon organized according to closed-/open-class words has come from Broca’s aphasics and specifically-language-impaired children (SLI), who seem to be selectively impaired predominantly in their production of closed-class words (Kean 1977, 1979; Leonard 1982, 1992; Menn & Obler 1990; Bates et al. 1987, 1991).

Researchers have argued that the distinction between content words and function words is not as relevant during lexical access as was once thought; rather a function word may be processed differently depending on its information load, its degree of stress, its length, and so on (Grosjean & Gee 1987:149). In fact, Cutler and Foss (1977) have shown evidence for this in a phoneme monitoring task: they found no reaction time differences between function and content words when stress was held constant, showing thereby that form class itself is not the critical factor; it is stress on the item that is.

Closed-class morphemes are so-termed because in the history of a given language new entries into this class are relatively rare. The term open-class refers to the fact that items can be added or lost within such a class at a relatively high rate. Mandarin and Taiwanese are genealogically related languages. There was a large-scale borrowing of Mandarin grammatical categories into Taiwanese. With regard to which lexical classes are most susceptible to borrowing, Cheng (1987) has found that members of the open classes (nouns, verbs, adjectives) are more readily borrowed than those of closed classes (pronouns, conjunctions, prepositions) and that nouns are the most frequently borrowed items. This distribution could however be to some extent simply a reflection of the overall sizes of the classes concerned and of the fact that the great majority of borrowed words are the names of new
objects or materials. In addition, it could be a reflection of the fact that both languages are so similar in their morphosyntactic system that there is no need to borrow structural elements from one language to another.

One characteristic which most of the function words seem to have in common is their high frequency in discourse/text. TMC is no exception to this. According to the dictionary of corpus-based frequency count of characters, out of the 50 most commonly used words, 36, or 72%, are function words. In a recent series of lexical decision experiments, Bradley (1978) found a frequency effect for words belonging to the open class and not to the closed class. She proposed that closed-class items are accessed independently of their frequency. Nevertheless, Segui et al. (1982) carried out five experiments to test the validity of this hypothesis for the French language. All of their results suggest that a frequency effect applies equally well to both open and closed items. The other characteristic which most of the function words tend to have in common is their polyfunctionality. They are usually monosyllabic and compose a small set of phonemes (in English, /ɔ/, /w/, /ð/, and /s, z/). TMC and TW are both simple morphologically, and many function words have multiple functions. For instance, in TMC, zai4, an adverb meaning "again", is homophonous with the zai4 progressive marker.

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13 A dictionary of corpus-based frequency count of characters in TW is not yet available. However, since TMC and TW are closely related in their morphosyntactic system, I assume that grammatical morphemes are similarly distributed in TW.

14 For details, see Zhongwen Shumian Yu Pinlu Cidian [The Dictionary of Corpus-based Frequency Count of Characters in Mandarin] (Chen et al. 1994).

15 There is very little morphological complexity in any of the Chinese languages. A typical word is not made up of component parts, called morphemes, but is, rather, a single morpheme. The Chinese languages have more homophones than most languages. Mandarin has a particularly small inventory of possible syllables, some 400 compared with tens of thousands of potential English syllables (Erbaugh 1992:379).
Progressive *zai4* is also homophonous with the locative marker *zai4*. All three occupy the same crowded preverbal slot. In TW, *e5*, a classifier, is homophonous with the *e5* genitive marker. Genitive *e5* is also homophonous with the nominalizer *e5*.

### 2.3 Prosodic/Phonological Correlates of Closed-Class Morphology

In order to establish a perspective from which we can understand the evidence from children learning either TMC or TW as their first language, we need to establish an adequate backdrop of the interaction of prosody with grammatical morphemes in TMC and TW. This section will therefore describe and evaluate a number of correlations between prosody/phonology and grammatical morphemes in the two languages.

#### 2.3.1 The Neutral Tone

In addition to the traditional four tones, Mandarin Chinese has a neutral tone. The phonetic detail of the neutral tone, especially of its tonal value, has been explored in depth (Gao 1980; Tseng 1981; Shih 1987; Shen 1989). It is generally admitted that the neutral tone in isolation is a low plateau, its tone range flattened to practically zero and its duration relatively short (Chao 1968; Tseng 1981; Shen 1989). There are two categories of neutral tone: syllables which are inherently toneless and those whose tone value is reduced (Shen 1989:38). Neutral-toned grammatical morphemes belong to the first category. The second category occurs in the case of a polysyllabic word and/or phrase where the last and penultimate syllables may lose their distinct intrinsic fundamental frequency patterns and become neutral.

Dialectically speaking, the neutral tone carries a much heavier phonological load in BMC than in other Chinese dialects (Chao 1968:38). Although non-native Mandarin speakers learn Mandarin Chinese through
formal education, their pronunciation is influenced by the contrasts in their native language. The frequent use of the neutral tone is one of the criteria for distinguishing native Mandarin speakers from speakers of other Chinese dialects. Here is an example of the occurrence of the neutral tone in BMC:16,17

(3) wo zhiDAO zhe-GE yiSHENG you wu-GE er-ZI
I know this-CL doctor have five-CL son-DIM

"I knew that this doctor had five sons."

There are five neutral-toned syllables in example (3). However, the same sentence in TMC has only three neutral-toned syllables, and they are all grammatical morphemes. Here is an example of the use of the neutral tone in TMC:

(4) wo zhidao zhe-GE yisheng you wu-GE er-ZI
I know this-CL doctor have five-CL son-DIM

"I knew that this doctor had five sons."

Many particles, suffixes, and the second syllables of some disyllabic words have the neutral tone in TMC.18 The occurrence of the neutral tone can be

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16 Mandarin tones are represented as follows: 1: "", 2: "", 3: "", 4: "", neutral: ""; neutral-toned syllables are also capitalized.
17 Due to typographical considerations, the Pin-yin romanization system, instead of the IPA (International Phonetic Alphabet), is adopted in this thesis for the transcription of TMC.
18 One distinct characteristic of Mandarin Chinese is that a sizable number of polysyllabic lexical items (the overwhelming majority of which are disyllabic) exhibit some tonal reduction; i.e., the last syllable becomes neutral-toned. However, in comparison with BMC, TMC has many fewer reductions in the second syllables of disyllabic words.
regarded as a phonological feature that distinguishes TMC closed-class items from open-class items.

Like TMC, in TW, in addition to the full tones, there is another tone category called the neutral tone. Since the distribution of this tone is limited and its occurrence is in general predictable, it is not regarded as a phonemic tone. The environments for the occurrence of the neutral tone in TW are limited: some are lexical and some are syntactic (Yuan et al. 1960; Cheng 1973, 1977, 1989, 1993, 1994a & b; Zhang 1983; Du 1988).

For a limited number of lexical words whether they have neutral tone or full tone is obligatory because the difference between the neutral tone and the full tone contributes to the difference in meaning. For example,\(^{20,21}\)

\[(5-a)\] au7 jit8  \hspace{1cm} (5-b) au7 jit

"future"  \hspace{1cm} "the day after tomorrow"

The difference between the full tone and the neutral tone in these words cannot be explained in terms of rules. They are lexically determined. For these noun phrases, the occurrence of the neutral tone in the last syllable has to be specified in the lexicon.

Interjection particles such as la, ho, and lo usually occur in sentence-final position and have the neutral tone. They are used to show request,

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\(^{19}\) In a tone language like Taiwanese, tone spreading is a common process in which a tone moves beyond its original segmental domain to replace or displace the tone of a following syllable. The syllable which is encroached upon is almost always neutral-toned. Hence, the environments for the occurrence of tonal neutralization such as object pronouns, directional verb complements, resultative verb complements, and vocative markers are often the ones for the occurrence of tone spreading (for details, see Cheng 1993, 1994a & b; Tseng 1995).

\(^{20}\) The Church romanization is adopted in this thesis for the transcription of TW.

\(^{21}\) Lexical tones are marked with a number at the end of each syllable; neutral tone is left unmarked.
confirmation, exclamation, etc. They never show up with full tones. Sentence-final particles such as bo5, boe7, and be7 have the neutral tone, except when kindness, intimacy, concern is expressed where they may retain their citation tone. Examples of the use of the sentence-final particle boe7 are given below:

(6-a) in7 lai5 boe7
    they come SF.PAR
    "Have they come?"

(6-b) in7 lai5 boe7
    they come SF.PAR
    "Have they come yet?"

The pronouns, goa2 "I", li2 "you", i1 "he/she/it", goan2 "we", in1 "they" in the object position at the end of a clause can either keep their citation tones for the purpose of focus, or carry the neutral tone. If these pronouns are in either the subject position or the non-clause final object position, they do not have the neutral tone. Examples of the use of the pronoun li2 "you" are given below:

(7-a) i1 phah4 li2
    he hit you
    "He hit you."

(7-b) i1 phah4 li2
    he hit you
    "It is you that he hit."

When directional verbs such as koe3, khi3, and lai5 function as verb complements, i.e., adverbs, and are at the end of a clause, they have the neutral tone, as shown in (8-a). When the directional verb complement is not at the end of a clause as in (8-b), it has the full tones and undergoes tone sandhi.

(8-a) li2 chau2 koe lai5
    you run cross come
    "Run toward me."

(8-b) li2 chau2 koe3 lai5 chia1
    you run cross come here
    "Run to this place."
Judging from the environments for the occurrence of the neutral tone in the two languages, it is important to note that unlike TMC, neutral-toned function words in TW are not inherently toneless. They simply lose their distinct intrinsic fundamental frequency and become neutral-toned in clause- and sentence-final positions. That is, other than these pitch-neutralization positions, function words in TW have a lexical tone and undergo sandhi changes.

Previous studies have commonly agreed that in Mandarin, the position of the neutral tone within the natural range of vocal pitch is governed by the tonal value of the preceding syllable, except for sentence-final syllables whose pitch level is determined by sentence intonation instead of by the preceding tone (Dreher & Lee 1966; Chao 1968; Kratochvil 1968; Rumjancev 1972; C. Cheng 1973; Gao 1980; Shi 1980; Tseng 1981; Shen 1989). Researchers, however, have divergent views regarding the tonal value of the neutral tone itself. One common generalization that can be made from a series of acoustic studies is: After the first, second, and fourth tones the neutral tone is falling, but after the third tone it is slightly rising. However, C. Cheng points out that the refined acoustic details perhaps do not necessarily represent the native speaker's knowledge (1973:56). The speaker's aim perhaps is to produce the neutral tone low after the first, second, and fourth tones, and high after the low third tone.

By contrast to TMC, instrumental evidence from Du's 1988 data shows that the tone pattern of the neutral tone in TW is not conditioned by its preceding tone at all, nor does it matter what the underlying tone is. For example, this neutral tone can appear after a mid level tone chhoe33 tioh11 "to find", after a low tone hii11 si11 "angry", or after a rising tone tan13
chhu11 "Tan's house". These three neutral-toned syllables have /5/, /33/, and /11/ underlying tones, respectively. The neutral tone in TW is perceived as similar to the underlying tone /11/. This phonetic low falling tone cannot be predicted by the general sandhi rules because an underlying tone can become a neutral tone as long as the required environment is present (Du 1988:109).

2.3.2 Vowel Type

In TMC, out of the 16 neutral-toned grammatical morphemes, 7, or 44%, contain schwa /ə/. If question particles and interjection particles are excluded, out of the total of 6 neutral-toned grammatical morphemes, 5, or 83%, have this vowel. The only exception is the diminutive marker -zi which contains an apical dental vowel. It is usually speculated that schwa /ə/ is reduced from certain front vowels or back vowels. For example, the aspect marker [la] is derived from the item liau3 "to finish", and the genitive marker [ta] perhaps can be traced back to di4, for the reason that in singing the item [to] is avoided and [ti] is used instead. However, C. Cheng argues that if these neutral-toned grammatical morphemes are posited as liau3 and di4 respectively, then a problem of vowel reduction arises (1973:65). Normally only low vowels in unstressed syllables are reduced to schwa, while the high vowels are not reduced. For instance, the finals [iau] and [i] are not reduced to schwa in the following examples, as pointed out by Tung (cited in C. Cheng 1973:65):

(9) [phau3 tiau] "to run away" [ti4 ti] "younger brother"

Thus, it seems unlikely to derive [la] and [ta] from liau3 and di4, respectively.

Investigations of the acquisition of word classes by children have focused almost exclusively on semantic and syntactic information for
grammatical classes. The semantic approach postulates that children's assignment of words to the correct grammatical category is a matter of associating a semantic property with the class, either by a process presumed to be one of discovery (e.g., Brown 1957) or because the association is taken as inborn (e.g., Grimshaw 1981). The syntactic approach, on the other hand, attempts to define grammatical classes in terms of distributional criteria. Thus, English nouns, but not other parts of speech, can appear in the structure *The _______ cleaned the yard*. Verbs, on the other hand, can appear in *She will ______ the garbage*, whereas nouns, adjectives, adverbs, and so on cannot (Maratsos & Chalkley 1980; Maratsos 1983).

However, as Braine argues (1987:65), a purely distributional approach cannot be sufficient because distributional criteria are language specific, whereas some classes (noun, at least) appear to be language universal. For any universal class, there must be some nondistributional property that marks it that is valid across languages. He goes on to argue that another problem with a purely distributional approach is the complexity of the distributional analysis that would be demanded of the learner. Moreover, Kelly (1992:363) points out that current research on the grammatical category assignment problem is heavily skewed away from phonology, and this bias may reflect theoretical and empirical assumptions that do not have a "sound" basis in fact. There exist numerous correlations between phonology and grammatical class across languages. Braine (1987:77) and Kelly (1992:355) provide examples from different languages in which speakers are sensitive to phonological cues to gender classes.

In Hebrew, nouns ending in *-a* and *-t* are usually feminine, and other nouns are usually masculine. Word-final /a/ or /t/ strongly predicts that a
noun is feminine, although exceptions do exist. Levy (1983) has shown, in both longitudinal and cross-sectional studies, that children learning Hebrew use this phonological cue to determine gender class. For example, children will treat masculine nouns as feminine if they end in the typical feminine phonemes. Furthermore, the children showed little evidence of using conceptual gender to assign nouns to the masculine or feminine classes. Thus, they did not base their nominal gender classifications on whether the referent of a noun had male or female associations. Such results suggest that researchers should not simply assume that semantic factors always dominate phonological factors in the acquisition and use of gender classes.

In Russian, there are three gender categories, which are partly predicted by semantic gender. In addition, the sound patterns on the ends of words are also correlated with these gender classes. Feminine nouns generally end in the vowel -a, though important exceptions exist, such as papa, dyadya, and dedushka, which respectively mean father, uncle, and grandfather. Neuter nouns tend to end in the vowel -o, and masculine nouns tend to end in consonants. Children learning Russian detect these phonological correlations by three years of age or earlier. Thus, masculine nouns are more likely to be treated as feminine if they end in -a than if they end in a consonant. Furthermore, these patterns are found even for nouns like papa, which have a strongly masculine meaning but have the standard feminine ending. For similar findings on the acquisition of Latvian, see Ruke-Dravina (1973).

As with Russian, German uses three gender categories which are correlated with semantic gender, although exceptions, such as neuter das Mädchen for girl, exist. In addition, semantic factors are not strong predictors of the gender class of inanimate nouns, although some patterns exist (e.g.,
words denoting alcoholic drinks tend to be masculine). In their studies, Zubin and Köpke (1981) have revealed that a variety of phonological cues to German gender exist and that high accuracy can be achieved in placing German nouns in gender classes when these cues are used in concert. For example, masculine nouns are more likely than other nouns to be monosyllabic and to end in a fricative followed by a /t/. Feminine nouns tend to end in vowels, as in *die Pfeife* (pipe) and *die Schweinerei* (mess). In studies designed to elicit gender classifications for real and invented words, MacWhinney (1978) found evidence that children learning German were sensitive to some of these phonological correlations.

Tucker, Lambert, Rigault, and Segalowitz (1968) demonstrated that the masculine and feminine gender categories of French can be predicted quite strongly by the ending patterns of words and, to a lesser extent, by the beginning patterns. For example, masculine nouns tend to end in *-ais* and *-oi*, among others, whereas feminine endings tend to end in *-ssion* and *-stion*. The number and strength of these predictors is impressive: Among 14 ending patterns examined, 10 had greater than 90% success at predicting whether a word was masculine or feminine. Tucker et al. presented French-speaking children between 8 and 16 years old with rare or invented nouns that they had to classify as masculine or feminine by picking the appropriate indefinite article *un* or *une* for each noun. The children's choices were clearly influenced by the endings of the target words. Indeed, across the various conditions of the experiment, children were significantly sensitive to every ending that reliably signaled whether a noun was masculine or feminine.

Among the various languages that have been studied so far, TMC is the language that makes virtually no use of any inflectional devices, as
compared with languages such as Hungarian, Turkish, or German which have rich inflectional systems. However, TMC makes use of a number of morphological devices. Unlike morphological markers in richly inflected languages, these markers do not form an organic part of the words with which they occur (for example, they are not bound to the words they modify and do not undergo phonological assimilations to the words), but they are functionally equivalent to the morphological devices in richly inflected languages. It seems reasonable to assume that the co-occurrence of schwa and the neutral tone may further aid children in identifying such major grammatical markers as de, ge, le, zhe, and men. This assumption made about children's ability to register properties of distribution is rooted in laboratory evidence about human pattern-learning abilities for linguistic or language-like material. There is laboratory evidence that such abilities exist, and for a crude, easy-to-difficult, learnability metric (cf. MacWhinney 1978, 1985; Braine 1987).

In sharp contrast to TMC, grammatical morphemes in TW may carry any of the seven citation tones. Like lexical syllables, these functor syllables also undergo sandhi changes. Although grammatical morphemes in TW are usually tonal, they tend to lose their distinct intrinsic fundamental frequency in clause- and sentence-final positions. However, it is important to keep in mind that the environments for the occurrence of the neutral tone such as directional verb complements, resultative verb complements, the durative aspect marker leh, and the vocative markers -e & -a, are frequently the ones for the occurrence of tone spreading. As a result, the neutral tone of these function words is often replaced or displaced by the tone of preceding content words. This greatly reduces the possibility of function words undergoing
tonal neutralization in utterance-final positions. Moreover, grammatical morphemes in TW may contain any of the six vowels /a, i, e, u, o, o/. There is not one single vowel that associates regularly with a certain pitch pattern (as does schwa with neutral tone in TMC), thus playing the role of associational focus for the grammatical morphemes in TW.

2.3.3 Stress and the Neutral Tone

In Mandarin, neutral-toned syllables are generally perceived as short and lax. Detailed acoustic measurements of the duration of the neutral tone have shown that the length of a neutral-toned syllable is about one half that of a full-toned syllable, and all neutral-toned syllables have about the same length (Zadoenko 1958; Speshnev 1959; Dreher & Lee 1966). That is, full-toned syllables and neutral-toned syllables differ considerably in duration. Phonetic research in the acoustic correlates of stress in Mandarin has led to the conclusion that Fo is not a necessary cue; stress can be identified on the basis of duration and intensity alone, and duration has been shown to be by far the more important cue of these two (Speshnev 1959; Lin 1985; Shen 1993). Accordingly, the strong-weak stress pattern is characterized by comparatively shorter duration of the neutral-toned syllable than its preceding full-toned syllable. Full-toned syllables followed by neutral-toned syllables help to impart a stress-timed sort of rhythm to Mandarin utterances.

In TW, however, stress and the neutral tone do not interact in terms of cause and effect. Regardless of stress, a functor syllable may lose or recover its underlying tone depending solely on whether or not it is in clause- and sentence-final positions. As a matter of fact, stress in TW has never been well studied. Information which is available in the literature is all based on an impressionistic view. Du (1988) investigated stress from production and
perception data to see what the acoustic correlates of stress were and what the
native speakers of TW used as cues for their perception of stress.

Du's experimental results reveal that if there is stress in TW, acoustically, except in the triple adjective reduplication phrases of which in the majority the first syllable is associated with a greater intensity, none of or any combination of the three parameters, intensity, duration, and fundamental frequency, show a consistent pattern for the presence of stress. Perceptually, stress could be anywhere in a phrase, mostly depending on the tones of the individual syllables. The native speakers will perceive a syllable as stressed if this syllable has one of the high tones. As "stress" in TW is not linguistically significant, Du concludes that there is no stress in TW (1988:4).

2.3.4 Timing/Rhythm Characteristics

Recent prosodic theories of language propose that the utterance has a suprasegmental, hierarchical organization defined in terms of a metrical grid with binary branching and strong/weak prominence relations. These prominence relations are defined for all the elements that make up the units of the prosodic structure, from the syllable through the word and phrase to the utterance as a whole (Liberman & Prince 1977; Kiparsky 1979; Hayes 1981; Selkirk 1984). At the lower level of the hierarchy, weak and strong syllables group together into feet. Feet in turn bundle into prosodic words (Selkirk & Shen 1990) which may, or may not correspond to lexical words. Prosodic words bundle into phonological phrases which comprise all the material up to and including the head of a syntactic phrase. Phonological phrases themselves bundle into intonational phrases.

Recent developments of prosodic theory have important implications for psycholinguistics, and models of language production, perception and
comprehension have put emphasis on the prosodic structure of spoken language utterances. Allen and Hawkins (1978, 1980) have proposed that the omission of unstressed elements is the result of a condition on the rhythmical structure of utterances. After an initial stage in which only monosyllabic utterances are possible, children's utterances will tend to meet two requirements: (1) weak (unstressed) and strong (stressed) syllables should alternate, and (2) initial syllables should be strong. Together, these requirements constitute a trochaic bias, which, as Allen and Hawkins surmise, reflects a universal of human perceptual and motor performance (Allen & Hawkins 1980:251).

Although in adult speech the universal tendency to alternate between strong and weak syllables in a regular fashion is still discernible (see Kelly & Bock 1988), stress and rhythm are largely determined by language-specific stress rules. However, in the speech of children who have not yet acquired language-specific rules of stress and rhythm, the trochaic bias is argued to be directly reflected by the widely reported tendency to omit unstressed syllables that either are word-initial ($W_1S(W_2) \rightarrow S(W_2)$), or precede other unstressed syllables ($SW_1W_2 \rightarrow SW_2$) (Wijnen et al. 1994:7). Allen and Hawkins' trochaic bias may be interpreted as a constraint on prosodic representations that is specific for an early stage in the development of language. This hypothetical representation has been referred to as the "SW-template".

Some evidence in support of this hypothesis was gathered by Gerken (1990, 1991) in a sentence imitation task with 2-year-old children. She found that (unstressed) closed class words, such as determiners and pronouns, which constituted weak parts of iambic feet were systematically omitted. In a later study (Gerken 1994a), a positive correlation was found between 2-year-
olds' MLUs and their tendency to preserve weak (unstressed) syllables in the imitations of multisyllabic nonsense words. Since increases of MLU in the stage of development Gerken studied predominantly reflect the increasing use of closed class morphemes, this correlation corroborates the idea that the omission of both closed class morphemes and unstressed syllables reflect the same underlying mechanism.

Several investigators have further demonstrated the importance of meter in children's early utterances, both in their production of filler syllables to maintain metrical patterns (Peters 1995; Gerken, in press) and in their omission of weak syllables from particular metrical patterns, the focus of the current work (Demuth 1992; Gerken 1994a & b; Wijnen et al 1994). There are now enough reports in the literature of children who use filler syllables to suggest that, while some fillers may indeed be protomorphemes, with a small set of identifiable targets, others may have been inserted simply to maintain a rhythmic beat. If Gerken is right that metrical footing is an important organizer of children's early multi-syllabic utterances, then it seems plausible that, while some children might delete syllables that fall outside of optimal feet, others might insert syllables to fill up otherwise defective feet (Peters 1995:20).

A suitably revised metrical tree might also be applicable to languages other than English. Some indication of its applicability to Mandarin is that the lowest levels of a hierarchical representation are well defined by the existence of neutral-toned syllables and tone sandhi (Chen 1979; Shih 1986; Hsiao 1991). The neutral-toned syllables are a phonological analogue to reduced syllables in English and define the comparable level in the hierarchy. There are also to some extent a phonetic analogue of the English
reduced syllables, since in addition to not having an assigned tone, they share with the English syllables the same shorter durations and lenited vowel qualities (Beckman 1986:104). In other words, although Mandarin is a tone language, it is similar to stress-timed languages in the presence of a contrast between full-toned syllables and neutral-toned syllables. Such salience contrasts result in rhythmical alternations of highlighted and lowlighted syllables in fairly rapid speech. This, in turn, defines a rhythmic beat which prosodically segments the speech stream into naturally graspable units (stressed syllables, trochaic feet, prosodic words).

"Stress" is defined by Lehiste (1970:119) as "linguistically significant prominence" and there are three primary acoustic cues for the perception of stress: fundamental frequency (F₀), intensity (amplitude), and duration. To determine which acoustic cues or what combination of them a native speaker uses in the perception of stress in TW, Du (1988) conducted three perception tests. In a perception test relevant to the present discussion, fourteen native speakers of TW were asked to identify which syllables in a general tone sandhi phrase were the loudest. The results showed that the native speakers usually used F₀ as a cue to judge which syllable in an utterance was louder than others if they perceived any. In other words, F₀ is the primary acoustic cue for the presence of loudness. The location of stress of these phrases, if there is any, mostly depends upon where a high-toned syllable is, and there is no independent stress in TW (Du 1988:203).

However, if loudness is the criterion for stress in TW and since stress depends on F₀, there is no metrical way to predict the location of stress. As a result, metrical theory cannot provide a generalized principle to account for the various stress locations for TW. Stress in TW is manifested in a way
different from what has been understood traditionally in that it is not contrastive and does not have any linguistic significance (Du 1988:228). As Chang puts it (1992:150), the employment of tones in the prosody of TW is perhaps sufficient for information-processing, leaving little need for exploiting other prosodic cues (e.g., stress) to facilitate the parsing of information.

TW appears to be a syllable-timed language, in which syllable durations show a tendency towards equality. In a language of this type, the four acoustic properties: pitch, duration, rhythm, and intensity, operate separately rather than in concert. Sequences of syllables, however, have less of the kind of rhythmic structure characteristic of stress-prominent languages, thus offering the novice less in the way of rhythmically defined units for segmentation.

2.4 Hypotheses

Now that we have developed a rudimentary framework for thinking about the kinds of prosodic characteristics that might affect the acquisition of grammatical morphemes in TMC and TW, we will conclude this chapter by formulating three hypotheses about how children actually use prosody in the early stages of language acquisition.

Hypothesis 1: The timing/rhythm difference in TMC and TW affords different acquisition paths (i.e., a foot path vs. a syllable path) for children learning grammatical morphemes.

The issue which arises here is whether rhythmic characteristics of languages can affect segmentation by providing different kinds of prosodic "handles" for the novice to grasp at. Child language researchers already noted that different acquisition paths (e.g., a tune path, a foot path, a syllable/segment path) have been found among learners of Danish, English, Finnish, German, Norwegian, and Portuguese. Peters suggests that one
crucial difference among these paths -- a difference lying near their starting points -- might involve the size of phonetic unit that children choose to reproduce and the role of prosody in the organization of their early productions (1995:30). This hypothesis makes three main predictions:

- The segmentation strategies employed by TMC- and TW-speaking children differ from the earliest stages of language production.
- There is a striking difference in the patterns of realization and omission of grammatical morphemes between the two groups of children.
- The degree to which grammatical morphemes are vulnerable to omission differs greatly between the two language groups.

**Hypothesis 2:** It is harder for young children to begin to produce the grammatical morphemes of TW that are full-toned than it is to produce the grammatical morphemes of TMC that are neutral-toned.

It has already been suggested that in TMC metrical feet may offer the learner one kind of segmentation handle. However, what might be some implications for segmentation in a non-stress language like TW? What kinds of evidence can we find to claim that it is relatively difficult for children to acquire full-toned grammatical morphemes of TW? What sorts of strategies will help the learners of TW focus on grammatical morphemes? Which grammatical morphemes in TW seem to be the least susceptible to omission? Will the diminutive marker -a2 offer greater resistance to omission than any other grammatical morpheme in TW? It appears that this morpheme possesses phonological salience, since -a2 has a low vowel with a high-falling tone and occurs in word-final position. Will TMC-speaking children omit grammatical morphemes, too? Which grammatical morphemes in TMC seem to be the most vulnerable to omission? Are there any prosodic explanations for the absence of grammatical morphemes in TMC? To answer these questions, we will need to test the validity of the following predictions by analyzing the patterns of realization and omission of a highly frequent
subset of grammatical morphemes in children learning either TMC or TW as their first language.

- There are significant differences between TMC- and TW-speaking children with regard to the omission of grammatical morphemes in their spontaneous and imitative speech.
- Grammatical morphemes in TMC are most vulnerable to omission when they do not fit within the strong-weak metrical production templates.
- Grammatical morphemes in TW are least susceptible to omission when they are associated with phonological salience.

Hypothesis 3: Frequency of grammatical morphemes in caregivers' speech will be reflected in the order of appearance of these morphemes in children's productions.

Brown (1973) and de Villiers & de Villiers (1973) explore three reasons for the order of acquisition of 14 grammatical morphemes for three English-speaking children: (i) frequency of the morphemes in parental speech, (ii) syntactic complexity, and (iii) semantic complexity. Neither study found any effects of (i), but both found that (ii) and (iii) had some predictive power. One weakness of their studies is that they fail to separate out the relative contributions of each type of complexity, namely syntactic and semantic complexity, frequency, and perceptibility in speech. By conducting the present comparison study, we hope to provide more information about how these factors interact with each other in determining the order of acquisition of grammatical morphemes in TMC and TW. This hypothesis makes the following predictions:

- There is a significant correlation between frequency of grammatical morphemes in input speech and their order of appearance in TMC- and TW-speaking children's productions.
- Other factors may interact with frequency of input in determining the order of appearance of grammatical morphemes in TMC- and TW-speaking children's productions.
CHAPTER 3
THE EXPERIMENT

3.0 Introduction

The present study explores the relationship between prosody and grammatical morphemes (both bound and free) by considering a contrastive study of the acquisition of grammatical morphemes in a pair of morphosyntactically similar but prosodically different languages. As a preliminary testing ground for investigating the effects of prosody on the acquisition of grammatical morphemes, we have chosen to focus on TMC and TW. The discrepancies that are found to exist in the prosodic structures of TMC and TW have led us to propose three hypotheses. In order to test the validity of these hypotheses, we utilize two sources of evidence -- longitudinal language samples and controlled experiments -- to describe and analyze the patterns of realization and omission of a highly frequent subset of grammatical morphemes in children learning either TMC or TW as their first language.

3.1 Hypotheses

The present investigation of the interaction of prosody with grammatical morphemes has focused on TMC and TW. The "experiment language" is TMC, which is similar to stress-timed languages in the presence of a contrast between full-toned lexical syllables and neutral-toned functor syllables. The "control language" is TW, because it has fewer neutral-toned functor syllables occurring in phrase-final position, even though its lexicon and morphology are extremely close to those of TMC.
Although we realize that prosodic patterns may not play the same role in acquisition as they do in adult perception or production, we feel there is a need to identify patterns that seem to be useful to learners, to map out how they are used in acquisition, and to specify how they eventually are re-analyzed to fit into an adult-like system. More specifically, we have proposed the following hypotheses:

**Hypothesis 1:** The timing/rhythm difference in TMC and TW affords different acquisition paths (i.e., a foot path vs. a syllable path) for children learning grammatical morphemes.

**Hypothesis 2:** It is harder for young children to begin to produce the grammatical morphemes of TW that are full-toned than it is to produce the grammatical morphemes of TMC that are neutral-toned.

**Hypothesis 3:** Frequency of grammatical morphemes in caregivers' speech will be reflected in the order of appearance of these morphemes in children's productions.

These hypotheses thus concern children's perception of salient prosody that fortuitously coincides with grammatical morphemes, with evidence to be drawn from what they produce. Since our interest in the role of prosody has grown out of both theoretical considerations and empirical observations across languages, we now begin to build the empirical basis for our hypotheses by looking at longitudinal development in six children learning either TMC or TW as their first language.

3.2 Longitudinal Language Sampling

The longitudinal language samples incorporate some of the experimental concerns of the large sample studies. The children are visited

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1 Longitudinal language sampling is a method commonly used in collecting data on language acquisition. It can be seen as an outgrowth of diary studies and large sample studies.
on a regular schedule at predetermined intervals for a predetermined amount of time. There are sometimes two visitors, one to take notes and one to interact with the child. All sessions are tape recorded for later transcription. With longitudinal sampling, much larger samples are sought, so that a more representative sample of the child’s general language ability is obtained.

3.2.1 Method
3.2.1.1 Subjects

At the beginning of the study, 16 or so families who had a child at 18- to 22-months of age were introduced to the investigator either by a day care center or by friends of the investigator’s. These families were then interviewed informally in their homes and asked to answer some simple questions about who lived in the household, the educational backgrounds, birthplaces and native dialects of all adults who lived in the household, as well as daily schedules for the child. The translation of the initial interview with families (Case Form) is presented in Appendix A. From this group, 7 families were eliminated either because they spoke TMC and TW simultaneously at home, or because they were not interested in participating in the study. After the first recording session, an additional 3 families were eliminated because the child refused to say anything at all when the investigator was present. Finally, 6 children who learned either TMC or TW

(Ingram1989:21). Diary studies are longitudinal, but they usually consist of notes rather than complete language samples for some predetermined length of time. Large sample studies such as cross-sectional studies take language samples, but they are normally quite short, and not longitudinal.

2 In this study, three children were selected for each group. This number is considered
as their first language and whose families were willing to participate for 6 months were chosen.

Children selected were divided into two groups. Group A consisted of three monolingual TMC-speaking children of normal intelligence. Jie (male) and Lon (female) lived in Taizhong, the biggest city in central Taiwan. Both of them were second born children. Ron (male) lived in Taipei, the capital of Taiwan. He was a first born child. That is to say, two children came from the central part of Taiwan, and one child came from the northern part of Taiwan. All children grew up in middle class families. Their parents had received formal schooling which was college level or above, and they claimed that they could not speak any TW. All children were enrolled in a day care center, and TMC was the only language spoken by the caregivers in the center. They went back home with their parents in the evening.

Group B consisted of three TW-speaking children of normal intelligence. Because TMC is the official language in Taiwan, and school education is conducted in TMC, these children knew some TMC lexical items either from adults around them or from their siblings who attended school. However, since these children were raised in the rural area of Taiwan, where TW was more commonly used in daily social contact, TW was still the predominant language spoken by their family members.

as an absolute minimum necessary to determine general features of acquisition: if one is chosen, we do not know if the child is typical or not; if two, we do not know which of the two is typical and which is unusual; with three, we at least have a majority that can be used to make such a decision (Ingram 1989:21).

3 I thank my sister for introducing Jie and Lon to me.
4 I thank Ana Guo for introducing Ron to me.
5 TMC is not the only language used in national broadcasting in Taiwan. In fact, there are many TV and radio programs conducted in TW.
Mao (male) and Xii (male) lived in Daya, a small town located in Taizhong County. San (female) lived in Madou, a small town located in Tainan County. That is, two children came from the central part of Taiwan, and one child came from the southern part of Taiwan. Caregivers of these children admitted that they could speak TMC, but they seldom had a chance to use it in their daily life. They all claimed that TW was the mother tongue of their children. As a matter of fact, the investigator found that TW was the only language used by the community they were living in. All children were third born, and stayed home with their mother and grandparents during the day. Their father usually came back home from work in the evening. All children grew up in middle class families. Their parents had received formal schooling which was either high school level, college level or above in TMC. A map indicating that all 6 children came from different regions of Taiwan is presented in Figure 1.

An effort was made to equate the gender distribution of the subjects in each of the group. Thus, each group had a total of three children -- two males and one female. For Group A, Jie was 1;8.15, Lon 1;7.21, and Ron 1;10.14 at the start of the experiment. At the end, their ages were 2;1.15, 2;1.16, and 2;3.20 respectively. For Group B, Mao was 1;10.2, San 1;8.10, and Xii 1;6.8 at the start of the experiment. At the end, their ages were 2;3.5, 2;1.15, and 1.11.19, respectively. Overall, the mean age was 20 months, 26 days for Group A and 20 months, 7 days for Group B at the time of the first transcribed recording. The average age of the two groups differed by 19 days. Since some children

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6 I thank my sister's mother-in-law for introducing Mao and Xii to me.
7 In this study children's ages are given as years;months;days, for example, 1;8.12.
Figure 1. Map of Taiwan
may simply be better at language learning than others, and acquire it faster, children's mean length of utterance (MLU) in morphemes described by Brown (1973:54), rather than children's age differences, was utilized as a means for dividing up the developmental continuum.\(^8\)

MLU is a measure that has been used widely in cross-linguistic studies of language acquisition (Tardif 1993:44). For most of children's utterances, the MLU is a good predictor of the degree to which functors are present in speech because an utterance that contains function morphemes receives a higher morpheme count than the telegraphic version of the utterance (e.g., *go u3 de yi3 ba1* "the tail of a dog" contains four morphemes, whereas *go u3 yi3 ba1* contains only three.).\(^9\) However, numerous "yes/no" utterances included in the calculation decrease MLU's predictive value for two reasons: First, responding simply "yes" or "no" to a class of questions is appropriate for adults as well as for children and does not reflect linguistic sophistication. Second, frequent "yes/no" responses reflect more about the linguistic style of one's conversational partner than about one's own linguistic abilities. In this study, some caregivers asked questions that required "yes/no" responses in order to elicit speech from their children, whereas other caregivers did not.

\(^8\) Brown (1973) decided to use the measure of the average length of sentences as a means for dividing acquisition into stages. To calculate this, he chose to count the number of morphemes in sentences, instead of words, because he felt that it would be a more sensitive measure. He arbitrarily divided up the MLU continuum into five stages by a range of MLUs. For example, Stage I is when the child's MLU falls between 1.0 and 2.0. Successive stages are marked by increments of .5.

\(^9\) MLU is certainly useful for making rough comparisons among most children learning to speak the same language. However, as Peters points out (1983:96), it is also true for some children such as Gestalt-oriented ones, it is virtually impossible to calculate MLU at all. She suggests that researchers need to deal with the problem of what is a "unit" on a child-by-child, and even utterance-by-utterance, basis.
Including "yes/no" utterances would have decreased the MLUs of children with "eliciting" caregivers in relation to those of other children, so they were excluded.

Also excluded were utterances with uncertain adult targets, utterances representing noises (e.g., "ba-ba" for a horn), sounds used to indicate "yes" or "no" such as "mm-hmm," and multiple repetitions of single words which conformed exactly to the adult target (and, therefore, provided no useful information for the analysis). "Mama" and "baba" were also excluded from the analysis unless they were used in a specifically referential sense (e.g., to refer to a mommy duck or a picture of a daddy). These words were excluded because they are extremely frequent and some are often distorted due to calling or whininess; these distortions are clearly not errors but would have to be counted as such in the analysis. Note that excluding these utterances results in our subjects having a higher average MLU than same-aged children in other studies in which MLU was calculated in the standard manner. Following Brown's criteria for calculating MLU in English, Tardif (1993) set some criteria for determining MLU in Mandarin (see Appendix B). In this study, our calculation of MLU in TMC and TW was largely based on her criteria.

Each child's MLU was calculated from the spontaneous speech he or she produced during each experimental session. For Group A, Jie's MLUs were 1.40 and 2.29 in the first and last samples, respectively. The values for Lon were 1.26 and 2.36. The values for Ron were 1.16 and 2.64. For Group B, Mao's MLUs were 1.22 and 2.04 in the first and last samples, respectively. The values for San were 1.98 and 3.12. The values for Xii were 1.41 and 2.28. These figures indicate that utterances were collected across several sessions.
during the period in which the child was producing primarily single-word utterances (including longer but unanalyzed sequences) and into the period of early two-word speech. A profile of the children's MLU is presented in Figure 2.

![Figure 2. MLU-profile for TMC- and TW-speaking children](image)

As can be seen in Figure 2, Xii (TW), Lon (TMC), and Jie (TMC) exhibited similar patterns of MLU development. Xii learned to speak earlier than Lon and Jie, but made slow progress during the period of data collection. In comparison with other children, Mao (TW) and Ron (TMC) were relatively slow in learning to speak. Ron's MLU grew slowly in the beginning, but increased sharply after he was 25 months old. However, the growth of MLU for Mao did not seem to go much further, and the other children surpassed him by the end of the experiment. Clearly better at language learning than the other children, San (TW) acquired the language so quickly that throughout the study the other children lagged behind her.
3.2.1.2 Procedure

The investigator, a native speaker of both TMC and TW, visited each child in his or her home. Each visit was scheduled at the convenience of the child's family. Each visit was spaced about two weeks apart. The families were told by the investigator that he was interested in children's language development and that he wanted to collect data which were as naturalistic as possible, so he needed to record the children in interaction with whomever they normally interacted in the household. Throughout the study, the investigator did not reveal to the families that he was particularly interested in the child's development of grammatical morphemes and the effects of adult speech on the child's language learning.

The subjects were recorded on audiotape. The audio equipment was of high quality (AIWA HS-JS315W cassette recorder with a tie-clip microphone), so as to allow for acoustic analysis of the children's speech. During the recording time, the child's mother wore the recorder in a fanny pouch with a tie-clip microphone attached to her clothes somewhere on the upper chest. In addition, it was intended that each child should wear a wireless microphone and carry their own transmitter in a small backpack throughout the visit. At the beginning of the study, the investigator did try to follow this method which Tardif (1993:31) used to collect spontaneous speech data from children for her experimental study. However, most of the children in the present

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10 Due to some uncontrollable factors, the schedule for each visit was frequently forced to change. For example, Jie and Xii frequently caught cold. Jie coughed so severely that he lost his voice. Lon and Ron sometimes were not in the mood. They screamed, cried, and refused to say anything at all. San had a sore throat for quite a while. The investigator had no choice but to postpone the tape-recording.
study did not like the idea of wearing a microphone and carrying a backpack during the recording time. They constantly touched the microphone and grabbed the backpack. So, after two or three visits, the investigator made sure that the child would not run too far away from the mother, and asked the mother alone to carry a cassette recorder with a tie-clip microphone attached to her clothes somewhere on the lower chest. The recording equipment was kept out of the child's view. By doing so, the natural flow of the interaction between mother and child was not interfered with by the child's curiosity. Each child was given toys or candy bars for their cooperation after each recording session, and they were rewarded with toys at the completion of their participation in the 6-month longitudinal study.

Spontaneous speech samples were tape recorded twice a month for each child over a period of six months. Each recording session lasted for approximately 60 minutes. Usually, the children were interacting with their mother. To get to know each child, the investigator presented some picture books and toys and engaged the child in play for about 20 minutes at the beginning of each visit. The other reason for doing this was that the investigator could ensure that the child was at ease. After this period, the mother started to interact with the child. Mother and child were often engaged in a variety of activities such as talking with each other, indoor toy play, picture drawing, and story telling. Also, picture books were frequently used to stimulate naming. After each recording was completed, the investigator would ask the mother about any of the conversation he did not fully understand. Very often the investigator had to confirm with the mother what the child actually said.
In some of the early recordings of Mao, his grandmother was present. Because Mao was extremely shy at the start of the study, his grandmother made great efforts to assist the investigator in eliciting speech from him. In the later recordings, however, the investigator had to interact with Mao alone, because his family members were usually very busy during the day. Mao had been very cooperative ever since he and the investigator became good friends. Ron's, Jie's, and Xii's fathers occasionally joined our recording when they did not have to work on Sunday. Unlike the mothers, the fathers did not spend much time talking to their children. Jie's, Lon's, Ron's, Xii's, and San's mothers were so excellent that they successfully conducted each recording without the assistance of the investigator. For each recording session, they would prepare a topic for their interaction with the child.

San's two elder sisters, Jie's and Lon's elder brothers also participated in the recordings when they had no school. Their participation definitely stimulated the child to talk more than usual. The child became active as soon as s/he saw his/her siblings come to join them. At the beginning of the study, the investigator usually stayed off to the side taking notes on the context of the interactions if there was no need for him to help the recording. However, interactions between the investigator and the family frequently occurred, particularly towards the end of the study when he was a familiar presence to the child and his/her families. Any speech that the investigator directed to the child or his/her caregivers was also included in the study.

3.2.1.3 Transcription and Coding

The taped utterances were first transcribed into the pinyin system of romanized Chinese spelling. Utterances were transcribed using a broad transcription; the detailed phonetic nature of the utterances was not
described. Thus, specific characteristics of phones, such as nasalization of
vowels or aspiration of stops, were not included in the transcriptions. Tones
were marked with a number at the end of each syllable. The neutral tone was
left unmarked. Here is an example of its use (Jie 2;1):

*CHI: mei1+mei1 de tou2 fa3 ne.
sister GEN hair SF.PAR
"the hair of the little girl"

*MOT: hao3.
good
"All right."

*MOT: zhao3 dao4 le la1
find ASP INTRJ.PAR
"I've found it!"

The transcriber not only wrote down the words that he heard, but also paid
close attention to the tones being produced, as well as to any errors, content
word omissions, functor omissions, or mispronunciations that occurred. The
transcribed utterances were then entered into a computer for analysis. All the
data input were in CHAT format (MacWhinney 1991). All the transcriptions
were checked with each child's caregiver.

These spontaneous speech samples were coded for the total number of
functors being used and the number of functors being omitted. To code a
functor omission, the zero symbol "0" was placed before the functor on the
text tier. This item would be counted for scoring conventions, but it would
not be included in the MLU count. Here is an example of its use (Mao 2;2):

*CHI: pit4 0ti7 chia1 oh?
pencil LOC here INTRJ.PAR
"Is the pencil here?"

However, since it was not always possible to determine from the
context whether a grammatical morpheme would have been obligatory in the
child's speech, and which grammatical morpheme a child should have used, we decided to register the appearance of functor omissions in the child's speech, according to the caregiver's repetition with correction. Although it has been suggested that children get little negative feedback from their caregivers (Braine 1971, Baker 1979), after examining the data we collected, we found that there were only a few cases in which the caregiver did not repeat the child's utterance with correction before proceeding further with the conversation. Here is an example in which the mother provides positive information for her child's omission of the genitive marker e5 (San 1;9).

*MOT: che1 sa2 e5 e5-a2?
this who GEN shoe-DIM
"Whose shoes are these?"

*CHI: Pei4+Qi2 0e5 e5-a2.11
Pei-Qi GEN shoe-DIM
"Pei-Qi shoes"12

*MOT: li2 si7 an2 choa2 chheng7 Pei4+Qi2 e5 e5-a2?
you are why wear Pei-Qi GEN shoe-DIM
"Why are you wearing Pei-Qi's shoes?"

Another example is when the mother offers positive feedback to her child's omission of the genitive marker de by rephrasing what the child had just said (Ron 2;2). Unfortunately, the child became angry and turned his back on the mother.

*MOT: hong2 se4 de qiu2.
red color NOM ball
"red ball"

11 Proper names in TW are often pronounced in TMC.
12 The asterisk (*) is placed before a phrase/sentence to indicate the ungrammaticality of the phrase/sentence.
An immediate explanation for the caregiver's frequent repetition and correction of the child's utterances is that the caregiver consciously or unconsciously knew that his/her conversation with the child was being tape-recorded, and s/he might feel responsible for providing positive information about the target language for the child. Another reason is that the caregiver was kind enough to help the investigator better understand the conversation between him/her and the child. Table 3 shows the children's ages and MLUs for the transcripts reported on here.

Table 3. Transcripts from which the data are drawn.

<table>
<thead>
<tr>
<th>Child</th>
<th>Language group</th>
<th>Age range</th>
<th>MLU range</th>
<th>No. tapes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jie</td>
<td>TMC</td>
<td>1;8 - 2;1</td>
<td>1.40 - 2.29</td>
<td>12</td>
</tr>
<tr>
<td>Lon</td>
<td>TMC</td>
<td>1;8 - 2;1</td>
<td>1.26 - 2.36</td>
<td>12</td>
</tr>
<tr>
<td>Ron</td>
<td>TMC</td>
<td>1;10 - 2;3</td>
<td>1.16 - 2.64</td>
<td>12</td>
</tr>
<tr>
<td>Mao</td>
<td>TW</td>
<td>1;10 - 2;3</td>
<td>1.22 - 2.04</td>
<td>12</td>
</tr>
<tr>
<td>San</td>
<td>TW</td>
<td>1;8 - 2;1</td>
<td>1.98 - 3.12</td>
<td>12</td>
</tr>
<tr>
<td>Xii</td>
<td>TW</td>
<td>1;6 - 1;11</td>
<td>1.39 - 2.28</td>
<td>12</td>
</tr>
</tbody>
</table>

3.2.1.4 Reliability

As an evaluation of the reliability of the transcriptions of the children's productions, 6 randomly chosen selections of each TMC child's tape-recorded spontaneous speech were transcribed by a second judge trained in phonetic
transcription. Also, 6 randomly chosen selections of each TW child's tape-recorded spontaneous speech were transcribed by a second judge trained in phonetic transcription. Each selection was about one hour long. Both judges were blind to the investigator's hypotheses. The judge for TMC group was working on her Ph.D. degree in the Department of Linguistics at the University of Hawaii's Manoa Campus. The judge for TW group was working on his Ph.D. degree in the Department of East Asian Languages and Literatures at the University of Hawaii's Manoa Campus. Reliabilities were calculated for agreement on "correct" and "incorrect" assignments for functor omissions in the child's spontaneous speech. The reliabilities attained were .90 for Jie, .84 for Lon, .90 for Ron, .86 for Mao, .90 for San, and .88 for Xii.

3.3 Controlled Experiments

It is important to note that if we try to study the child's knowledge of grammatical morphemes exclusively from spontaneous language samples, we will run into two immediate problems. One problem with spontaneous samples is that grammatical morphemes in TMC/TW are often omitted under appropriate discourse contexts. The other problem is that it is not always possible to determine from the context which grammatical morpheme a TMC-/TW-speaking child should have used. For these reasons, imitation and comprehension tests were used to assist in this study. The goal of the imitation test is to see if the children would process the sentences through their own grammatical system, or simply rote-imitate. The goal of the comprehension test is to allow us to probe the children's knowledge of these grammatical morphemes.
3.3.1 Imitation Tests

As soon as the TMC- and TW-speaking children's MLUs approached 1.80, a practice session of the imitation test procedure was conducted in order to familiarize the children with the procedure. The imitation test was formally conducted for both groups of children when their MLUs, calculated from spontaneous utterances, reached above 1.90. For Group A, Jie was tested when his MLU was 1.95 at the age of 23 months. Lon was tested when her MLU was 1.93 at the age of 23 months. Ron was tested when his MLU was 2.15 at the age of 26 months. For Group B, Mao was tested when his MLU was 1.91 at the age of 25 months. San was tested when her MLU was 2.42 at the age of 22 months. Xii was tested when his MLU was 1.96 at the age of 22 months.

3.3.1.1 Method

3.3.1.1.1 Stimuli

TMC-speaking children were asked to imitate a set of 14 sentences they heard from the investigator. Each test sentence had four syllables, and contained only one neutral-toned target grammatical morpheme. That is, there were 56 syllables in the test -- 42 lexical syllables and 14 neutral-toned functor syllables. These functors were selected from the following set: the nominalizer/genitive marker *de*, the aspect marker *le*, the classifier *ge*, the durative aspect marker *zhe*, the plural marker *men*, and the diminutive...
marker -zi. Based on its grammatical function, each functor appeared twice in the test.

There were two criteria for selecting these functors. The first criterion was that they were neutral-toned. However, question particles such as ma and ne were not included in the test because they always occurred in sentence-final position, and had a rising intonational pattern. In addition, interjection particles such as a, la, and ya were not considered because though without tone, they are usually stressed, and have a variety of intonational patterns. The second criterion was that they occurred frequently in adult speech. The Institute of Information Science Academia Sinica in Taiwan has recently compiled a dictionary called Corpus-Based Frequency Count of Characters in Mandarin Chinese. Among 14,457,537 characters collected in the dictionary, the nominalizer/genitive marker de is the 1st, the aspect marker le the 25th, the classifier ge the 33rd, the durative aspect marker zhe the 166th, the plural marker men the 339th, and the diminutive marker -zi the 734th the most commonly used words in TMC. The goal of this test is to allow us to ask whether or not TMC-speaking children would selectively preserve neutral-toned grammatical morphemes. The list of the 14 test sentences appears in Appendix C.

For TW-speaking children, they were also asked to imitate a set of 14 TW sentences they heard from the investigator. Each test sentence had four syllables, and contained only one target grammatical morpheme. That is, there were 56 syllables in the test -- 42 lexical syllables and 14 functor syllables. All functors were tonal, and underwent sandhi changes if they did not occur in phrase-final position. These functors were selected from the following set: the classifier/nominalizer/genitive marker e5, the locative marker ti7, the
progressive aspect marker *teh4*, the durative aspect marker *leh4*, and the diminutive marker *a2*. Based on its grammatical function, each functor appeared twice in the test. There were three criteria for selecting these functors. The first criterion was that in terms of their grammatical function, they were equivalent to those selected for TMC. For example, *e5* is equivalent to *de* and *ge*; *leh4* and *-a2* are equivalent to *zhe* and *-zi*, respectively. The second criterion was that they were tonal.

The third criterion for the selection of these functors was based on their probable frequency in the lexicon of TW. Because TW does not have an equivalent for the plural marker *men*, and because *a*, the TW equivalent for the TMC completive aspect marker *le*, almost always remains neutral-toned in utterance-final position, the locative marker *ti7* and the progressive aspect marker *teh4* were chosen instead. These two morphemes are very high frequency words in TW. The goal of this test is to allow us to ask whether or not TW-speaking children would selectively omit tonal grammatical morphemes. The list of the 14 test sentences appears in Appendix D.

3.3.1.1.2 Procedure

After the investigator finished tape-recording spontaneous speech from the child, he showed the child a bag of toys that he had brought and encouraged the child to talk about them. After about 20 minutes of playing

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14 The dictionary of corpus-based frequency count of characters in TW is not yet available. However, since TMC and TW are closely related in their morphosyntactic system, I assume that the classifier/nominalizer/genitive marker *e5*, the durative aspect marker *leh4*, and the diminutive marker *-a2* in TW would have a ranking similar to *de*, *ge*, *zhe*, and *-zi* in TMC. In addition, the locative marker *ti7* and the progressive aspect marker *teh4* are equivalent to *zai4* in TMC, and it is the 3rd most frequently used word in TMC. Therefore, as to order of frequency, the above grammatical morphemes were tentatively ranked as follows: *e5 > ti7 > teh4 > leh4 > -a2*. 

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with the toys, the investigator presented the child with a to-be-imitated sentence in the form of a statement and then asked the child to say it. The child was told that if s/he said what the investigator had just said, s/he could choose the toys s/he liked. If the child refused, the investigator tried again up to two more times. The mother also tried to help the investigator by enticing her child with the toys. If the child agreed, the investigator read the first string and asked the child to repeat the four-syllable string. For example, the investigator said "mao1 chi1 le yu2. Can you say that? -- 'mao1 chi1 le yu2'." After the child imitated the utterance, the investigator said "Excellent" and continued to the next string until the child had been asked to imitate all 14 strings.\footnote{Most of the children imitated six or seven sentences at a time and then went on to play with their toys. The investigator and the mother had to ask the child many times to imitate the rest of the sentences.}

Because it was plausible that attention to the utterance would be enhanced by providing an explicit referent, one half of the strings were accompanied by a brief enactment of the sentence by the investigator. For example, in "san1 ge ping2 guo3," the investigator showed the child a picture of three red apples. The mother also did a pretty good job in encouraging the child to imitate the utterances. All of the sentences were spoken with normal TMC/TW prosody.

\subsection*{3.3.1.1.3 Transcription and Coding}

The imitation tests were tape recorded. The tapes were first transcribed into the pinyin system of romanized TMC/TW spelling by the investigator. Imitations were then coded for the number of functor or content elements omitted. The scoring criteria were devised as follows: function morpheme
omissions, content word omissions, and accurate content words. Specifically, two scores were calculated by the investigator: (1) number of functors omitted (out of a total of 14), (2) number of content words omitted (out of a total of 42). Function morpheme omissions were defined as those imitations in which the only function morpheme in the four-syllable string was omitted. Because TMC-speaking children sometimes produced neutral-toned functors as schwa (i.e., syllable-initial consonant omission) in spontaneous speech, neutral-toned functors that were imitated as schwa were not counted as omitted.\(^{16}\) Content word omissions were defined as those imitations in which any of the three lexical syllables in the four-syllable string were omitted. The segmental accuracy of content word imitations was also examined. Accurate content words were scored as imitations of content words that matched the target exactly or deviated from it by a single phoneme. For example, /am5/, /tan5/, and /lam5/ would all be considered accurate imitations of the syllable /tam5/ "wet". Also, /tsia1/ would be counted as an accurate imitation of /tshia1/ "car" because it is common for young children to have a problem with the aspirated sound.

3.3.1.1.4 Reliability

To check for reliability, two independent judges, trained in phonetic transcription and blind to the investigator’s hypotheses, transcribed each TMC- and TW-speaking child’s tape-recorded imitations. The judges were working on their Ph.D. degree in the department of East Asian Languages and Literatures at the University of Hawaii’s Manoa Campus. The judge for TMC

\(^{16}\) There are reports in the literature of children who produce functors as filler syllables (usually schwa) in spontaneous speech (Bloom 1979; Peters 1983).
group agreed with the investigator's transcription on 100% of the strings for Jie, 93% of the strings for Lon, and 100% of the strings for Ron. The judge for TW group agreed with the investigator's transcription on 100% of the strings for Mao, 100% of the strings for San, and 100% of the strings for Xii. Results from the imitations were presented in terms of the percentage of functors omitted and the percentage of accurate content words.

3.3.2 Comprehension Tests

A comprehension test was conducted for both groups in the last month of the data collection process. Cross-language research on the acquisition of grammatical morphemes has suggested that imitation is easier than comprehension. This might also be the case for TMC- and TW-speaking children. However, both groups of children may have no difficulty comprehending certain grammatical morphemes. We are particularly interested in finding which grammatical morphemes they have no problem with at this stage, and what properties these grammatical morphemes have (e.g., frequency in input, perceptual salience, syntactic complexity, and semantic complexity). Moreover, we would like to know whether TW-speaking children, overall, perform better than TMC-speaking children in the comprehension test, or vice versa. Specifically, we are looking for an answer to the question: Does the effect of perceptual salience (tonal vs. neutral-toned) contribute to the comprehension of grammatical morphemes between these two groups of children? The test sentences for Group A are presented in Appendix E, and the test sentences for Group B in Appendix F.
3.3.2.1 Method

3.3.2.1.1 Stimuli

For TMC-speaking children, five grammatical contrasts were selected in such a way that the children would need to know specific grammatical morphemes in order to process the sentences correctly. These contrasts included: (1) the durative aspect marker zhe versus the completive aspect marker le, (2) the presence versus absence of the plural marker men, (3) the presence versus absence of the classifier ge, (4) the presence versus absence of the genitive marker de, and (5) the presence versus absence of the nominalizer de. Each contrast appeared twice in the test. The diminutive marker -zi was not included in the test because it is no longer productive in TMC. However, because it always has the neutral tone, and constitutes the obligatory second syllable of a large number of nouns when they occur as independent words, -zi was given special attention in the spontaneous speech samples and the imitation test.

There were six grammatical contrasts for TW-speaking children. These contrasts included: (1) the progressive aspect marker teh4 versus the completive aspect marker a, (2) the durative aspect marker leh4 versus the completive aspect marker a, (3) the presence versus absence of the classifier e5, (4) the presence versus absence of the locative marker ti7, (5) the presence versus absence of the genitive marker e5, and (6) the presence versus absence of the nominalizer e5. Each contrast appeared twice in the test. Like -zi in TMC, the diminutive marker -a2 was not included in the test. The goal of the test was to examine TMC-/TW-speaking children's knowledge of these grammatical morphemes.
3.3.2.1.2 Procedure

TMC-/TW-speaking children were shown two pictures and then heard one of a test pair of sentences. They then had to point to the picture named. Next they were given the second test sentence and again asked to select the appropriate picture. Most of the pictures contained animals familiar to them. It was hoped that these pictures would attract them to perform the task.

3.3.2.1.3 Reliability

The results were presented in terms of percentages of correct responses on each contrast. However, it is important to note that the comprehension test can only be regarded as a pilot test. The reasons for this are as follows: One reason is that because the child was given only two pictures from which to choose, s/he could randomly select the right picture without even listening to the test sentence. The other reason is that if the child needed to listen to the test sentence and then respond to it, s/he would easily lose his/her patience and concentration. A third reason is that this is the first time that such test sentences have been constructed for the Chinese-speaking children, and some of them may be too hard for a 2-year-old child to comprehend. Since there are so many variables that might occur in the test, we will present the results but not place any special weight upon them.
CHAPTER 4
RESULTS

4.0 Introduction

The purposes in this study were threefold: first, to investigate the effect of timing/rhythm differences in TMC and TW on children's acquisition of grammatical morphemes; second, to look for prosodic explanations for any relative difficulty in learning grammatical morphemes within each language group and between the language groups; and, finally, to examine the role of input frequency in the acquisition of grammatical morphemes in TMC and TW. This chapter consists of five main sections. Section 4.1 examines various phonological aspects of children's utterances across the period of spontaneous data collection. Section 4.2 presents the order of appearance of grammatical morphemes within each language group and between the language groups. Section 4.3 examines the data regarding realization and omission of a highly frequent subset of grammatical morphemes from longitudinal language samples and imitation tests. In order to demonstrate the relative difficulty in learning grammatical morphemes within each language group and between the language groups, this section also compares and contrasts the patterns of omission of grammatical morphemes from children's spontaneous and imitative speech. Because frequency of grammatical morphemes in child-directed speech for both language groups was still unknown, Section 4.4 examines the frequency of grammatical morphemes in caregivers' speech, and then looks at correlations between frequency of grammatical morphemes in adult-to-child speech and their
order of appearance in children's productions. Section 4.5 summarizes the major findings.

4.1 Early Productions

In this study, we analyzed the patterns of realization and omission of a highly frequent subset of grammatical morphemes in the spontaneous speech of three TMC-speaking children and three TW-speaking children, recorded between the ages 1;6 and 2;3. Each recording session lasted for approximately 60 minutes. An imitation test was also conducted for both groups of children when their MLUs, calculated from spontaneous utterances, reached above 1.90. In the last month of the data collection, a comprehension test was conducted for both groups of children.

The present study was begun when both groups of children were in the initial period of word combination. For TMC group, the average length of utterance in morphemes was 1.27 and 2.43 in the first and last samples, respectively. For TW group, the average length of utterance in morphemes was 1.53 and 2.48 in the first and last samples, respectively. These figures indicate that utterances were collected across several sessions from the period in which the children were producing primarily single-word utterances (including longer but unanalyzed sequences) and into the period of early two-word speech.

There are several reasons why we need to examine various phonological aspects of the TMC- and TW-speaking children's utterances across the period of spontaneous data collection in the ensuing sections. First, the tone system of TMC is relatively simple in comparison with that of TW: TMC has four tones; TW seven. Second, unlike TMC, TW has syllable-final stops. Moreover, TW has one of the most complex tone sandhi systems in
the Chinese languages. Hence, we need to consider if the differences in syllable structure patterns, segmental phonemes, tonemes, and tone sandhi rules between the languages might affect the children’s acquisition of grammatical morphemes.

4.1.1 Syllabic Structures

Most utterances produced by both groups of children contained one or two syllables. Syllabic structure was usually CV, CVN, VN, V, or CV(N)CV(N)-reduplicated for TMC-speaking children.\(^1\) In addition to these syllable structure patterns, because TW has syllable-final consonants, TW-speaking children also produced CVC and VC targets, such as [pit4] "pen" and [a?4] "duck".\(^2\)\(^3\) However, there were very few CVC or VC words actually produced by TW-speaking children, and many of these were modified in production. The final consonant /p, t, k, ?/ might be omitted or undergo lenition.\(^4\) For example, a word such as ap8 "box" when followed by the diminutive marker -a2 was produced as [βa], approximating a CV construction after the dropping of the word-initial vowel /a/. Syllable-initial stops, fricatives, and affricates were frequently omitted by both groups of children, thus generating a V or VN pattern for TMC-speaking children and a V, VN, or VC pattern for TW-speaking children. The /m, n, η/ three-way contrast in syllable-final position was often maintained by TW-speaking children. However, for TMC-speaking children, syllable-final /η/ tended to merge with the dental nasal /n/ when it occurred before the high front vowel

\(^1\) The capitalized N represents the nasals /n, η/ in TMC and /m, n, η/ in TW.
\(^2\) Syllable-final stop consonants in TW can be one of the following sounds /p, t, k, ?/.
\(^3\) Material in square brackets: phonetic transcription.
\(^4\) Material between slashes: phonemic transcription.

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/i/. For example, words such as bing3 for cookie and bing1 for ice might be produced as [pin3] and [pin1], respectively.

Caregivers in both language groups liked to produce lexical items in reduplicated forms. The most common form of reduplication occurred when the caregiver asked the child to repeat the initial consonant and vowel of a two-syllable word, as in gou3+gou3 for doggie and nai3+nai3 for milk.5 Although in TMC there are some reduplicated kinship terms in which the second syllable is neutral-toned, caregivers usually liked to produce this syllable as tonal for their young children. For instance, the words mei4+mei "younger sister" and ma1+ma "mother" were produced as mei1+mei1 and ma1+ma1, respectively. As a result, the use of the neutral tone in TMC seems to be exclusively reserved for grammatical morphemes in adult-to-child speech.

For both groups of children, a substantial proportion of their early utterances can be regarded as extractions of final syllables from adult models. Nouns, which made up a large proportion of early words, were especially likely to occur in sentence-final position in caregivers' speech, and therefore had an advantage in perceptibility. Overall, syllables which were final in the adult target were far less frequently omitted than were non-final syllables of the target word. Here is an example taken from the conversation between Mao (1;10.13) and his grandmother.

---

5 The symbol + is used to indicate segmentation of reduplications, proper names, or terms of address in TMC and TW. Proper names, babytalk reduplications, and terms of address have been counted as single morphemes.
Another example is taken from a conversation between Jie (1;8.23) and his mother.

*MOT: zhe4 ge ne1?
this CL Q.PAR
"What is this?"
sit: The mother asks Jie to identify the icon before they play a game.
*MOT: qing1 wa1.
frog
"frog"
*JIE: 0qing1 wa1.
frog
"frog"
*MOT: tai4 yang2.
sun
"sun"

---

6 The grandmother actually tried to pronounce the word for airplane in TMC; however, her pronunciation was strongly colored by the sound system of TW.

7 To code a syllable as missing, the zero symbol "0" is placed right before the syllable on the text tier. Examples such as 0hoe1 chi1 and 0qing1 wa1 mean that the first syllables hoe1 and qing1 were omitted, but not the second syllables chi1 and wa1.

8 sit: describes the situation.
In addition, final syllables of the target were more accurately produced than non-final syllables which were included in a child's production. Here is an example taken from a conversation between Lon (1;7.21) and her mother.

*MOT: ma1 +ma1 chang4 cuo4 oh?  
  mother sing wrong INTRJ.PAR
  "Did I sing in a wrong way?"

*LON: hā?  
  Q.PAR  
  "What?"

*MOT: hā?  
  Q.PAR  
  "What?"

*LON: kang4 [*] cuo4.  
  sing wrong  
  "You sang in a wrong way."


The example given below involves a conversation among San (1;9.14), her mother, and her elder sister.

*MOT: che1 kam2 u7 sui2?  
  this NEG have pretty  
  Isn't it pretty?

*SIS: phāi2 khoā3!  
  bad look  
  "Ugly!"

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These findings provide support for the claim made by Echols (1987, 1993) Echols & Newport (1992) that syllables which are stressed or final in the adult target are particularly salient to young children and, as a result, are particularly likely to be extracted from the stream of speech, stored in a representation, and included in first productions.

4.1.2 Acquisition of Tones vs. Segments

The present study provides support for the claim made by Li and Thompson (1977:189) that the tonal system is mastered well in advance of the segmental system. Regardless of the number of distinct tonal categories each language possesses, children speaking either TMC or TW seldom made mistakes in tones, when they still had difficulty with many kinds of segmental phonemes. There were many examples indicating that both groups of children produced a phrase or word with the appropriate tone pattern, in a manner that was segmentally very far away from the adult form and often completely incoherent. Here are some typical examples taken from TMC- and TW-speaking children’s spontaneous speech samples.

<table>
<thead>
<tr>
<th>TMC children</th>
<th>Adult9</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ku4]</td>
<td>[tʰu4]</td>
</tr>
<tr>
<td>[ki3 tou2]</td>
<td>[tsi3 tou2]</td>
</tr>
<tr>
<td>[lao3 ku3]</td>
<td>[lao3 şu3]</td>
</tr>
<tr>
<td>[ti1]</td>
<td>[tsu1]</td>
</tr>
</tbody>
</table>

---

9 Although for many TMC speakers, the retroflex initials /tʂ, ʈʂʰ, ʂ-/ have merged with the dental sibilants /ts, tsʰ, s/, caregivers of TMC group sometimes still maintained the distinction between them in their productions. For example, the word lao3 şh1 "teacher" was
In comparing the longitudinal speech data of TMC-speaking children with those of TW-speaking children, we found that TMC-speaking children made more mistakes in segmental phonemes than TW-speaking children did. In particular, TMC-speaking children showed greater difficulty in producing syllable-initial fricatives and affricates than TW-speaking children did. If we look at the phonemic inventory of TMC, we find that there are five fricatives and four affricates in TMC, as shown in Table 4.

Table 4. The fricatives and affricates of TMC

<table>
<thead>
<tr>
<th></th>
<th>Labiodental</th>
<th>Dental</th>
<th>Alveolo-palatal</th>
<th>Velar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voiceless fricative</td>
<td>f</td>
<td>s</td>
<td>c</td>
<td>X</td>
</tr>
<tr>
<td>Voiced fricative</td>
<td>z</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voiceless affricate</td>
<td>ts</td>
<td></td>
<td>ts</td>
<td></td>
</tr>
<tr>
<td>Aspirated affricate</td>
<td>ts\textsuperscript{h}</td>
<td>ts\textsuperscript{h}</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In TW, however, there are only two fricatives and two affricates, as shown in Table 5.\textsuperscript{10}

\textsuperscript{10} Compared to Mandarin, Wu, and Xiang, Min and the other southern Chinese language groups have relatively simple initial systems.

pronounced as [lao\textsuperscript{3} si\textsuperscript{1}] instead of [lao\textsuperscript{3} si1]. A possible explanation for this is that the caregivers of the TMC group could not speak any TW, and thus were not influenced by the sound system of TW. In addition, it is important to note that although the retroflex initials, in general, are not present in TMC, they are taught at school.
Table 5. The fricatives and affricates of TW

<table>
<thead>
<tr>
<th></th>
<th>Dental</th>
<th>Glottal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voiceless fricative</td>
<td>s</td>
<td>h</td>
</tr>
<tr>
<td>Voiceless affricate</td>
<td>ts</td>
<td></td>
</tr>
<tr>
<td>Aspirated affricate</td>
<td>tsh</td>
<td></td>
</tr>
</tbody>
</table>

Accordingly, it is predictable that TMC-speaking children would make more mistakes in syllable-initial fricatives and affricates than TW-speaking children would.

4.1.3 Acquisition of Tone Sandhi

In TW, each syllable can have two different tones depending on the environments in which it is found. When the syllable occurs alone, in the final position of a tone group, or before a neutral tone, it carries the citation tone; when the syllable occurs in the non-final position in a tone group, it carries the sandhi tone. Because of the complexity of the tone sandhi, Chinese linguists have attempted to offer explanations for the interaction between citation and sandhi tones in TW. Some linguists see citation tones as the underlying forms (Li & Roberts 1963; Cheng 1968; Chen 1987). Tung (1958), however, treats the sandhi tones as underlying. More recently, a series of experimental studies has been carried out by Hsieh (1970) and Wang (1995) to test the psychological reality of tone sandhi in TW.

Although our data cannot pinpoint either the citation tones or the sandhi tones as the underlying forms, one thing for sure is that both citation and sandhi tones had been stored in the lexicons of TW-speaking children long before they began to produce single-word utterances. Evidence supporting this claim is as follows: (i) There are monosyllabic as well as polysyllabic words in TW. (ii) Children's initial language consists of single-
word utterances, which may be one-syllable or two-syllables long. (iii) As mentioned earlier, TW-speaking children are biased to extract final syllables from adult models, and (iv) They also extracted phrases as early units at the earliest stages of language production. For these reasons, TW-speaking children did have access to the presence of citation and sandhi tones from the beginning. The following example is taken from a conversation between XII (1;7.4) and his mother. The mother spared no effort to teach XII formulaic phrases that she thought might be useful for him in communicating with other adults.

*MOT: li2 kong2 mai3 theh8.
you say NEG take
"Say 'Don't take it'."

*XII: mai3 theh8.
NEG take
"Don't take it."

*MOT: mai3 an2 ne1.
NEG this way
"Don't do this to me."

*MOT: phai2 gin2-a2.
bad child-DIM
"bad boy"

In the meantime, the mother also taught XII (1;7.4) how to rebuff a person by saying mai3 and chin1 phai2 followed by a neutral-toned interjection particle. The words mai3 and phai2 did not undergo sandhi changes in this context because they occurred after the neutral-toned functors la and oh.

*MOT: li2 kong2 mai3 la!
you say NEG INTRJ.PAR
"Say 'Don't!'"
The examples presented above provide support for the claim that both citation and sandhi tones were learned almost simultaneously by the TW-speaking children. However, it is important to note that the co-existence of citation and sandhi tones does not enable a TW-speaking child to utilize "the sandhi rule" to derive forms. The following example shows that Mao (1;11) was unable to apply a sandhi rule to a novel form in a relevant environment.

*MAO: chau2 bang2.
  go mosquito
  "Go away, mosquito!" 11
*RIC: bang2-a2.
  mosquito-DIM
  "mosquito"
*RIC: li2 kong2 bang2-a2.
  you say mosquito-DIM
  "Say 'mosquito'.'"
*MAO: bang2 # -a2 [bang2 does not undergo a sandhi change],
  mosquito-DIM
  "mosquito"

---

11 Mao was the first child I worked with in this study. I did not pay much attention to his frequent omission of the diminutive marker -a2 until the third recording session. This example was obtained when I was quite annoyed by his numerous-a2 omissions in one visit, and asked him to add -a2 to bang2.
Instead of applying a sandhi rule, Mao chose to place a short pause between the two morphemes, thus preserving the citation tone for each morpheme. This example suggests that citation tones may be the underlying forms for TW-speaking children.

However, examples also abound from the early recordings of TW-speaking children in which they did not know how to change the sandhi tone of a content word back to its citation tone after the diminutive marker -a2 that followed the content word was dropped.

*XI: chiau1 [*] -0a2.
   bird-DIM
   "birds"
exp: The sandhi form for chiau2 is chiau1.
err: chiau1 = chiau2; -a2 is omitted.
*MAO: theng7 [*] -0a2.
   candy-DIM
   "candy"
exp: The sandhi form for theng5 is theng7.
err: theng7 = theng5; -a2 is omitted.

These examples suggest that sandhi tones may be the underlying forms for TW-speaking children. The evidence supporting both citation tones and sandhi tones as underlying forms can be found in the productions of TW-speaking children. In other words, our data can be interpreted as providing support for the results of Hsieh's (1970) and Wang's (1995) experimental studies that the sandhi behaviors are influenced not only by sandhi rules, but also by analogy and product-oriented schemas.

There are only two relevant tone sandhi rules in TMC, both affecting Tone 3 (Low Dipping). One rule is that Low Dipping tone (3rd tone) becomes High Rising tone (2nd tone) when it occurs before another Low Dipping tone. The other rule is that Low Dipping tone becomes a single Low tone when it
occurs before High Level tone (1st tone), High Rising tone, or High Falling tone (4th tone). With regard to the acquisition of tone sandhi in TMC, our data provide support for the claim made by Li and Thompson (1977:189) that these two tone sandhi rules are learned, with infrequent errors, as soon as the TMC-speaking child begins to produce his/her own multi-word utterances.

4.2 The Emergence of Grammatical Morphemes

The process of acquiring the major grammatical morphemes of a target language is gradual and lengthy. Some are still not fully controlled until the child enters school. Nevertheless, the process begins early, as soon as the MLU approaches 1.50. Based on the longitudinal language samples collected, we will first present the order of appearance of grammatical morphemes within each language group. Since TMC and TW are similar in their morphosyntactic system, we will then compare the order of appearance of grammatical morphemes between the language groups. A profile of the children's MLU is given in Table 6.
Table 6. A profile of TMC and TW children's MLU

<table>
<thead>
<tr>
<th>Age in months</th>
<th>TMC Group</th>
<th>TW Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Jie</td>
<td>Lon</td>
</tr>
<tr>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>1.40</td>
<td>1.26</td>
</tr>
<tr>
<td>21</td>
<td>1.46</td>
<td>1.61</td>
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<tr>
<td>22</td>
<td>1.75</td>
<td>1.88</td>
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<tr>
<td>23</td>
<td>1.95</td>
<td>1.93</td>
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<tr>
<td>24</td>
<td>2.12</td>
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<tr>
<td>25</td>
<td>2.39</td>
<td>2.36</td>
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<tr>
<td>26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>1.85</td>
<td>1.87</td>
</tr>
<tr>
<td>Group Mean</td>
<td>1.85</td>
<td></td>
</tr>
</tbody>
</table>

4.2.1 Grammatical Morphemes for TMC Group

Jie produced the neutral-toned grammatical morphemes -zi and ge very early. Nouns followed by the diminutive marker -zi were almost always produced as units. The classifier ge was normally produced with numerals or the demonstratives zhe4 "this" and na4 "that". ge was the only classifier used by Jie, and he never omitted it where it was obligatory. The locative marker zai4 was the only full-toned grammatical morpheme that Jie produced, along with the two neutral-toned grammatical morphemes -zi and ge, at the early stages of language learning. It is not surprising to find that zai4 was one of the most productive grammatical morphemes in Jie's spontaneous speech because he frequently used it to inquire about the location of his snacks, toys, story books, etc. zai4 usually occurred before the locative phrase zhe4 (li3) "here" or na4 (li3) "there". An example of its use is given below (1;9.6).
Where is the home of the airplane?

The mother is playing the game "Where does the icon belong?" with Jie.

Here

Jie is pointing out the icon "airport" to his mother.

"Yes."

Jie occasionally produced the completive aspect marker le, but it was not used spontaneously by him until his MLU approached 2.12 at the age of 24 months. Jie produced the nominalizer/genitive marker de spontaneously when his MLU was around 2.0 at the age of 23 months. It is noteworthy that Jie started to use the progressive aspect marker zai4* sporadically when his MLU reached just above 2.0.12 Because the number of progressive zai4*'s Jie produced was very limited, it is not included in Figure 3. The plural marker men and the durative aspect marker zhe were never produced by Jie during the period of spontaneous data collection. Hence, they are not shown in Figure 3, either. The order of appearance of grammatical morphemes in Jie's productions is: -zi > zai4 > ge > de > le > zai4*.

12 To differentiate the progressive marker zai4 from the locative marker zai4, an asterisk (*) is placed right after the tone for the progressive.
In addition to the diminutive marker -zi, the classifier ge, and the locative marker zai4, Lon also started to use the nominalizer/genitive marker de spontaneously when her MLU was just around 1.30 at the age of 20 months. Lon's earliest use of de was very common with possessives as, wo3 de "my", ba1+ba1 de "father's", and the like. The following example shows her (1;7.21) use of the genitive marker de in a conversation with her mother.

*MOT: zhe4 shei2 de?
this who GEN
"Whose is this?"
sit: The mother is asking Lon whose dress is this.
Most stative verbs followed by de are nominalized. Lon did this easily and correctly at 21 months of age when her MLU was right around 1.61. The example given below is taken from Lon’s conversation with her mother.

Lon used the completive aspect marker le spontaneously when her MLU reached around 1.90 at the age of 22 months. She also started to use the progressive aspect marker zai4* sporadically at this stage. Neither the plural marker men nor the durative aspect marker zhe was produced by Lon during the period of spontaneous data collection. Hence, the progressive zai4*, the plural men, and the durative zhe are not included in Figure 4.
The order of appearance of grammatical morphemes in Lon's productions is:

-zi > de > ge > le > zai4 > zai4*

Like other TMC-speaking children, Ron produced the diminutive marker -zi, the classifier ge, and the locative marker zai4 very early. However, the nominalizer/genitive marker de and the completive aspect marker le did not appear until his MLU reached 2.0 at the age of 25 months. His spontaneous use of the progressive aspect marker zai4* also appeared late, as compared with Jie and Lon. The plural marker men and the durative marker zhe were never produced by Ron during the period of spontaneous data collection. As can be seen in Figure 5, Ron's use of grammatical
morphemes increased drastically after he was 25 months of age when his MLU surpassed 2.0. The progressive aspect marker *zai4*, the plural marker *men*, and the durative aspect marker *zhe* are not included in the following graph.

Figure 5. Grammatical morphemes for Ron
The order of appearance of grammatical morphemes in Ron's productions is: 

- 

To sum up, except for the locative marker *zai4*, all the functors produced by the TMC-speaking children at the earliest stages of language learning were neutral-toned. Of all the neutral-toned functors, the diminutive marker *-zi* and the classifier *ge* were mastered when the
children's MLU reached around 1.50. The nominalizer/genitive marker *de* and the completive aspect marker *le* were used spontaneously when the children's MLU fell between 1.50 and 2.0. The progressive aspect marker *zai4* appeared sporadically when the children's MLU surpassed 2.0. The plural marker *men* and the durative aspect marker *zhe* were the grammatical morphemes that required more time for the children to acquire. Overall, the order of appearance of grammatical morphemes in the TMC children's productions is: *-zi > ge > zai4 > de > le > zai4*.

A composite graph computed by summing all tokens for all three TMC children is presented in Figure 6.

![Figure 6. Grammatical morphemes for TMC group](image-url)

Figure 6. Grammatical morphemes for TMC group
4.2.2 Grammatical Morphemes for TW Group

The diminutive marker -a2 occurred very frequently in Mao's productions. The reason Mao produced so many diminutive markers is that he was relatively slow in learning to speak, and his grandmother encouraged the investigator to use pictures to stimulate naming by him. Since the diminutive marker -a2 constitutes the obligatory second syllable of a large number of nouns in TW, and since nouns are the most commonly used grammatical class in picture-naming, it is not surprising to see a high frequency of occurrence of -a2 in Mao's early recorded speech. Mao started to produce the classifier e5* at 23 months when his MLU was around 1.40.13 The locative marker ti7 appeared late for Mao. The nominalizer/ genitive marker e5 and the completive aspect marker a were used spontaneously when Mao's MLU was around 1.90 at the age of 25 months. The progressive aspect marker teh4 and the durative aspect marker leh4 were never produced by Mao during the period of spontaneous data collection. Therefore, they are not shown in Figure 7. The order of appearance of grammatical morphemes in Mao's productions is: -a2 > a > e5* > e5 > ti7.

13 To differentiate the classifier e5 from the nominalizer/genitive marker e5, an asterisk (*) is placed right after the tone of classifier.
In comparison with the other five children, San is faster at language learning. Her MLU reached 1.98 the first time her spontaneous speech was tape-recorded, and she was just 20 months old. Because her MLU increased so rapidly, grammatical morphemes such as the diminutive marker -a2, the locative marker ti7, the classifier e5*, the nominalizer/genitive marker e5, and the completive aspect marker a, all seemed to appear simultaneously in her spontaneous speech. However, it is interesting to note that San seldom used the classifier e5*. Instead, she liked to use the classifier chiong2 "a kind of". An example of its use is given below.
*MOT: li2 beh4 ka7 wa1+wa1 pak8 thau5 chang1?
you want OBJ.M doll dress hair
"Are you going to dress the hair of the doll?"

*MOT: hâ?
Q.PAR
"What?"

*SAN: pak8 chit8 chiong2!
dress this kind
"(I want to) dress her hair with this kind (of rubber band)!

*SAN: goa2 0beh4 pak8 chit8 chiong2 chhiu7 ni1-a2.
I want dress this kind rubber band-DIM
"I want to dress (her hair) with this kind of rubber band."

The progressive aspect marker teh4 did not appear in San's spontaneous speech until her MLU reached 2.42 at the age of 22 months. An example of its use is given below.

*MOT: Pei4-Qi2 teh4 chhong3 sâ2?
Pei-Qi PROG do what
"What is Pei-Qi doing?"

exp: Proper names are pronounced in TMC.

*SAN: teh4 sia2 gi7.
PROG write word
"She is writing."

The durative aspect marker leh4 was produced by San for the first time at 23 months when her MLU was 2.77. An example of its use is given below.

*MOT: ang5 sek4 e5 +...
red color NOM
"It is red ...."

*SAN: ++ ka7 khng3 (l)eh4 chia1 a.
OBJ.M place DUR here SF.PAR
"Put it here!"
Due to their limited numbers, these last two morphemes are not included in the following graph.

Figure 8. Grammatical morphemes for San

The order of appearance of grammatical morphemes in San's productions is:

\[ ti7 > -a2 > e5 > a > e5^* > teh4 > leh4 \]

Xii began to produce the diminutive marker -a2 before his MLU reached 1.50. The nominalizer/genitive marker e5, the classifier e5*, and the completive aspect marker a appeared sporadically when Xii's MLU reached around 1.63 at the age of 20 months. His earliest use of e5 almost always came with possessives, as in \( w o3\ e5 \) "my", \( ba1+ba1\ e5 \) "father's", and \( ma1+ma1\ e5 \)
"mother's". Although $e5^*$ was the first classifier Xii produced, he rarely used it. The locative marker $ti7$ did not appear in Xii's productions until his MLU reached 1.72 at the age of 21 months. The progressive aspect marker $teh4$ and the durative aspect marker $leh4$ were never produced during the period of spontaneous data collection, so they are not included in the following graph.

Figure 9. Grammatical Morphemes for Xii

The order of appearance of grammatical morphemes in Xii's productions is: 

$-a2 > e5 > a > ti7 > e5^*$. 

To sum up, the diminutive marker $-a2$ was the first grammatical morpheme produced by the TW-speaking children. The nominalizer/genitive $e5$, the completive $a$, and the locative $ti7$, and the classifier $e5^*$ were
used spontaneously when the children's MLU reached around 1.90. The progressive *teh4* and the durative *leh4* were the grammatical morphemes that required more time for the children to acquire. Overall, the order of appearance of grammatical morphemes in the TW children's productions is: 

- \(-a2 > e5 > a > ti7 > e5^* > teh4 > leh4\). A composite graph computed by summing all tokens for all three TW children is presented below.

![Figure 10. Grammatical morphemes for TW group](image)

4.2.3 Comparison Between Language Groups

Altogether, the three TMC-speaking children produced 933 grammatical morphemes from 6,120 utterances in 12 hours of tape-recorded conversation. Likewise, the three TW-speaking children produced 1,321
grammatical morphemes from 8,172 utterances in 12 hours of tape-recorded conversation. In comparing the total number of grammatical morphemes produced by the two groups of children, we found that neither the TMC-speaking children nor the TW-speaking children produced significantly more functors in their spontaneous speech, \( t = .546, p = .6140 \), two-tailed. Figure 11 shows the relative percentages of grammatical morphemes produced by the TMC- and TW-speaking children. For both language groups, frequency of occurrence of grammatical morphemes almost completely corresponds with their order of appearance in the children's productions.

![Figure 11. Grammatical morphemes for TMC and TW groups](image)

In both TMC- and TW-speaking children, grammatical morphemes appeared in essentially the same order: the diminutive \(-zi/\) (30%) and \(-a2/\) (54%); the locative \(zai4/\) (19%) and \(ti7/\) (13%); the nominalizer/genitive \(de/\) (17%) and \(e5/\) (15%), and the completive aspect \(le/\) (14%) and \(a/\) (14%). An important exception to this order is that for the TMC-speaking children \(ge/\) acted as a general classifier, while for the TW-speaking children \(e5*/\) was never used in this way. Since TW has no general classifier, we wonder if the TW-speaking children need to learn specific classifiers earlier than the TMC-speaking children do. We will return to this issue in Chapter 6.
4.3 The Omission of Grammatical Morphemes

Young children typically omit grammatical morphemes in their early spontaneous and imitative speech. This type of language production has been referred to as a "telegraphic speech" (Brown & Fraser 1963) because it is characterized by the retention of content words and the omission of function words, and the sentences are relatively short. In comparison with languages such as Hungarian, Turkish, or German which have rich inflectional systems, English is poor in the amount of inflections it offers. However, TMC and TW are even more extreme than English in that they make virtually no use of any inflectional devices. There are no case markings, no tense suffixes, no agreement markings, and no plural markings on the verbs.

Despite a lack of inflectional markers on nouns and verbs, TMC and TW make use of a number of morphological devices. Unlike morphological markers in richly inflected languages, these markers do not form an organic part of the words with which they occur (for example, they are not bound to the words they modify and do not undergo phonological assimilations to the words), but they are functionally equivalent to the morphological devices in more richly inflected languages. The question which arises here is: Regarding the omission of grammatical morphemes, are there any differences between children learning TMC or TW as their first language and children learning an inflected language as their first language? In the following sections, we will address this question by analyzing the patterns of realization and omission of a highly frequent subset of grammatical morphemes in children's spontaneous and imitative speech.

4.3.1 Functor Omissions in Spontaneous Speech

Table 7 presents the percentages of neutral-toned functors omitted in all three TMC-speaking children's spontaneous speech. To give a frequency count of all the functor omissions, the FREQ program was used to produce a
list of all the functors omitted in a transcript. To code a functor omission, the zero symbol "0" was placed before the functor on the text tier. For example, the command -- freq +s"0e5*" mao001.cha -- would conduct a frequency analysis on all the e5 omissions in the file called mao001.cha.

Because TW does not have an equivalent for the plural marker *men*, and because *a*, the TW equivalent for the TMC completive aspect marker *le*, almost always remains neutral-toned in utterance-final position, we chose to focus on the locative marker *ti7* and the progressive aspect marker *teh4* instead. We also need to keep track of the patterns of realization and omission of the locative maker *zai4* and the progressive aspect marker *zai4* in TMC.

Table 7. Percentages of functors omitted in the spontaneous speech of all three TMC-speaking children

<table>
<thead>
<tr>
<th>Mo.</th>
<th>de</th>
<th>ge</th>
<th>-zi</th>
<th>le</th>
<th>men</th>
<th>zhe</th>
<th>zai4*</th>
<th>zai4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(0/17)</td>
<td>(0/21)</td>
<td>(0/37)</td>
<td>(0/3)</td>
<td>(0/0)</td>
<td>(0/0)</td>
<td>(0/0)</td>
<td>(0/16)</td>
</tr>
<tr>
<td>2nd</td>
<td>33%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(1/3)</td>
<td>(0/15)</td>
<td>(0/20)</td>
<td>(0/3)</td>
<td>(0/0)</td>
<td>(0/0)</td>
<td>(0/1)</td>
<td>(0/18)</td>
</tr>
<tr>
<td>3rd</td>
<td>8%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>(2/25)</td>
<td>(0/40)</td>
<td>(0/22)</td>
<td>(0/7)</td>
<td>(0/0)</td>
<td>(0/0)</td>
<td>(3/3)</td>
<td>(0/26)</td>
</tr>
<tr>
<td>4th</td>
<td>11%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(5/45)</td>
<td>(0/35)</td>
<td>(0/49)</td>
<td>(0/13)</td>
<td>(0/0)</td>
<td>(0/0)</td>
<td>(0/3)</td>
<td>(0/33)</td>
</tr>
<tr>
<td>5th</td>
<td>17%</td>
<td>3%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(7/42)</td>
<td>(1/31)</td>
<td>(0/65)</td>
<td>(0/46)</td>
<td>(0/0)</td>
<td>(0/0)</td>
<td>(0/3)</td>
<td>(0/19)</td>
</tr>
<tr>
<td>6th</td>
<td>27%</td>
<td>5%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(16/59)</td>
<td>(2/43)</td>
<td>(0/85)</td>
<td>(0/57)</td>
<td>(0/0)</td>
<td>(0/0)</td>
<td>(0/3)</td>
<td>(0/62)</td>
</tr>
<tr>
<td>M</td>
<td>16%</td>
<td>2%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>23%</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(31/191)</td>
<td>(3/185)</td>
<td>(0/278)</td>
<td>(0/129)</td>
<td>(0/0)</td>
<td>(0/0)</td>
<td>(3/13)</td>
<td>(0/174)</td>
</tr>
</tbody>
</table>

Note: M is short for Mean. The mean is the sum of all the functors omitted by all three TMC children divided by the total number of functors required.
As shown in Table 7, the proportions of functor omissions were very low for the TMC-speaking children. The nominalizer/genitive marker *de* was more susceptible to omission than any other neutral-toned grammatical morpheme in spontaneous speech. The diminutive marker *-zi*, the completive aspect marker *le*, the plural marker *men*, the durative aspect marker *zhe*, and the locative marker *zai4* were never omitted in the children's spontaneous speech. The progressive aspect marker *zai4* was frequently omitted in the third month of data collection and virtually never omitted afterwards by the children.

A consideration of the position in which the nominalizer/genitive marker *de* and the classifier *ge* were omitted reveals that out of the 31 *de* omissions, 28, or 90%, occurred when *de* was followed by a noun phrase. The first noun phrase together with *de* is the modifier, while the second noun phrase is the head noun being modified, as schematized below:

```
NP modifier de NP
```

Thus, one type of NP-*de* modifier is the possessive, or genitive, phrase:

```
ma1 ma1 de yi1 fu2
mother GEN clothes
"mother's clothes"
```

Some adjectives can appear in a relative clause, that is, with the nominalizer *de*. An example of this usage is given as follows:

```
hong2 se4 de hua1
red color NOM flower
"a flower that is red"
```

As for *ge*, all three omissions occurred in only one child's speech, when *ge* was followed by a noun phrase. A combination of demonstrative
and/or number or quantifier plus ge is the classifier phrase. The following NP is the head noun being modified, as schematized below:

\[
\text{demonstrative}/\text{number}/\text{quantifier} \quad - \quad \text{ge} \quad \text{NP} \\
\text{classifier phrase} \\
\text{head noun}
\]

An example of this usage is given below:

\[
zhe4 \quad \text{ge} \quad \text{wan2 ju4} \\
\text{this} \quad \text{CL} \quad \text{toy} \\
\text{"this toy"}
\]

A comparison of the omission of \textit{de}/\textit{ge} in phrase-medial position and in phrase-final position is shown in Figure 12. It shows that phrase-medial position is much the more vulnerable.

\[\text{Figure 12. The omission of de and ge}\]

The example given below shows that Ron (2;2.23) omitted \textit{de} and \textit{ge} only when they occurred in phrase-medial position.

98
*MOT: mei2 you3 le!
   NEG have SF.PAR
   "Nothing is left!"

sit: The mother is playing hide-and-seek with Ron.

*RON: san1 ge.
   three CL
   "three pieces"

sit: Ron shows his mother what he has got.

*RON: san1 0ge wan2ju4.
   three CL toy
   "three toys"

*MOT: san1 ge wan2ju4.
   three CL toy
   "three toys"

*MOT: ni3 kan4 zhe4 ge qiu2 shi4 hong2se4 de ye!
   you see this CL ball is red color NOM INTRJ.PAR
   "Look! This ball is red!"

*RON: shi4 hong2se4 de.
   is red color NOM
   "(It) is red."

sit: Ron agrees with his mother that the ball is red.

*RON: hong2 se4 0de qiu2.
   red color NOM ball
   "red ball"

*MOT: hong2 se4 de qiu2.
   red color NOM ball
   "red ball"

Table 8 presents the percentages of full-toned functors omitted in the	hree TW-speaking children's spontaneous speech. Although during the
period of data collection, we did not pay much attention to the completive
aspect marker a, we feel there is a need to look at whether the patterns of
realization and omission of this neutral-toned functor differ from those of
full-toned functors in TW.
Table 8. Percentages of functors omitted in the spontaneous speech of all three TW-speaking children

<table>
<thead>
<tr>
<th>Mo.</th>
<th>teh4</th>
<th>e5</th>
<th>e5*</th>
<th>ti7</th>
<th>-a2</th>
<th>leh4</th>
<th>a</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>100%</td>
<td>65%</td>
<td>-</td>
<td>22%</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(12/12)</td>
<td>(11/17)</td>
<td>(0/0)</td>
<td>(0/23)</td>
<td>(17/78)</td>
<td>(0/0)</td>
<td>(0/4)</td>
</tr>
<tr>
<td>2nd</td>
<td>100%</td>
<td>64%</td>
<td>44%</td>
<td>7%</td>
<td>17%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(6/6)</td>
<td>(9/14)</td>
<td>(11/25)</td>
<td>(3/45)</td>
<td>(30/179)</td>
<td>(0/0)</td>
<td>(0/6)</td>
</tr>
<tr>
<td>3rd</td>
<td>88%</td>
<td>29%</td>
<td>18%</td>
<td>28%</td>
<td>7%</td>
<td>-</td>
<td>32%</td>
</tr>
<tr>
<td>4th</td>
<td>91%</td>
<td>36%</td>
<td>-</td>
<td>26%</td>
<td>2%</td>
<td>-</td>
<td>16%</td>
</tr>
<tr>
<td></td>
<td>(10/11)</td>
<td>(22/61)</td>
<td>(0/15)</td>
<td>(8/31)</td>
<td>(3/152)</td>
<td>(0/1)</td>
<td>(7/44)</td>
</tr>
<tr>
<td>5th</td>
<td>92%</td>
<td>32%</td>
<td>20%</td>
<td>34%</td>
<td>-</td>
<td>-</td>
<td>4%</td>
</tr>
<tr>
<td></td>
<td>(11/12)</td>
<td>(33/104)</td>
<td>(1/5)</td>
<td>(14/41)</td>
<td>(0/90)</td>
<td>(0/0)</td>
<td>(3/72)</td>
</tr>
<tr>
<td>6th</td>
<td>92%</td>
<td>15%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(11/12)</td>
<td>(7/48)</td>
<td>(0/20)</td>
<td>(0/35)</td>
<td>(0/36)</td>
<td>(0/0)</td>
<td>(0/53)</td>
</tr>
<tr>
<td>M</td>
<td>93%</td>
<td>33%</td>
<td>18%</td>
<td>16%</td>
<td>9%</td>
<td>-</td>
<td>9%</td>
</tr>
<tr>
<td></td>
<td>(57/61)</td>
<td>(94/286)</td>
<td>(15/82)</td>
<td>(32/200)</td>
<td>(68/782)</td>
<td>(0/1)</td>
<td>(18/204)</td>
</tr>
</tbody>
</table>

Note: M is short for Mean. The mean is the sum of all the functors omitted by all three TW children divided by the total number of functors required.

Regardless of their pitch value (full-toned or neutral-toned), grammatical function (semantic and syntactic complexity), frequency in input, and/or position in which they occurred in an utterance, all the grammatical morphemes were susceptible to omission in the TW-speaking children's spontaneous speech. However, it is important to note that the diminutive marker -a2 and the completive aspect marker a showed greater resistance to omission than any other grammatical morpheme in TW.

In comparing functors omitted in spontaneous speech between the two language groups, we found that the TW-speaking children omitted significantly more functors than the TMC-speaking children did, $t = 2.243$,
$p < .05$, two-tailed. A comparison of functor omissions in spontaneous speech between the TMC and TW groups is shown in Figure 13.

**Figure 13. Comparison of functor omissions in spontaneous speech between TMC and TW groups**

4.3.2 Functor and Content Word Omissions in Imitation

Table 9 presents the imitations that were elicited from the three TMC-speaking children. Each test sentence had three full-toned lexical syllables and one target neutral-toned functor syllable. That is, there were 56 syllables in the test -- 42 full-toned lexical syllables and 14 neutral-toned functor syllables. The list of the 14 test sentences appears in Appendix C.
Table 9. Imitations of 14 sentences by the three TMC-speaking children

<table>
<thead>
<tr>
<th></th>
<th>Jie 23 months, MLU = 1.95</th>
<th>Lon 23 months, MLU = 1.93</th>
<th>Ron 26 months, MLU = 2.15</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>kan4 zhe ma1 ma1</td>
<td>kan4 zhe ma1 ma1</td>
<td>kan4 ----- ma1 ma1</td>
</tr>
<tr>
<td>2</td>
<td>----- ----- che1-zi</td>
<td>hao3 du1 che1-zi</td>
<td>hao3 du1 che1-zi</td>
</tr>
<tr>
<td>3</td>
<td>san1 ge wan2 ju4</td>
<td>san1 ge wan2 ju4</td>
<td>san1 ge wan2 ju4</td>
</tr>
<tr>
<td>4</td>
<td>----- se4 de qiu2</td>
<td>hong2 se4 de qiu2</td>
<td>hong2 se4 de qiu2</td>
</tr>
<tr>
<td>5</td>
<td>ma3 de wei3 ba1</td>
<td>----- ----- wei3 ba1</td>
<td>ma3 ----- wei3 ba1</td>
</tr>
<tr>
<td>6</td>
<td>zuo4 zhe ----- ge1</td>
<td>zuo4 zhe chang4 ge1</td>
<td>zuo4 zhe chang4 ge1</td>
</tr>
<tr>
<td>7</td>
<td>mao1 chi1 le yu2</td>
<td>mao1 chi1 le yu2</td>
<td>mao1 chi1 le yu2</td>
</tr>
<tr>
<td>8</td>
<td>da4 de fei1 ji1</td>
<td>----- ----- fei1 ji1</td>
<td>da4 ----- fei1 ji1</td>
</tr>
<tr>
<td>9</td>
<td>mao1 mi1 shui4 le</td>
<td>mao1 mi1 shui4 le</td>
<td>mao1 mi1 shui4 le</td>
</tr>
<tr>
<td>10</td>
<td>ya1-zi you2 shui3</td>
<td>ya1-zi -----</td>
<td>ya1-zi you2 shui3</td>
</tr>
<tr>
<td>11</td>
<td>san1 ge ping2 guo3</td>
<td>san1 ge ping2 guo3</td>
<td>san1 ge ping2 guo3</td>
</tr>
<tr>
<td>12</td>
<td>ma1 ma1 ----- shu1</td>
<td>ma1 ma1 de shu1</td>
<td>ma1 ma1 de shu1</td>
</tr>
<tr>
<td>13</td>
<td>xiao3 peng2 you3 men</td>
<td>xiao3 peng2 you3 men</td>
<td>xiao3 peng2 you3 men</td>
</tr>
<tr>
<td>14</td>
<td>----- ----- lai2</td>
<td>wo3 men ----- wan2</td>
<td>wo3 men lai2 wan2</td>
</tr>
</tbody>
</table>

Note: The dotted line indicates where a lexical syllable or a functor syllable was omitted by the child.

Table 10 gives the results in the form of the percentage of functors and content words omitted by the TMC-speaking children in imitation.

Table 10. Functors and content words omitted by the TMC children in imitation

<table>
<thead>
<tr>
<th>Child</th>
<th>Age</th>
<th>MLU</th>
<th>Functors omitted</th>
<th>Content words omitted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jie</td>
<td>23</td>
<td>1.95</td>
<td>14% (2/14)</td>
<td>14% (6/42)</td>
</tr>
<tr>
<td>Lon</td>
<td>23</td>
<td>1.93</td>
<td>14% (2/14)</td>
<td>12% (5/42)</td>
</tr>
<tr>
<td>Ron</td>
<td>26</td>
<td>2.15</td>
<td>21% (3/14)</td>
<td>0% (0/42)</td>
</tr>
</tbody>
</table>

MLU in morphemes was calculated from spontaneous utterances produced before the imitation test was conducted. The three TMC-speaking children ranged in age from 23 to 26 months. Their MLUs ranged from 1.93 to 2.15.
For the TMC group, the proportions of functor omissions were not significantly higher than those of content word omissions, $t = -1.172, p = .3619$, two-tailed. That is, the TMC-speaking children, overall, did not show a significant difference in the omission of full-toned content words and neutral-toned grammatical morphemes.

Table 11 lists the functors omitted by the TMC-speaking children in imitation.

Table 11. Functors omitted by the TMC children in imitation

<table>
<thead>
<tr>
<th>Child</th>
<th>de</th>
<th>men</th>
<th>zhe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jie</td>
<td>25% (1/4)</td>
<td>50% (1/2)</td>
<td>0% (0/2)</td>
</tr>
<tr>
<td>Lon</td>
<td>50% (2/4)</td>
<td>0% (0/2)</td>
<td>0% (0/2)</td>
</tr>
<tr>
<td>Ron</td>
<td>50% (2/4)</td>
<td>0% (0/2)</td>
<td>50% (1/2)</td>
</tr>
</tbody>
</table>

As in spontaneous speech, the nominalizer/genitive marker *de* was more vulnerable to omission than any other neutral-toned grammatical morpheme in imitation. Although the plural marker *men* and the durative aspect marker *zhe* were never produced in the children's spontaneous speech, they were infrequently omitted in the children's imitative speech.

Table 12 presents the imitations that were elicited from the three TW-speaking children. Each test sentence had three full-toned lexical syllables and one target full-toned functor syllable. That is, there were 56 syllables in the test -- 42 full-toned lexical syllables and 14 full-toned functor syllables. The list of the 14 test sentences appears in Appendix D.
Table 12. Imitations of 14 sentences by the three TW-speaking children

<table>
<thead>
<tr>
<th></th>
<th>Mao 25 months, MLU = 1.91</th>
<th>San 22 months, MLU = 2.42</th>
<th>Xii 22 months, MLU = 1.96</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>kau2-a2 ----- koai1</td>
<td>kau2-a2 chin1 koai1</td>
<td>kau2-a2 chin1 koai1</td>
</tr>
<tr>
<td>2</td>
<td>che7 leh4 ----- sng2</td>
<td>che7 ----- chia1 sng2</td>
<td>che7 ----- chia1 sng2</td>
</tr>
<tr>
<td>3</td>
<td>----- sā e5* lang5</td>
<td>----- sā1 e5* lang5</td>
<td>u7 sā1 ----- lang5</td>
</tr>
<tr>
<td>4</td>
<td>ng5 e5 kin1 chio1</td>
<td>ng5 ----- kin1 chio1</td>
<td>ng5 e5 kin1 chio1</td>
</tr>
<tr>
<td>5</td>
<td>ma1 ma1 ----- chia1</td>
<td>ma1 ma1 ti7 chia1</td>
<td>ma1 ma1 ti7 chia1</td>
</tr>
<tr>
<td>6</td>
<td>----- mi1 ----- khun3</td>
<td>niau1 mi1 ----- khun3</td>
<td>----- mi1 ----- khun3</td>
</tr>
<tr>
<td>7</td>
<td>pa1 pa1 ----- chheh4</td>
<td>pa1 pa1 e5 chheh4</td>
<td>pa1 pa1 ----- chheh4</td>
</tr>
<tr>
<td>8</td>
<td>poe1-a2 ----- chui2</td>
<td>poe1-a2 u7 chui2</td>
<td>poe1-a2 ----- chui2</td>
</tr>
<tr>
<td>9</td>
<td>be2 ----- chiah8 chhau2</td>
<td>be2 ----- chiah8 chhau2</td>
<td>be2 ----- chiah8 chhau2</td>
</tr>
<tr>
<td>10</td>
<td>----- khng3 ti7 chia1</td>
<td>----- khng3 ti7 chia1</td>
<td>----- khng3 ti7 chia1</td>
</tr>
<tr>
<td>11</td>
<td>che7 ----- sia2 gi7</td>
<td>----- ----- sia2 gi7</td>
<td>----- ----- sia2 gi7</td>
</tr>
<tr>
<td>12</td>
<td>sā1 ----- ko3 su7</td>
<td>----- ----- ko3 su7</td>
<td>----- ----- ko3 su7</td>
</tr>
<tr>
<td>13</td>
<td>----- ----- bak8 chiu1</td>
<td>goa2 ----- bak8 chiu1</td>
<td>----- ----- bak8 chiu1</td>
</tr>
<tr>
<td>14</td>
<td>----- ----- hoe1</td>
<td>ang5 sek4 e5 hoe1</td>
<td>ang5 sek4 e5 hoe1</td>
</tr>
</tbody>
</table>

Note: The dotted hoe indicates where a lexical syllable or a functor syllable was omitted by the child.

Table 13 gives the results in the form of the percentage of functors and content words omitted by the TW-speaking children in imitation.

Table 13. Functors and content words omitted by the TW children in imitation

<table>
<thead>
<tr>
<th>Child</th>
<th>Age</th>
<th>MLU</th>
<th>Functors omitted</th>
<th>Content words omitted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mao</td>
<td>25</td>
<td>1.91</td>
<td>57% (8/14)</td>
<td>21% (9/42)</td>
</tr>
<tr>
<td>San</td>
<td>22</td>
<td>2.42</td>
<td>50% (7/14)</td>
<td>10% (4/42)</td>
</tr>
<tr>
<td>Xii</td>
<td>22</td>
<td>1.96</td>
<td>57% (8/14)</td>
<td>14% (6/42)</td>
</tr>
</tbody>
</table>

MLU in morphemes was calculated from spontaneous utterances produced before the imitation test was conducted. The three TW-speaking children ranged in age from 22 to 25 months. Their MLUs ranged from 1.91 to 2.42.
For the TW group, the proportions of functor omissions were significantly higher than those of content word omissions, $t = 18.965, p < .003$, two-tailed. That is, the TW-speaking children demonstrated a significant difference in the omission of full-toned content words and full-toned grammatical morphemes.

Table 14 lists the functors omitted by the TW-speaking children in imitation.

Table 14. Functors omitted by the TW children in imitation

<table>
<thead>
<tr>
<th>Child</th>
<th>teh4</th>
<th>leh4</th>
<th>e5*</th>
<th>e5</th>
<th>ti7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mao</td>
<td>100%</td>
<td>50%</td>
<td>50%</td>
<td>75%</td>
<td>50%</td>
</tr>
<tr>
<td>San</td>
<td>100%</td>
<td>100%</td>
<td>50%</td>
<td>50%</td>
<td>0%</td>
</tr>
<tr>
<td>Xii</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>50%</td>
<td>0%</td>
</tr>
</tbody>
</table>

As in spontaneous speech, nearly all the grammatical morphemes were susceptible to omission in the TW-speaking children's imitative speech. The diminutive marker -a2 was the only grammatical morpheme that was not omitted by the children in imitation. The locative marker ti7 showed relatively strong resistance to omission in imitation. The progressive aspect marker teh4 and the durative aspect marker leh4 were rarely produced in spontaneous speech, and very frequently omitted in imitation.

In comparing functors omitted in imitation between the two language groups, we found that the TW-speaking children omitted significantly more functors than the TMC-speaking children did, $t = -16.085, p < .004$, two-tailed. The proportions of content word omissions were low for both groups of children, and the TW-speaking children did not omit significantly more content words than the TMC-speaking children did, $t = 1.1310, p = .3026$, two-
talled. A comparison of functor and content word omissions between TMC and TW groups is shown in Figure 14.

![Figure 14. Comparison of functor and content word omissions between TMC and TW groups](image)

4.3.3 Results from the Comprehension Tests

There were five grammatical contrasts selected for the three TMC-speaking children. Each contrast appeared twice in the comprehension test. Table 15 presents the results in terms of percentages of correct responses on each test sentence of a grammatical contrast in the comprehension test for TMC group (2 test sentences x 2 appearances x 3 children = 12). The test sentences for TMC group are presented in Appendix E.
Table 15. Results from the comprehension test for the TMC Group

<table>
<thead>
<tr>
<th>Contrast</th>
<th>% correct responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. durative aspect zhe vs. completive aspect le</td>
<td>50 (6/12)</td>
</tr>
<tr>
<td>2. presence vs. absence of the plural men</td>
<td>67 (8/12)</td>
</tr>
<tr>
<td>3. presence vs. absence of the classifier ge</td>
<td>42 (5/12)</td>
</tr>
<tr>
<td>4. presence vs. absence of the genitive de</td>
<td>75 (9/12)</td>
</tr>
<tr>
<td>5. presence vs. absence of the nominalizer de</td>
<td>58 (7/12)</td>
</tr>
<tr>
<td>M</td>
<td>58 (35/60)</td>
</tr>
</tbody>
</table>

At the time of testing the three TMC-speaking children ranged in age from 25 to 27 months. Their MLUs ranged from 2.29 to 2.64.

There were six grammatical contrasts selected for the three TW-speaking children. Each contrast appeared twice in the test. Table 16 presents the results in terms of percentages of correct responses on each test sentence of a grammatical contrast in the comprehension test for TMC group (2 test sentences x 2 appearances x 3 children = 12). The test sentences for TW group are presented in Appendix F.

Table 16. Results from the comprehension test for TW group

<table>
<thead>
<tr>
<th>Contrast</th>
<th>% correct responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. durative aspect tēh4 vs. completive aspect a</td>
<td>50 (6/12)</td>
</tr>
<tr>
<td>2. progressive aspect tēh4 vs. completive aspect a</td>
<td>58 (7/12)</td>
</tr>
<tr>
<td>3. presence vs. absence of the locative ti7</td>
<td>50 (6/12)</td>
</tr>
<tr>
<td>4. presence vs. absence of the classifier e5</td>
<td>50 (6/12)</td>
</tr>
<tr>
<td>5. presence vs. absence of the genitive e5</td>
<td>58 (7/12)</td>
</tr>
<tr>
<td>6. presence vs. absence of the nominalizer e5</td>
<td>58 (7/12)</td>
</tr>
<tr>
<td>M</td>
<td>54 (39/72)</td>
</tr>
</tbody>
</table>

At time of testing the three TW-speaking children ranged in age from 23 to 27 months. Their MLUs ranged from 2.04 to 3.12.
Results indicate that neither the TMC-speaking children nor the TW-speaking children performed significantly better in the comprehension test of grammatical morphemes, $t = 0.236, p = 0.8247$, two-tailed. One weakness of the comprehension test is that because these children were given only two pictures from which to choose, they often selected the right picture without even listening to the test sentence. Another weakness is that these children often lost their patience and concentration after they heard three or four test sentences. A third weakness is that because children's attention was frequently taken away by the picture, they chose the picture they liked without even thinking about the test sentence they heard. Since there were so many variables that occurred in the test, we will not analyze the children's responses to the test sentences in great detail.

4.4 Frequency of Grammatical Morphemes Within Each Language Group

Since the speech heard by children constitutes the primary data they have available from which to discover the workings of the language to which they are exposed, it is reasonable to ask whether frequency of grammatical morphemes in input speech might be reflected in the order of appearance of these morphemes in children's speech. Studies by Brown (1973) and de Villiers & de Villiers (1973) explore three reasons for the order of acquisition of 14 grammatical morphemes for three English-speaking children: (i) frequency of the morphemes in parental speech, (ii) syntactic complexity, and (iii) semantic complexity. Neither study found any effects of (i), but both found that (ii) and (iii) had some predictive power. However, one weakness of their studies is that they fail to separate out the relative contribution of syntactic complexity, semantic complexity, frequency, and perceptibility in speech. By conducting the present comparison study, we hope to look closely
at what other factors might become involved and how these factors interact
with each other in determining the order of appearance of grammatical
morphemes in children's speech.

4.4.1 Frequency of Grammatical Morphemes in TMC Group

Table 17 shows, in descending order of frequency, the total number of
grammatical morphemes produced by the TMC caregivers from 26,979
utterances in 12 hours and by the three TMC-speaking children from 6,120
utterances in 12 hours. As mentioned in 4.2.3, frequency of occurrence of
grammatical morphemes almost completely corresponds with their order of
appearance in the TMC-speaking children's productions.

Table 17. Grammatical morphemes produced by TMC caregivers and children

<table>
<thead>
<tr>
<th>Item</th>
<th>Caregivers</th>
<th>Children</th>
</tr>
</thead>
<tbody>
<tr>
<td>the classifier ge</td>
<td>2,576</td>
<td>182</td>
</tr>
<tr>
<td>the nominalizer/genitive marker de</td>
<td>2,204</td>
<td>160</td>
</tr>
<tr>
<td>the completive aspect marker le</td>
<td>1,825</td>
<td>129</td>
</tr>
<tr>
<td>the diminutive marker -zi</td>
<td>1,569</td>
<td>278</td>
</tr>
<tr>
<td>the locative marker zai4</td>
<td>1,548</td>
<td>174</td>
</tr>
<tr>
<td>the plural marker men</td>
<td>580</td>
<td>0</td>
</tr>
<tr>
<td>the progressive aspect maker zai4*</td>
<td>301</td>
<td>10</td>
</tr>
<tr>
<td>the durative aspect marker zhe</td>
<td>225</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>8,252</td>
<td>933</td>
</tr>
</tbody>
</table>

Of all the grammatical morphemes, the classifier ge occurred the
greatest number of times in adult-to-child speech. The nominalizer/genitive
marker de and the completive aspect marker le occurred frequently in the
caregivers' speech. The diminutive marker -zi and the locative marker zai4
occurred nearly equally in child-directed speech. In comparison with other
grammatical morphemes, the plural marker men, the progressive aspect
marker *zai4*, and the durative aspect marker *zhe* were less frequently produced in adult-to-child speech.

Of all the grammatical morphemes, the diminutive marker *-zi* occurred the greatest number of times in the children's productions. The classifier *ge*, the locative marker *zai4*, the nominalizer/genitive marker *de*, and the completive aspect marker *le* frequently occurred in the children's productions. The progressive aspect marker *zai4* appeared relatively late and was infrequently produced by the children. The plural marker *men* and the durative aspect marker *zhe* were never produced by the children during the period of spontaneous data collection.

For the TMC group, results indicate a moderately high correlation between frequency of grammatical morphemes in input speech and their order of appearance in the children's productions, \( r = .786, p < .02 \). A comparison of frequency of occurrence of grammatical morphemes between input and child speech is shown in Figure 15.

---

14 When a perfect correlation exists, its value is plus or minus 1.0. When no relationship exists, its value is 0. Thus, intermediate degrees of correlation are represented by values between 0 and ±1.0. Values between ±.80 and ±1.0 are considered to be high correlation; values between ±.60 and ±.79 reflect a moderately high correlation; values between ±.35 and ±.59 are of moderately low correlation; values less than ±.35 have a low correlation (Minium et al. 1970:150).
Figure 15. Comparison of frequency of occurrence of grammatical morphemes between adult-to-child and child speech in TMC group

However, other factors besides frequency might influence the frequency of input in determining the order of appearance of grammatical morphemes in the children's productions. For instance, the diminutive marker -zi was produced earlier than any other grammatical morpheme by the TMC-speaking children. But it was not the most frequently occurring grammatical morpheme in adult-to-child speech. One possible explanation for such a mismatch is that nouns made up a large proportion of the children's early words, and the diminutive marker -zi constitutes the obligatory second syllable of a large number of nouns when they occur as independent words. Another possible explanation is that to produce grammatical morphemes such as de and le, children need to be able to combine words into longer utterances. To form longer sentences, children need time to increase their existing state of memory and processing skills.
The present study was begun when the children were in the initial period of word combination. Although they all began to form simple multi-word utterances, they still produced a great many single-word utterances. Since nouns predominated in the children's early productions and the children had difficulty in producing grammatical morphemes other than -zi, -zi had an advantage over any other grammatical morpheme in production. In other words, children's production limitations may play an important role in determining the order of appearance of grammatical morphemes in production.

In this study the suffix \textit{-men} always occurs as a plural marker with pronouns in adult speech:

\begin{itemize}
  \item wo3-men \quad "I-plural = we"
  \item ni3-men \quad "you-plural = you"
  \item ta1-men \quad "s/he-plural = they"
\end{itemize}

Figure 16 shows the distribution of the plural \textit{-men} with the pronouns \textit{wo3}, \textit{ta1}, and \textit{ni3} in adult speech. The KWAL program was used to search for these three plural personal pronouns in adult speech.

![Pie chart showing distribution of plural \textit{-men} with \textit{wo3}, \textit{ta1}, and \textit{ni3} in adult speech. 2% for wo3-men, 19% for ta1-men, and 79% for ni3-men.]

Figure 16. Distribution of \textit{-men} in adult speech

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With regard to the acquisition of personal pronouns in Mandarin, studies by Erbaugh (1982) and Zhu et al. (1986) have found that Mandarin-speaking children mastered two singular personal pronouns early and used them appropriately. \( Ni3 \) "you" and \( wo3 \) "I" emerged before the age of 2;0. However, third person \( ta1 \) and the plurals appeared much later, still lagging behind at age 5;6 (Zhu et al. 1986). Our data provide support for these findings. Hence, it is not surprising to discover that frequency of occurrence of the plural \( men \) in adult-to-child speech did not match the order of appearance of this morpheme in the TMC children's productions. In other words, the semantic complexity of the plural marker may override the effect of input speech.

4.4.2 Frequency of Grammatical Morphemes in TW Group

Table 18 shows, in descending order of frequency, the total number of grammatical morphemes produced by the TW caregivers from 21,932 utterances in 12 hours and by the three TMC-speaking children from 8,172 utterances in 12 hours. As mentioned in 4.2.3, frequency of occurrence of grammatical morphemes almost completely corresponds with their order of appearance in the TW-speaking children's speech.

Table 18. Grammatical morphemes produced by TW caregivers and children

<table>
<thead>
<tr>
<th>Item</th>
<th>Caregivers</th>
<th>Children</th>
</tr>
</thead>
<tbody>
<tr>
<td>the diminutive marker -a2</td>
<td>2,139</td>
<td>707</td>
</tr>
<tr>
<td>the completive aspect marker a</td>
<td>1,242</td>
<td>186</td>
</tr>
<tr>
<td>the nominalizer/genitive marker e5</td>
<td>1,168</td>
<td>192</td>
</tr>
<tr>
<td>the locative marker ti7</td>
<td>963</td>
<td>164</td>
</tr>
<tr>
<td>the progressive aspect marker teh4</td>
<td>636</td>
<td>4</td>
</tr>
<tr>
<td>the classifier e5*</td>
<td>505</td>
<td>67</td>
</tr>
<tr>
<td>the durative aspect marker leh4</td>
<td>127</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>6,780</strong></td>
<td><strong>1,321</strong></td>
</tr>
</tbody>
</table>
Of all the grammatical morphemes, the diminutive marker -a2 occurred the greatest number of times in adult-to-child speech. The completive aspect marker a, the nominalizer/genitive marker e5, and the locative marker ti7 frequently occurred in the caregivers' speech. In comparison with other grammatical morphemes, the progressive aspect marker teh4 and the classifier e5* were less frequently produced in adult-to-child speech. The durative aspect marker leh4 rarely occurred.

Likewise, of all the grammatical morphemes, the diminutive marker -a2 occurred the greatest number of times in the children's productions. The nominalizer/genitive marker e5, the completive aspect marker a, and the locative marker ti7 frequently occurred in the children's productions. The progressive aspect marker teh4 and the durative aspect marker leh4 were only produced by the child with the highest MLU (San) during the period of spontaneous data collection.

For the TW group, results indicate a high correlation between frequency of grammatical morphemes in input speech and their order of appearance in the TW-speaking children's productions, $r = .935, p < .001$. A comparison of frequency of occurrence of grammatical morphemes between input and child speech is shown in Figure 17.
Figure 17. Comparison of frequency of occurrence of grammatical morphemes between adult-to-child and child speech in TW group

The only mismatch is that the classifier e5* was produced earlier than the progressive aspect marker teh4 by the TW-speaking children, but it occurred less frequently than progressive teh4 in adult-to-child speech. One possible explanation for this mismatch is that in comparison with e5* classifier, progressive teh4 is harder for children to learn. Research on the acquisition of progressives in TMC has shown that progressives remained rare until the children were nearly 3 (Erbaugh 1992:428). In a recent study, Leung (1995) investigated the development of three major grammatical aspect markers jə (perfective), jyu (durative), and gan (progressive) in a Cantonese-speaking child, and found that the progressive gan remained rare until the child was 3;3. So, it is also possible that the semantic complexity of the progressive marker overrides the effect of frequency in input speech.
4.5 Summary

The correct tone system in both TMC and TW was acquired relatively early, on the evidence that even when children were still at one-word stage they had the adult tone system almost completely under control. For the TMC group, the tone sandhi rules were learned, with infrequent errors, as soon as the children began to produce their own multi-word utterances. For the TW group, both citation and sandhi tones were stored in the mental representation of the children. The tone sandhi behaviors of the children were influenced not only by sandhi rules, but also by analogical connections established among items.

In comparing the total number of grammatical morphemes produced by the two groups of children, we found that neither the TMC-speaking children nor the TW-speaking children produced significantly more functors in their spontaneous speech. A comparison of functor omissions in spontaneous speech between TMC and TW groups indicates that the TW-speaking children omitted more functors than the TMC-speaking children did. In spontaneous speech, the TW-speaking children often omitted each of the 7 grammatical morphemes studied, regardless of pitch value, grammatical function, frequency in input, and/or position in which they occurred in an utterance. In contrast, the proportions of functor omissions were very low for the TMC-speaking children. The nominalizer/genitive marker de was more susceptible to omission than any other neutral-toned grammatical morpheme in spontaneous speech.

Results obtained from the imitation tests indicate that the TW-speaking children demonstrated a significant difference in the omission of full-toned content words and full-toned grammatical morphemes. As in
spontaneous speech, nearly all grammatical morphemes modeled in the imitation test were susceptible to omission. The diminutive marker -a2 was the only grammatical morpheme that was not omitted by the children in imitation. The TMC-speaking children, overall, did not show a significant difference in the omission of full-toned content words and neutral-toned grammatical morphemes. As in spontaneous speech, the nominalizer /genitive marker de was more vulnerable to omission than any other neutral-toned grammatical morpheme in imitation. The results from the between-language comparisons indicate that the TW-speaking children omitted significantly more functors than the TMC-speaking children did in imitation. The proportions of content word omissions in the imitation task were low for both groups of children, and the TW-speaking children did not omit significantly more content words than the TMC-speaking children did.

The plural marker men and the durative aspect marker zhe were never produced in the TMC-speaking children's spontaneous speech. However, these morphemes were seldom omitted in the TMC-speaking children's imitative speech. In contrast, the progressive aspect marker teh4 and the durative aspect marker leh4 were rarely produced in the TW children's spontaneous speech, and also very frequently omitted in their imitative speech. These results suggest that the TMC- and TW-speaking children employed a different strategy of segmenting continuous speech into its component words. The TMC-speaking children may have developed segmentation procedures based on experience with the rhythmic or metrical structure of their language. The TW-speaking children, however, may have developed segmentation procedures based on experience with the semantic salience between content words and grammatical morphemes. A further
analysis of these different segmentation strategies between the language groups will be discussed in Chapter 5.

Results indicate that neither the TMC-speaking children nor the TW-speaking children performed significantly better in the comprehension tests of grammatical morphemes. This finding suggests that production failure is not a useful source of evidence about children's underlying linguistic representation. However, it should be noted that since the children were given only two pictures from which to choose, they could randomly select the right picture 50% of the time without even listening to the test sentence. Future research needs to address this question of how to eliminate variables that might occur in the comprehension test.

In order to compare the rates of production of grammatical morphemes in the input of the two languages, we present the total number of content words, grammatical morphemes, and utterances produced by TMC and TW caregivers in 12 hours of tape-recorded spontaneous speech in Table 19.

Table 19. Total number of content words, grammatical morphemes, and utterances in input speech

<table>
<thead>
<tr>
<th>Item</th>
<th>TMC Caregivers</th>
<th>TW Caregivers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of content words</td>
<td>105,275</td>
<td>70,835</td>
</tr>
<tr>
<td>Number of grammatical morphemes</td>
<td>8,252</td>
<td>6,780</td>
</tr>
<tr>
<td>Number of utterances</td>
<td>26,976</td>
<td>21,932</td>
</tr>
</tbody>
</table>

The ratio of content words over utterances is 3.903 for the TMC caregivers and 3.230 for the TW caregivers. The ratio of grammatical morphemes over utterances is 0.306 for the TMC caregivers and 0.309 for the TW caregivers. The ratio of grammatical morphemes over content words is 0.078 for the TMC caregivers and 0.096 for the TW caregivers. These ratios in inputs are
very similar across languages. We can infer that the ratio of grammatical morphemes over utterances in input does not contribute to the differences in the omission of grammatical morphemes between TMC- and TW- speaking children.

Results indicate a significant correlation between frequency of grammatical morphemes in input speech and their order of appearance in the TMC- and TW-speaking children's productions. However, other factors may have interacted with frequency of input in determining the order of appearance of grammatical morphemes in the children's productions. So far, we have identified prosody, semantic complexity, and children's production limitations as three of the most important factors that might interact with frequency of input.
5.0 Introduction

Speech is an intermittent stream of sounds containing acoustic chunks, often longer than a single word. There are very few unambiguous cues speakers use to mark explicitly the boundaries of words, phrases, or other units of meaning. Thus, a major part of the child's task of extracting meaning from speech is segmenting the continuous signal into portions which can be mapped onto meaning units. The task of identifying word-level units in adult speech is far from simple for the very young child because segmentation will involve perceiving units in a partly or an incompletely analyzed stream of sound. This task is further complicated by the fact that language is a system whose structure depends on combinations of content words and grammatical morphemes. In comparison with content words, grammatical morphemes have relatively low semantic content and phonological salience. The difficulty of perceiving grammatical morphemes in adult speech is frequently reflected in children's retention of content words and omission of grammatical morphemes in early productions. Children's telegraphic speech, consisting primarily of strings of content words, becomes more adultlike as children learn to add grammatical morphemes to their utterances. To understand how young children overcome their difficulty in acquiring grammatical morphemes, we need to consider what kinds of strategies they employ to segment continuous speech into its component words and to what extent these strategies vary from language to language and/or from child to child.
The present investigation of the acquisition of grammatical morphemes has chiefly focused on two isolating languages, namely TMC and TW. In principle, the perception and segmentation of morphemes should be far easier in isolating languages than in synthetic languages: regular syllable structure and clear syllable boundaries should aid segmentation; irregular syllable structure and obscure syllable boundaries obstruct it. This would amount to a claim that children's segmentation strategies vary, depending solely upon the morphological typology of a language. That is, the segmentation of lexical and function morphemes is predicted to be relatively easy for children learning any of the isolating languages. However, results obtained from the spontaneous and imitative speech of TMC children and TW children suggest that this is not so. TMC children appear not to be segmenting speech in the way TW children do, even though TMC and TW have both been referred to as isolating languages, languages in which it is generally true that each word consists of just one morpheme and cannot be further analyzed into component parts. The results of this study, therefore, suggest that segmentation strategies in continuous speech perception may also be affected by phonological and prosodic characteristics of the language being learned. The present study was prompted by a consideration of phonological and prosodic differences between TMC and TW. Discrepancies such as are found in the prosodic structures of TMC and TW have led us to propose several hypotheses. In the following sections, evidence relating to these hypotheses will be discussed in detail.

5.1 Effects of Prosody on Segmentation

The most significant outcome of this research is the finding that the patterns of realization and omission of grammatical morphemes differ greatly
between TMC children and TW children. For TMC children, neutral-toned grammatical morphemes that closely follow full-toned content words were frequently produced in spontaneous and imitative speech. In TW, on the other hand, all 7 grammatical morphemes studied were vulnerable to omission, regardless of pitch value, grammatical function, frequency in input, and/or position in which they occurred in an utterance. These findings suggest that speech segmentation procedures differ for children learning either TMC or TW as their first language. Because of their morphosyntactic similarities, we infer that this difference reflects the phonological and prosodic differences between TMC and TW which we outlined in Chapter 2.

The difference in speech segmentation procedures between TMC children and TW children raises two issues for the study of the acquisition of grammatical morphemes.

I. How is the acquisition of grammatical morphemes influenced by prosodic and phonological characteristics of the language being learned?

II. What sorts of prosodic and phonological properties do grammatical morphemes have that may aid children in applying particular segmentation strategies?

Below we will try to answer these questions by gleaning evidence that supports the hypotheses we propose in this study.

**Hypothesis 1**: The timing/rhythm difference in TMC and TW affords different acquisition paths (i.e., a foot path vs. a syllable path) for children learning grammatical morphemes.

This hypothesis makes three main predictions for each group of children. The first prediction states that the segmentation strategies characteristically employed by TMC children and TW children differ from the earliest stages of language production. TMC is similar to stress-timed
languages in the presence of a contrast between full and reduced syllables. The latter are syllables which carry what is referred to as "neutral tone", and are both shorter and less tonally distinctive than the full-toned syllables. Major grammatical morphemes in TMC carry this neutral tone. Content words in TMC almost always have one of the four full tones. Although children's early speech typically shows a high frequency of content words, the appearance of the neutral tone is no later than that of the full tones in TMC children's productions. TMC children learn to use the neutral tone early, as soon as they begin to produce nouns which contain the diminutive marker -zi. In addition to the diminutive -zi, neutral-toned functors such as the classifier ge, the nominalizer/genitive marker de, and the completive aspect marker le also appear early in TMC children's productions.

One characteristic which neutral-toned grammatical morphemes in TMC seem to have in common is that they contain a short, central vowel (i.e., schwa). The only exception is the diminutive marker -zi which contains an apical dental vowel. These two vowels and the neutral tone recur predictably in adult speech, thus providing a clue for the presence of each other. The example given below shows that Jie (1;8.23) acted as if the apical dental vowel /i/ should always have a neutral tone; evidence is in the last line.

*MOT: bei1-zi yong4 lai2 he1 shui3 de. cup-DIM use come drink water NOM
"A cup is used for drinking water."
*MOT: hai2 you3 zhe4 ge shen2mo? still have this CL what
"And what is this?"
*JIE: cha1-zi. fork-DIM
"fork"

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Another characteristic is that TMC children tend to include neutral-toned grammatical morphemes when extracting a final syllable sequence from adult models. The example given below shows that Lon (1;7.21) tried to emphasize her ability to produce the nominalizer de by speaking de loudly or by prolonging de in utterance-final position.

*MOT: zhe4 ge ping2guo3 shi4 shen2mo yan2 se4 de?
   this CL apple is what color NOM

"What is the color of the apple?"

*LON: hong2 se4 <de!>.
   red color NOM

"It's red!"

*MOT: xiang1 jiao1 shi4 shen2mo yan2 se4 de!
   banana is what color NOM

"What is the color of the banana?"

*LON: huang2 se4 <de ->.
   yellow color NOM

"It's yellow."
Unlike TMC children, however, TW children tend to retain only content words and drop functors which become neutral-toned in utterance-final position. The example given below shows that her mother tried to signal San (1;11,12) not to omit the nominalizer e by repeating San's utterance with correction.

* MOT: hel ang sek4 e.
  that red color NOM
  "That is red."

* SAN: ang sek4 0e.
  red color NOM
  "red"

* MOT: he ma3 ang sek4 e.
  that also red color NOM
  "That is red, too."

* MOT: che1 na sek4 e.
  this blue color NOM
  "This is blue."

* SAN: na sek4 0e.
  blue color NOM
  "blue"

* MOT: na sek4 e.
  blue color NOM
  "This is blue."

These examples suggest that the neutral tone plays quite different roles in speech segmentation for TMC children and TW children. Full-toned content words followed by neutral-toned grammatical morphemes constitute segmentation units in TMC but not in TW.

There are some examples from the earliest recordings of the TMC children indicating that the diminutive marker -zi, rather than the preceding
content word, was retained. The following example is taken from a conversation between Jie (1;8.23) and his mother.

*MOT: zhe4 shi4 shen2mo?
this is what
"What is this?"

*JIE: 0pan2 -zi.
plate -DIM
"plate"

exp: Jie omits pan2, but still retains -zi.

*MOT: pan2-zi.
plate-DIM
"plate"

*MOT: zhe4 ge ne1?
this CL Q.PAR
"What is this?"

*JIE: 0cha1 -zi.
fork -DIM
"fork"

exp: Jie omits cha1, but still retains -zi.

*MOT: cha1-zi.
fork-DIM
"fork"

This is reminiscent of Pye's (1983) findings for Quiché, where children reproduced a final grammatical morpheme in preference to the penultimate (lexical) stem.

In contrast, examples abound from the earliest recordings of TW children in which they retained content words and deleted the diminutive marker -a2. The following example is taken from a conversation between Xii (1;7.17) and his mother.

*MOT: li2 ka7 mal+ma1 e5 liu2-a2 theh8 khi3 ta3?
you OBJ.M mother GEN button-DIM take go where
"Where did you put my button?"
The mother emphasizes the item she is looking for.

*XII: liul [·] 0a2?

"button?"

exp: The sandhi form for liu2 is liu1.

err: liu2 > liu1; -a2 is omitted.

*MOT: ti7 ta3?

"Where?"

*XII: phoe2 [·] 0a2.

"quilt"

exp: The sandhi form for phoe7 is phoe2.

err: phoe7 > phoe2; -a2 is omitted.

This difference in the use of the diminutive marker between TMC children and TW children suggests that although both groups of children are biased to extract final syllables from adult models, unlike TMC children, TW children favor the penultimate syllable when it carries more semantic content.

A third characteristic is that sequences of content words followed by neutral-toned grammatical morphemes tend to be produced by TMC children as units. Evidence from longitudinal language samples indicates that the proportions of functor omissions were very low for TMC children. Neutral-toned grammatical morphemes that closely follow content words were frequently produced in TMC children's speech. However, results obtained from the spontaneous and imitative speech of TW children indicate that
grammatical morphemes that closely follow content words were often omitted in speech. In fact, grammatical morphemes were prone to omission in TW children's productions, no matter where they occurred in an utterance. The features of grammatical morphemes in TMC and TW are compared in Table 20.

Table 20. The features of grammatical morphemes in TMC and TW

<table>
<thead>
<tr>
<th>Feature</th>
<th>TMC</th>
<th>TW</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Closely follow content words</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>2. Associate regularly with a pitch pattern (i.e., neutral tone)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>3. Almost always contain a short, central vowel (i.e., schwa)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>4. Frequently produced with preceding content words as units</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

In TMC, speech rhythm has a characteristic pattern which is expressed in the opposition of strong versus weak syllables. Strong syllables bear primary stress and contain full vowels, whereas weak syllables are unstressed and contain short, central vowels such as schwa. A child encountering a strong syllable in spontaneous TMC conversation would have a good chance of finding that strong syllable to be the onset of a new content word. A weak syllable, on the other hand, would be most likely to be a neutral-toned grammatical morpheme. It would appear, therefore, that TMC speech indeed provides a good basis for the implementation of a segmentation strategy which assumes that full-toned lexical syllables followed by neutral-toned functor syllables constitute a strong-weak trochaic foot.

Segmentation of nonstress languages like TW does not have such an obvious prosodic basis, since in such languages there is no opposition between strong and weak syllables; all syllables contribute equally to linguistic rhythm. Although grammatical morphemes in TW share with content
words the phonological property of being tonal, they do not have the same transparent semantic meanings of the major content words. Grammatical morphemes do not refer to anything concrete. The concepts they express (e.g., progressiveness, possession) are more abstract than those expressed by the content words, and are therefore expected to be more difficult to acquire. TW children's difficulty in learning grammatical morphemes is reflected in their retention of content words and deletion of grammatical ones in spontaneous and imitative speech.

The second prediction Hypothesis 1 makes is: If it is true that the trochaic foot functions as a segmentation unit in TMC children's speech while the syllable acts as a segmentation unit in TW children's speech, we expect to see a striking difference in the patterns of realization and omission of grammatical morphemes between the two groups of children. Evidence would be first that neutral-toned grammatical morphemes that fit a strong-weak template would be frequently preserved in the spontaneous and imitative speech of TMC-speaking children. Second, for lack of segmentation handles, grammatical morphemes would be frequently omitted in the spontaneous and imitative speech of TW-speaking children. The results of the present study indeed provide substantial support for these predictions. For TMC children, neutral-toned grammatical morphemes that closely follow full-toned content words were frequently produced. In TW, however, children had a very strong tendency to retain content words but delete grammatical ones.

TMC children's pattern of weak syllable preservations is highly consistent with the strong-weak production template hypothesis proposed by Gerken (1987, 1991, 1994), Gerken et al. (1990), Demuth (1992, 1994), Wijnen et
This hypothesis states that children learning languages construct a template for producing a strong syllable followed by an optional weak syllable. This production template might be constructed, based on the canonical stress pattern of words in the language (e.g., Demuth 1994). Alternatively, this production template might reflect an innate bias toward producing SW sequences. When children apply an S(W) template to an intended word; the strong syllable of the word is mapped onto the strong syllable of the template. Weak syllables that fit the template are retained, while those that do not are omitted (Gerken 1994:576).

The third prediction Hypothesis 1 makes is very powerful. This prediction states that if it is true that the segmentation strategies employed by TMC children and TW children differ (i.e., TMC children consistently make use of the metrical foot in segmentation, while TW children do not), we expect to see the degree to which grammatical morphemes are vulnerable to omission differs greatly between the two language groups. For TMC children, neutral-toned grammatical morphemes would be prone to omission only if there is a change in the metrical structure of an utterance. In TW, on the other hand, all the grammatical morphemes would be susceptible to omission, regardless of pitch value (full-toned or neutral-toned), grammatical function (semantic and syntactic complexity), frequency in input, and/or position in which they occur in an utterance. The results of the present study indeed provide strong support for these predictions.

TW children did often omit each of the grammatical morphemes in spontaneous speech. The characteristics of TW children's imitative speech paralleled those of their spontaneous speech. Nearly all the grammatical morphemes modeled in the TW imitation test were likely to be omitted.
TMC children, the nominalizer/genitive marker *de* was more vulnerable to omission than any other neutral-toned grammatical morpheme. Most of the *de* omissions occurred when *de* was followed by a noun phrase consisting of the head noun being modified by the NP-*de* modifier. The addition of the head noun to the NP-*de* modifier may cause a change in the metrical structure of an utterance. We will return to this topic in Section 5.2.

To sum up, there is ample evidence from early language production supporting the three predictions Hypothesis 1 makes. The evidence suggests that rhythmic characteristics of languages can affect segmentation by providing different kinds of prosodic "handles" for the novice to grasp. Metrical feet may offer TMC children one kind of segmentation handle because neutral-toned grammatical morphemes that closely follow full-toned content words are in position to be "picked up" as parts of unopened packages. In TW, however, since there is no opposition between full- and neutral-toned syllables, all syllables contribute equally to linguistic rhythm, and the syllable more likely functions as a segmentation unit for TW children. Specifically, lexical syllables which are more semantically salient than functor syllables have an advantage in perceptibility and therefore in processing. This advantage is reflected in TW children’s retention of content words and deletion of grammatical morphemes in spontaneous and imitative speech.

5.2 Relative Difficulty in Learning Grammatical Morphemes

It has been suggested that metrical footing may serve as an important organizer of TMC children's early multi-syllabic utterances. Children working at the foot level choose a salient foot (often the syllable carrying full tones) including some or all of the weak syllable(s). This metrical bias
predicts TMC children's frequent preservations of neutral-toned grammatical morphemes that fit a strong-weak template. Although the syllable can act as a segmentation unit in speech processing, TW children tend to pay less attention to the frames (the closed-class bits) and focus on the slots, i.e., the open-class items which they juxtapose in their early utterances. This difference in speech segmentation procedures between TMC children and TW children results in different patterns of realization and omission of grammatical morphemes in children's spontaneous and imitative speech. It is thus necessary to consider how children's acquisition of grammatical morphemes might be affected by the phonological and prosodic properties of these morphemes.

Hypothesis 2: It is harder for young children to begin to produce the grammatical morphemes of TW that are full-toned than it is to produce the grammatical morphemes of TMC that are neutral-toned.

Although children cannot tell adults how hard it is to learn grammatical morphemes in their native language, some clues to their difficulty with these morphemes can be obtained by considering the nature of children's earliest productions. Of course, young children quite often perceive much more than they produce. Production limitations, as well as incomplete representations may constrain a child's productions. It can be argued, however, that the particular syllables which the child produces will tend to be those, out of a longer sequence of speech, which are particularly salient to that child. Similarly, it seems safe to assume that if a sequence is produced as a single unit by a child, then that child perceives that sequence as coherent.

Hypothesis 2 makes three main predictions for each group of children. The first prediction states that there are significant differences between TMC
children and TW children with regard to the omission of grammatical morphemes in their spontaneous and imitative speech. A comparison of functor omissions in spontaneous and imitative speech between TMC and TW groups indicates that TW children omitted significantly more functors than TMC children did. For TW children, grammatical morphemes were vulnerable to omission in spontaneous and imitative speech, regardless of pitch value, grammatical function, frequency in input, and/or position in which they occurred in an utterance. However, the proportions of functor omissions were very low for TMC children.

In TMC, grammatical morphemes tend to be neutral-toned and unstressed, whereas major lexical items tend to be full-toned and have at least one stressed syllable. Stress and syllable weight together help define potential segmentation handles that favor units that are prosodically defined and include at least parts of closed-class items. In TW, however, sequences of syllables have less of the kind of rhythmic structure characteristic of stress-prominent languages, thus offering young children less in the way of rhythmically defined units for segmentation. Lexical syllables are typically far more semantically salient than functor syllables, and therefore possess a processing advantage which is clearly exhibited in TW children's retention of content words and omission of grammatical ones.

The second prediction Hypothesis 2 makes is: Grammatical morphemes in TW are least susceptible to omission when they are associated with phonological salience. Results obtained from TW children's spontaneous speech indicate that nearly all the grammatical morphemes studied were vulnerable to omission. Figure 18 shows the distribution of
functor omissions in the spontaneous speech of all three TW-speaking children.

Figure 18. Distribution of functor omissions for TW group

As can be seen in Figure 18, grammatical morphemes such as the diminutive marker -a2 and the completive aspect marker a show greater resistance to omission than any other grammatical morpheme in TW. As a matter of fact, even the children with low MLUs (Mao and Xii) stopped omitting the diminutive -a2 after the third recording session. The child with the highest MLU (San) was never found to omit the diminutive -a2 in her productions. One characteristic which these functors have in common is that both functors contain a low vowel. The low (open) vowel /a/ is the most sonorous sound. In addition, the diminutive -a2 carries a high-falling tone (53). Another characteristic is that the diminutive -a2 occurs in word-final
position; the completive aspect a occurs in utterance-final position. The syllables at the ends of utterances have particular phonological salience since they are adjacent to silence (Peters 1983:36). Slobin (1973) has presented substantial evidence, based on cross-linguistic differences in the order of acquisition of grammatical inflections, for the perceptual salience of word-endings. Slobin noted that, for example, locative markers are acquired earlier in languages such as Hungarian in which they occur in word-final position than in languages like Serbo-Croatian, Russian, and Latvian, in which locatives are marked with prepositions. A final characteristic is that both functors occur frequently in input speech. These characteristics, taken together, should make -a2 and a easier to perceive and therefore extract from a sequence of speech.

The third prediction Hypothesis 2 makes is: Grammatical morphemes in TMC are most vulnerable to omission when they do not fit within the strong-weak metrical production templates. Results obtained from TMC children's spontaneous and imitative speech suggest that TMC children approach the problem of segmentation for lexical access by applying a metrical segmentation strategy: the strong syllable of the word is mapped onto the strong syllable of the template; weak syllables that fit the template are retained, while those that do not are omitted. The examples given below show that Lon (1;7.21) included the nominalizer/genitive marker de in her productions when the content word followed by de was adaptable to a S(W) template.
Gerken’s S(W) production template hypothesis predicts that in $SW_1W_2$ words children should preserve the second weak syllable more frequently than the first. In this study, there were indications that TMC children, but not TW children, tended to neutralize the second syllable of a reduplicated form. As the following example shows, Lon (1;8.2) produced the second syllables of the reduplicated forms as neutral-toned, even though these syllables were produced by her mother as full-toned:

*MOT: Rong2+Rong2 de shou3+shou3 zai4 na3 li3?
   Rong-Rong GEN hand LOC where
   "Where are Rong-Rong’s hands?"

*LON: shou3+shou.
   hand
   "Here"

*MOT: jiao3+jiao3 ne1?
   leg Q.PAR
   "Where are your legs?"

*LON: jiao3+jiao.
   leg
   "Here"

In $SW_1W_2SW$ utterances, Gerken’s S(W) production template hypothesis predicts that children should preserve the first weak syllable more frequently than the second. This is because the first two syllables fit a S(W)
template, whereas the first and third syllables do not. The examples given below show that Ron (2;2.23) omitted the nominalizer/genitive marker \( de \) when \( de \) occurred in the \( SW_1W_2S(W) \) metrical patterns.

\[
\begin{align*}
\text{ma1 ma1 de shu1} & \quad | & \quad | \\
S & - W & * & S - (W) \\
\text{mother GEN book} & \\
\text{"mother's book"}
\end{align*}
\]

\[
\begin{align*}
\text{hong2 se4 de ka3 che1} & \quad | & \quad | & \quad | \\
S & - W & * & S - W \\
\text{red color NOM truck} & \\
\text{"a truck that is red"}
\end{align*}
\]

So far, we have not found any evidence to support the assumption that the second syllable of the word for red is a weak syllable. However, we cannot exclude the possibility that TMC children may adapt the rhythmic form of words and phrases in such a way that trochaic patterns result. Future research needs to address this question of whether the composition of early vocabularies reflects a bias toward words that match a rhythmic constraint.

There are some cases that the \( S(W) \) production template hypothesis fails to account for. The following examples show that Ron (2;3) omitted the classifier \( ge \) even though \( ge \) fits a \( S(W) \) template.

\[
\begin{align*}
\text{san1 ge wan2 ju4} & \quad | & \quad | & \quad | \\
S & - * & S - W \\
\text{three CL toy} & \\
\text{"three toys"}
\end{align*}
\]

\[
\begin{align*}
\text{san1 ge ping2 guo3} & \quad | & \quad | & \quad | \\
S & - * & S - W \\
\text{three CL apple} & \\
\text{"three apples"}
\end{align*}
\]
However, it should be noted that the S(W) production template hypothesis indeed successfully predicts differential preservation of the neutral-toned functors which fit a S(W) template. Specifically, it predicts that neutral-toned functors that fit a S(W) template are more likely to be preserved than those that don't.

5.3 Frequency of Grammatical Morphemes

Young children typically omit grammatical morphemes in their early spontaneous and imitative speech. There have been at least three different hypotheses concerning why young children seem to have difficulty with grammatical morphemes. According to Brown (1973), and others after him, grammatical morphemes have less clear semantic correlates than content words. The concepts they express (e.g., determinacy, number) are more abstract than those expressed by the content words, and are therefore expected to be more difficult to acquire. In support of this idea, Brown provides evidence showing that the order of appearance of the famous first fourteen grammatical morphemes can be explained by their cumulative semantic complexity.

A second hypothesis hangs on the assumption that young children have problems with grammatical morphemes of low perceptual salience. Investigators have suggested that the physical properties of grammatical morphemes figure importantly in the manner in which young children acquire the language (Slobin 1973, 1985; Pinker 1984; Peters 1985). Many of these morphemes pose a challenge perceptually because as nonsyllabic consonant segments and unstressed syllables, they are shorter in duration than adjacent morphemes. From the standpoint of production, they are vulnerable to final consonant deletion and weak syllable deletion.
Recently, attempts have been made to relate the absence of grammatical morphemes to the acquisition of syntax. Many of the grammatical morphemes are specifically linked to what syntacticians call functional projections. For instance, articles and other determiners, as well as pronouns, are heads of DET projections, and auxiliaries are heads of INFL projections. It has been argued that functional projections are not yet present in the syntactic representations of Stage I children, so that, even if they knew the morphemes that are linked to them, they would be unable to express them, as they cannot be syntactically licensed (Radford 1990).

Each hypothesis seems to treat such factors as semantic complexity, syntactic complexity, and perceptibility in speech as independent from each other, and thus they fail to offer a complete picture of how these factors interact with each other. One problem with these hypotheses is: How can we separate out the relative contribution of syntactic complexity, semantic complexity, and perceptibility in speech for a particular grammatical morpheme? Another problem is: What role is played by frequency in the acquisition of grammatical morphemes? A third problem is: Besides the physical properties of grammatical morphemes, will children's production limitations also exert an influence on the appearance of grammatical morphemes? By conducting the present comparison study, we aimed to look closely at how these factors (i.e., syntactic complexity, semantic complexity, frequency in input, and perceptibility in speech) interact with each other and what other factors (e.g., children's production limitations) might become involved in determining the order of appearance of grammatical morphemes in children's speech. We first need to examine correlations between
frequency of grammatical morphemes in adult-to-child speech and their order of appearance in children's productions.

**Hypothesis 3:** *Frequency of grammatical morphemes in input speech will be reflected in the order of appearance of these morphemes in children's productions.*

Hypothesis 3 makes two predictions for each group of children. The first prediction states that there is a significant correlation between frequency of grammatical morphemes in input speech and their order of appearance in TMC and TW children's productions. Results obtained from the correlational analysis indeed provide strong support for this prediction. For both language groups, there exists a high correlation between frequency of grammatical morphemes in input speech and their order of appearance in children's productions.

The second prediction states that other factors may interact with frequency of input in determining the order of appearance of grammatical morphemes in TMC and TW children's productions. The results of the within-language comparisons indicate that frequency of grammatical morphemes in input, overall, did reflect the order of appearance of these morphemes in children's productions. However, other factors besides frequency may have interacted with frequency of input in determining the order of appearance of grammatical morphemes in children's speech. In this study, we have identified prosody, semantic complexity, and children's production limitations as three of the most important factors that might interact with frequency of input. We thus propose to take a complex view of the interaction of these factors, as shown in Figure 19.
5.4 Summary

The most significant outcome of the present study is the finding that the patterns of realization and omission of grammatical morphemes differ greatly between TMC children and TW children. For TMC children, neutral-toned grammatical morphemes that closely follow full-toned content words were frequently produced in speech. In TW, on the other hand, all 7 grammatical morphemes studied were vulnerable to omission, regardless of pitch value, grammatical function, frequency in input, and/or position in which they occurred in an utterance. These findings suggest that speech segmentation processes differ for children learning either TMC or TW as their first language. Because of their morphosyntactic similarities, we infer...
that this difference reflects the phonological and prosodic differences between TMC and TW.

There is ample evidence from early language production supporting the hypotheses we investigated in this study. The evidence suggests that rhythmic characteristics of languages can affect segmentation by providing different kinds of prosodic "handles" for the novice to grasp. Metrical feet may offer TMC children one kind of segmentation handle because neutral-toned grammatical morphemes that closely follow full-toned content words are in position to be "picked up" as parts of unopened packages. In TW, however, since there is no opposition between full- and neutral-toned syllables, all syllables contribute equally to linguistic rhythm, and the syllable more likely functions as a segmentation unit for TW children. Specifically, lexical syllables which are more semantically salient than functor syllables have an advantage in perceptibility and therefore in processing. This advantage is reflected in TW children's retention of content words and deletion of grammatical morphemes in their speech.

Although grammatical morphemes are very likely to be omitted in TW children's speech, it is interesting to note that some grammatical morphemes such as the diminutive marker -a2 and the completive aspect marker a show greater resistance to omission. In comparison with other grammatical morphemes, -a2 and a contain a sonorous low vowel and -a2 carries a high pitch. Both functors occur in word- or utterance-final position, and are high frequency words in input speech. These characteristics, taken together, should make -a2 and a easier to perceive and therefore extract from a sequence of speech.
The difficulty of learning grammatical morphemes has been explained by Brown (1973), and others after him, by referring to their semantic complexity. Investigators such as Slobin (1973, 1985), Pinker (1984), and Peters (1985), on the other hand, attribute the vulnerability of grammatical morphemes in children's productions to a lack of perceptual salience of these morphemes. Recently, attempts have been made to relate the absence of grammatical morphemes in early productions to the acquisition of syntax (Radford 1990). Each proposal seems to focus solely on one of the possible factors responsible for children's difficulty with grammatical morphemes, and hence fails to offer a complete picture of how these factors interact with each other. In addition, there is no reason why frequency of grammatical morphemes in input speech is not taken into consideration. By conducting the present comparison study, we have not only looked at how these factors (i.e., syntactic complexity, semantic complexity, frequency in input, and perceptibility in speech) interact with each other, but also considered what other factors (e.g., children's production limitations) may become involved.
6.0 Introduction

This dissertation examines two issues concerning the acquisition of grammatical morphemes: (1) How is the acquisition of grammatical morphemes influenced by prosodic and phonological characteristics of the language being learned? and (2) What sorts of prosodic and phonological properties do grammatical morphemes have that might aid children in applying particular segmentation strategies? To address these issues, we compared the acquisition of grammatical morphemes in a pair of morphosyntactically similar but prosodically different languages, namely Taiwan Mandarin Chinese (TMC) and Taiwanese (TW). In the following sections, we will summarize the research findings, present implications for the study of prosody in children's speech, and propose an agenda for future explorations.

6.1 Summary of Findings

Results obtained from longitudinal language samples and controlled experiments are summarized as follows:

**TMC Group**

(1) The proportions of functor omissions were very low for the TMC-speaking children (Section 4.3.1, page 97).

(2) The nominalizer/genitive marker *de* was more vulnerable to omission than any other neutral-toned grammatical morpheme in the TMC-speaking children's productions (Section 4.3.1, page 97 & Section 4.3.2, page 103).

(3) The plural marker *men* and the durative aspect marker *zhe* were never produced in the TMC-speaking children's spontaneous speech. These
morphemes, however, were seldom omitted in the children's imitative speech (Section 4.3.2, page 103).

(4) There is a moderately high correlation between frequency of grammatical morphemes in input speech and their order of appearance in the TMC-speaking children's productions (Section 4.4.1, page 110).

**TW Group**

(5) All 7 grammatical morphemes studied were susceptible to omission in the TW-speaking children’s productions, regardless of pitch value (full-toned vs. neutral-toned), grammatical function (semantic and syntactic complexity), frequency in input, and/or position in which they occurred in an utterance (Section 4.3.1, page 100 & Section 4.3.2, page 105).

(6) The diminutive marker -a2 and the completive aspect marker a showed greater resistance to omission than any other grammatical morpheme in TW (Section 4.3.1, page 100 & Section 4.3.2, page 105).

(7) The progressive aspect marker teh4 and the durative aspect marker leh4 were rarely produced in the TW-speaking children’s spontaneous speech, and also very frequently omitted in their imitative speech (Section 4.3.1, page 100 & Section 4.3.2, page 105).

(8) There is a high correlation between frequency of grammatical morphemes in input speech and their order of appearance in the TW-speaking children’s productions (Section 4.4.2, page 114).

**Comparison Between TMC and TW Groups**

(9) Neither the TMC-speaking children nor the TW-speaking children produced significantly more functors in their spontaneous speech (Section 4.2.3, page 94).

(10) The TW-speaking children omitted significantly more functors than the TMC-speaking children did in spontaneous and imitative speech (Section 4.3.1, page 101 & Section 4.3.2, page 105).

(11) The proportions of content word omissions in the imitation task were low for both groups of children, and the TW-speaking children did not omit significantly more content words than the TMC-speaking children did (Section 4.3.2, page 105).
Neither the TMC-speaking children nor the TW-speaking children performed significantly better in the comprehension tests of grammatical morphemes (Section 4.3.3, page 108).

6.2 Implications

The most exciting results of this dissertation are that the segmentation processes characteristically employed by TMC children and TW children differ: TMC children consistently make use of bisyllables in segmentation, while TW children do not. Because of their morphosyntactic similarities, we infer that this difference reflects the phonological and prosodic differences between TMC and TW. The characteristic rhythm patterns of TMC and TW thus seem to affect the perception and segmentation of grammatical morphemes. Metrical feet may offer TMC-speaking children one kind of segmentation handle because neutral-toned grammatical morphemes that closely follow full-toned content words are in position to be “picked up” as parts of unopened packages. In TW, however, since there is no opposition between full- and neutral-toned syllables, all syllables contribute equally to linguistic rhythm, and the syllable more likely functions as a segmentation unit for TW-learning children. Specifically, lexical syllables which are more semantically salient than functor syllables have an advantage in perceptibility and therefore in processing.

The importance of syllable-sized units to young infants is supported by Jusczyk’s research (summarized in Jusczyk 1992) on early perceptual abilities. Mehler et al. (1990) also argue that both infants (acquiring speech) and adults (processing speech) make use of a perceptual unit that corresponds roughly to the syllable. Certainly, in some languages such as TMC and TW, syllable and morpheme boundaries coincide perfectly and the syllable would be a linguistically useful unit of attack. However, during language acquisition,
children may adapt their perceptual routines so as to exploit with maximal efficiency the rhythmic properties of their native language. Effectively, TMC children seem to extract and operate on the basis of a salient foot (the syllable carrying full tones) including some or all of the weak syllable(s), while TW children tend to make use of individual syllables in segmentation.

The speech segmentation problem must be solved differently across languages. Depending upon the characteristic rhythmic pattern of a language, speech segmentation strategies employed by children seem to vary. We assume that the effects of the finding that the trochaic foot functions as a segmentation unit in TMC children’s speech, while the syllable acts as a segmentation unit in TW children’s speech are not specific to these two languages, but that children learning any language with salient contrasts between stressed and unstressed syllables will show foot-level effects, while children of any language with a relatively uniform sequence of syllables will show syllable effects.

The difficulty of learning grammatical morphemes has been explained by child language researchers by referring to their semantic complexity, syntactic complexity, frequency in input, and perceptibility in speech. However, it is hard to single out a single type of complexity responsible for the vulnerability of grammatical morphemes in children’s early productions. In attempting to understand better the relative contributions of each type of complexity, we need to take a complex view of how these factors interact with each other and what other factors may become involved.

6.3 Limitations of This Study

The present study has focused on the development of grammatical morphemes in children learning either TMC or TW as their first language. I
have analyzed the patterns of realization and omission of grammatical morphemes in the spontaneous and imitative speech of three TMC-speaking children and three TW-speaking children, recorded between the ages 1;6 and 2;3. Because of some grammatical morphemes such as the progressive aspect markers zai4 and teh4, the durative aspect markers zhe and leh4, and the specific classifiers, remained rare in the children’s productions, future research needs to collect longitudinal speech samples from at least six children between the ages 1;7 and 4;0 for each language group. A further longitudinal study of several more children can confirm or refute some of the findings in this study. In addition, the comprehension test of grammatical morphemes can only be regarded as a pilot test. Because the children were given only two pictures from which to choose, they could randomly select the right picture 50% of the time without even listening to the test sentence. Future research needs to address this question of how to eliminate variables that might occur in the comprehension test.

6.4 Topics for Future Research

One way to further test the hypotheses investigated in this study could be to make comparisons with other southern Chinese languages, such as Hakka or Cantonese in which there are no neutral-toned grammatical morphemes. Such research needs to collect longitudinal speech samples from at least 6 children between the ages 1;7 and 4;0 for each language group.

Minimal pair sets of languages can differ in attributes other than prosodic ones. By conducting the present comparative study, we have found a new topic for future research. This topic deals with the acquisition of numeral classifiers in TMC and TW.
In isolating languages such as TMC and TW, nouns are not inflected for number. In the absence of inflection, numeral classifiers are used to indicate both individual objects (e.g., liu4 fu2 hua4 “six-piece-picture” = “six pictures”) and groups of objects (e.g., liang3 dui1 yi1 fu2 “two-pile-clothes” = “two piles of clothes”). Numeral classifiers are so called because they (i) occur obligatorily in noun phrases containing an expression of quantity and (ii) partly classify nouns according to inherent semantic features of the associated referents (Gandour et al. 1984:455). The basic word order in a numeral classifier phrase in TMC and TW is DEMONSTRATIVE/NUMBER/QUANTIFIER-CLASSIFIER-NOUN (e.g., san1-kuai4-dan4 gao1 “three-piece-cake” = “three cakes”). Both languages possess approximately 200 classifiers. Nearly all the classifiers in TMC have an equivalent in TW. Prescriptive grammars in both languages claim that each object must take a specific classifier. TMC-speaking adults say that using the general classifier ge rather than a specific one typically sounds childish.

Results obtained from longitudinal speech samples show that the classifier ge was very frequently used by TMC caregivers and children as a “general classifier”, while the classifier e5, the nearest TW equivalent to ge, was never used by TW caregivers and children in this way. For TMC caregivers and children, out of the 3,186 classifiers used in conversation, 2,758, or 87% were ge. Specific classifiers were rare in TMC conversation. In TW, however, out of the 1,898 classifiers used in conversation, only 572, or 30% were e5. Since TW has no “general classifier”, caregivers frequently used specific classifiers in conversation. It is interesting to note that TW children in this study began to learn to use such specific classifiers as pun2 “a book of”, liap8 “a grain of”, tai5 “a set of”, and chiong2 “a kind of”, as soon as their
MLUs reached around 1.80. We thus hypothesize that for lack of a "general classifier", TW children need to learn specific classifiers earlier than TMC children do. To test the validity of this hypothesis, future research needs to include more subjects and collect spontaneous language samples from both caregivers and children for a longer period of time.

6.5 Conclusion

This dissertation investigates how the acquisition of grammatical morphemes may be influenced by prosodic and phonological characteristics of the language being learned as well as by its morphological typology. We compared the acquisition of grammatical morphemes in a pair of morphosyntactically similar but prosodically different languages, namely Taiwan Mandarin Chinese and Taiwanese. We analyze the patterns of realization and omission of a highly frequent subset of grammatical morphemes in six children's speech, recorded between the ages 1;6 and 2;3. The results from the between-language comparisons suggest that rhythmic characteristics of languages can affect segmentation by providing different kinds of prosodic handles for children to grasp. Metrical feet may offer TMC children one kind of segmentation handle because neutral-toned grammatical morphemes that closely follow full-toned content words are in position to be "picked up" as parts of unopened packages. In TW, however, since there is no opposition between full- and neutral-toned syllables, all syllables contribute equally to linguistic rhythm, and the syllable more likely functions as a segmentation unit for TW children.
## APPENDIX A

### CASE FORM

<table>
<thead>
<tr>
<th>Mother's Full Name:</th>
<th>Child's Full Name:</th>
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</thead>
<tbody>
<tr>
<td>Place of Birth:</td>
<td>Sex:</td>
</tr>
<tr>
<td>Place she grew up:</td>
<td>Date of Birth:</td>
</tr>
<tr>
<td>Occupation:</td>
<td>Age at the time of experiment:</td>
</tr>
<tr>
<td>Level of Education:</td>
<td>Brother Age</td>
</tr>
<tr>
<td>Language spoken at home:</td>
<td>1</td>
</tr>
<tr>
<td>Language spoken to the child:</td>
<td>Sister</td>
</tr>
<tr>
<td>Other language spoken:</td>
<td>1</td>
</tr>
<tr>
<td>When:</td>
<td>Language(s) spoken by the siblings:</td>
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</table>

<table>
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<th>Father's Full Name:</th>
<th>Daily schedule of the child:</th>
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</thead>
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<td>Place of Birth:</td>
<td></td>
</tr>
<tr>
<td>Place he grew up:</td>
<td></td>
</tr>
<tr>
<td>Occupation:</td>
<td></td>
</tr>
<tr>
<td>Level of Education:</td>
<td></td>
</tr>
<tr>
<td>Language spoken at home:</td>
<td>Time spent with the child:</td>
</tr>
<tr>
<td>Language spoken to the child:</td>
<td></td>
</tr>
<tr>
<td>Other language spoken:</td>
<td></td>
</tr>
<tr>
<td>When:</td>
<td></td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>Other members</th>
<th>Birthplace</th>
<th>Place he/she grew up</th>
<th>Language(s) spoken</th>
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<tbody>
<tr>
<td>Other caregivers</td>
<td>Birthplace</td>
<td>Place he/she grew up</td>
<td>Language(s) spoken</td>
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</tbody>
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<th>Telephone No.:</th>
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<tbody>
<tr>
<td></td>
<td>151</td>
</tr>
</tbody>
</table>
APPENDIX B
CRITERIA FOR DEFINING MLU IN TMC AND TW
(cited from Tardif 1993:45)

1. Count the number of productive morphemes in each productive utterance and divide it by the total number of utterances for each speaker.

2. Proper names, babytalk reduplications, and terms of address are counted as single rather than multiple morphemes.

3. Multiple occurrences of a single word in an utterance are not counted if they are stutters or incomplete attempts at a single word. They are counted, however, if they are repeated for emphasis or appear in different phrasal units.

4. Interjected syllables such as ".ou" ("oh") and ".em" which appear in productive utterances are generally not counted. However, words such as aiyou" (roughly, "oh no!" or "oops!") which have a more specific meaning are counted if they appear in a productive utterance.
APPENDIX C
MATERIAL FOR TMC IMITATION TEST

1. kan4 zhe ma1 ma1 see DUR mother "looking at mommy"

2. hao3 duo1 che1-zi very many car-DIM "many cars"

3. san1 ge wan2 ju4 three CL toy "three toys"

4. hong2 se4 de qiu2 red color NOM ball "a ball that is red"

5. ma3 de wei3 ba1 horse GEN tail "the tail of the horse"

6. zuo4 zhe chang4 ge1 sit DUR sing song "sitting there singing"

7. ma01 chil le yu2 cat eat ASP fish "The cat has eaten the fish."

8. da4 de fei1 ji1 big NOM airplane "an airplane that is big"

9. mao1 mi1 shui4 le cat sleep ASP "The cat is asleep."

10. ya1-zi you2 shui3 duck-DIM paddle "The duck is paddling."

11. san1 ge ping2 guo3 three CL apple "three apples"

12. ma1 ma1 de shu1 mother GEN book "mother’s book"

13. xiao3 peng2 you3 men little friend PL "little friends"

14. wo3-men lai2 wan2 I-PL come play "Let’s play."
APPENDIX D

MATERIAL FOR TW IMITATION TEST

1. kau2-a2 chin1 koai1 dog-DIM very good "good dog"
2. che7 leh4 chia1 sng2 sit DUR here play "sitting here playing"
3. u7 sā1 e5 lang5 have three CL people "There are three persons."
4. ng5 e5 kin1 chio1 red NOM banana "a banana that is yellow"
5. ma1 ma1 ti7 chia1 mother LOC here "Mommy is here"
6. niau1 mil teh4 khun3 cat PROG sleep "The cat is sleeping."
7. pa1 pa1 e5 chheh4 father GEN book "father's book"
8. poe1-a2 u7 chui2 cup-DIM have water "There is water in the cup."
9. be2 teh4 chiah8 chhau2 horse PROG browse "The horse is browsing."
10. chheh4 khng3 ti7 chia1 book put LOC here "Books are placed here."
11. che7 leh4 sia2 gi7 sit DUR write character "sitting there writing"
12. sā1 e5 ko3 su7 three CL story "three stories"
13. goa2 e5 bak8 chiu1 I GEN eye "my eyes"
14. ang5 sek4 e5 hoe1 red color NOM flower "a flower that is red"
APPENDIX E
MATERIAL FOR TMC COMPREHENSION TEST

1A hou2-zi ch1 zhe xiang1 jiao1
monkey-DIM eat DUR banana
"The monkey is eating a banana."

1B hou2-zi ch1 le xiang1 jiao1
monkey-DIM eat ASP banana
"The monkey has just eaten a banana."
2A mao1 zhui1 zhe lao3 shu3
cat chase DUR mouse
"The cat is chasing the mouse."

2B mao1 zhui1 le lao3 shu3
cat chase ASP mouse
"The cat has just chased the mouse."
3A ta1-men zai4 wan2 qiu2
he-PL PROG play ball
"They are playing with a ball."

3B ta1 zai4 wan2 qiu2
he PROG play ball
"He is playing with a ball."
4A yāl-zi mèn zài yǒu shuǐ
duck-DIM PL PROG paddle
“Ducks are paddling in the water.”

4B xiǎo yāl-zi zài yǒu shuǐ
little duck-DIM PROG paddle
“A little duck is paddling in the water.”
There are two eggs here.

There are two loads here.
6A zhe4 li3 you3 san1 ge dong4
here have three CL hole
"There are three holes here."

6B zhe4 li3 you3 san1 dong4
here have mountain hole
"There is a tunnel here."
7A zhe4 shi4 mi4 feng1 de fang2-zi
"This is a house for bees."

7B zhe4 shi4 mi4 feng1 fang2-zi
"These are bees and this is a house."
8A zhe4 shi4 wu1 gui1 de dan4
turtle GEN egg
"This is an egg of the turtle."

8B zhe4 shi4 wu1 gui1..... dan4
turtle egg
"This is a turtle and this is an egg."
9A zhe4 li3 you3 yi1 xiang1-zi de wan2 ju4
here have one box-DIM NOM toy
"There is a box of toys here."

9B zhe4 li3 you3 xiang1-zi..... wan2 ju4
here have box-DIM box
"There is a box and there are toys."
"This is a red flower."

"This is red and this is a flower."
APPENDIX F
MATERIAL FOR TW COMPREHENSION TEST

1A kau5 teh4 chiah8 kin1 chio1
monkey PROG eat banana
“The monkey is eating a banana.”

1B kau5 kin1 chio1 chiah8 tiau7 a
monkey banana eat finish ASP
“The monkey has just eaten a banana.”
The cat is eating the fish.

The cat has just eaten the fish.
3A sail-a2 boe2 khiau3 leh
lion-DIM tail raise DUR
"The tail of the lion is raising."

3B sail-a2 boe2 bo5 khiau3 a
lion-DIM tail NEG raise ASP
"The tail of the lion has stopped raising."
4A khok8 hi5 boe2 khiau3 leh
crocodile tail raise DUR
"The tail of the crocodile is raising."

4B khok8 hi5 boe2 bo5 khiau3 a
crocodile tail NEG raise ASP
"The tail of the crocodile has stopped raising."
5A chial u7 sā1 e5 lang5 here have three CL people "There are three persons here."

5B chial u7 sā1..... lang5 here have clothes people "There are clothes and there are people."
6A chia1 u7 nng7 e5 lang5
here have two CL people
"There are two persons here."

6B chia1 u7 nng7...... lang5
here have two people
"There are eggs and there are people."
7A chiau2-a2 ti7 chhiu7-a2
bird-DIM LOC tree-DIM
"The bird is on the tree."

7B chiau2-a2..... chhiu7-a2
bird-DIM tree-DIM
"This is a bird and this is a tree."
"There are eggs in the box."

These are eggs and this is a box."
9A chia1 u7 phang1 e5 chhu3
dhere have bee GEN house
"There is a house for bees here."

9B chia1 u7 phang1..... chhu3
dhere have bee house
"There are bees and there is a house."
10A chel si7 kau2-a2 e5 chhu3
this is dog-DIM GEN house
"This is a house for the dog."

10B chel si7 kau2-a2...... chhu3
this is dog-DIM house
"This is a dog and this is a house."
11A che1 si7 ang5 sek4 e5 hoe1
this is red color NOM flower
"This is a red flower."

11B che1 si7 ang5 sek4..... hoe1
this is red color flower
"This is red and this is a flower."
12A che1 si7 ng5 sek4 e5 sāi
this is yellow color NOM clothes
"This is a yellow dress."

12B che1 si7 ng5 sek4.... sāi
this is yellow clothes
"This is yellow and this is a dress."
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