Phonological Acquisition in Three Languages:

A Cross-Sectional Study of English, Mandarin and Malay

Volume II

Lim Hui Woan

Department of Human Communication Sciences
University of Sheffield

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CHAPTER 7

RESULTS OF THE MAIN STUDY-QUALITATIVE ANALYSIS

7.0 INTRODUCTION

In this chapter, a qualitative analysis of the children's phonological acquisition in English, Mandarin and Malay will be described in order to answer the sixth and seventh research questions set out in Chapter 1 (see section 7.1 below). The children's consonants, vowels, syllable structures, tones (Mandarin only) and word consistency production were analysed in terms of age of acquisition and error patterns (simplifications). A retrospective comparison of the present findings to that of monolingual and bilingual children in the past studies will be made where appropriate.

7.1 RESEARCH QUESTIONS

6. What are the developmental patterns of the three phonologies being acquired by the multilingual children, each from age 2;06 to 4;05?

7. What are the developmental patterns of consistency of word production in each of the three languages from age 2;06 to 4;05?

7.2 DEFINING THE "AGE OF ACQUISITION" & "ERROR PATTERNS"

Age of acquisition

In the present study, the following criterion for age of acquisition was employed:

"A segment was considered acquired when 90% of children (i.e. a minimum of 14 out of 16 children) in an age group produced it correctly at least once in any legal word position".

This criterion was adopted based on the following reasons:

1. The number of children in each age group was small, hence a strict criterion of 90% was adopted (c.f. 50% and 75% used in some other studies referred to in Chapter 2).

2. Some vowels and all consonant clusters were tested once only, due to reasons such as low frequency of occurrence or non-occurrence in certain word-positions, or occurrence mainly in words not familiar to children. In order to be consistent for all the individual segments tested across the three languages, the relatively generous criterion of one correct production per child was adopted. Because some segments were only tested once, the distinction between "phoneme emergence" and "phoneme stabilisation" discussed in Chapter 2 was not addressed when scoring the present data.

3. Due to differences of phonotactics, similar segments were not available at similar legal word positions across the three languages. A similar segment may be available in word initial, medial and final positions in one language but not the other two. In order to be consistent for all the individual segments tested across the three languages, the criterion adopted was a correct production of the segment in any legal word position in the language. This leniency was counterbalanced by the high age group-acquisition percentage criterion (90%) mentioned in (1) above.

4. Because of the complication caused by local socio-linguistic variants (see Chapter 3), the distinction between "phonetic acquisition" "phonemic acquisition" discussed in Chapter 2 was not used when scoring the present data. Owing to the fact that scoring of the variant realisation of one target consonant (especially in Manglish) overlaps with scoring of the variant realisation of a different target consonant, the distinction between phonetic acquisition and phonemic acquisition is blurred. Based on careful definition of the acceptable realisation for each target segment, segmental (phonemic) acquisition was preferred as the focus for the present study since both standard and non-standard forms of realisation of target segments in the three languages are frequently present in an individual speaker's pronunciation (see Chapter 3).

Error patterns

An error pattern was defined as a mismatched pattern found between child's pronunciation and adult's pronunciation. In the present study, the following criterion for error pattern was employed:

"An error pattern was considered as age-appropriate when a minimum of 2 out of 16 children in the age group used a similar segment to replace the target segment".

This criterion was employed based on the following reasons:

1. The use of a minimum of two children reduced the possibility of distortion of the results from a single child who might have severely delayed or disordered speech development. There were outliers on most variables tested in the present study (see Chapter 6).

2. The present criterion of 2/16 children=12.5% will allow comparison of the present study with the past studies. Most past studies have adopted a 10% criterion.

3. It was logical to use a criterion of 10% for error patterns because a 90% criterion was used for age of acquisition (see discussion on definition of "age of acquisition" above).

Amalgamation of data

In the analysis of age of acquisition and error patterns, spontaneous and cued responses were collapsed together for the reasons given in Chapter 5.

7.3 PATTERNS OF PHONOLOGICAL DEVELOPMENT

In this section, the age of acquisition and the error patterns (simplifications) of consonants (singletons and clusters), vowels, syllable structures and tones (Mandarin only) developed from 2;06 to 4;06 will be reported.

7.3.1 Consonant acquisition

7.3.1.1 Age of acquisition for consonants

Based on 90% age of acquisition criterion, the age of acquisition for consonants in the three languages is presented in the following Table 7.1 and Table 7.2:

Table 7.1: Age of acquisition for singleton consonants in English, Mandarin and Malay

Consonant Age group	English (n=23)	Mandarin (n=22)	Malay (n=19)
2;06-2;11 (n=16) Acquired	p, b, t, d, k, g f, ð, s, z, ʃ, h tʃ, dʒ m, n, ŋ l w, j	p, t, k, kʰ f, s, ʂ, ɕ, x ts, tʂ, tɕ m, n, ŋ l	p, b, t, d, k, g, ʔ s, h tʃ, dʒ m, n, ŋ l w, j
Not acquired	v, θ, ɹ	pʰ, tʰ, tsʰ, tʂʰ, tɕʰ, ɻ	ɲ, r
3;00-3;05 (n=16) Acquired	p, b, t, d, k, g f, θ, ð, s, z, h tʃ, dʒ m, n, ŋ l w, j, ɹ	p, pʰ, t, tʰ, k, kʰ f, s, ʂ, ɕ, x ts, tsʰ, tʂ, tʂʰ, tɕ, tɕʰ m, n, ŋ l	p, b, t, d, k, g, ʔ s, h tʃ, dʒ m, n, ŋ l w, j
Not acquired	v, ʃ	ɻ	ɲ, r
3;06-3;11 (n=16) Acquired	p, b, t, d, k, g f, v, θ, ð, s, z, ʃ, h tʃ, dʒ m, n, ŋ l w, j, ɹ	p, pʰ, t, tʰ, k, kʰ f, s, ʂ, ɕ, x ts, tsʰ, tʂ, tʂʰ, tɕ, tɕʰ m, n, ŋ l	p, b, t, d, k, g, ʔ s, h tʃ, dʒ m, n, ŋ, ɲ l w, j
Not acquired	Nil.	ɻ	r
4;00-4;05 (n=16) Acquired	p, b, t, d, k, g f, v, θ, ð, s, z, ʃ, h tʃ, dʒ m, n, ŋ l w, j, ɹ	p, pʰ, t, tʰ, k, kʰ f, s, ʂ, ɕ, x ts, tsʰ, tʂ, tʂʰ, tɕ, tɕʰ m, n, ŋ l ɻ	p, b, t, d, k, g, ʔ s, h tʃ, dʒ m, n, ŋ, ɲ l w, j r
Not acquired	Nil.	Nil.	Nil.

Table 7.2: Age of acquisition for consonant clusters in English

CC-cluster / Age group	English (n=19)
2;06-2;11 (n=16) Acquired	Nil.
Not acquired	pl, bl, kl, gl, fl, bɹ, tɹ, dɹ, kɹ, gɹ, fɹ, sp, st, sk, sm, sn, sl, s ndʒ
3;00-3;05 (n=16) Acquired	Nil.
Not acquired	pl, bl, kl, gl, fl, bɹ, tɹ, dɹ, kɹ, gɹ, fɹ, sp, st, sk, sm, sn, sl, sw ndʒ
3;06-3;11 (n=16) Acquired	pl, bl, kl, gl, sp, sw
Not acquired	fl, bɹ, tɹ, dɹ, kɹ, gɹ, fɹ, st, sk, sm, sn, sl, ndʒ
4;00-4;05 (n=16) Acquired	pl, bl, kl, gl, fɹ, st, sk
Not acquired	fl, bɹ, tɹ, dɹ, kɹ, gɹ, sp, sm, sn, sl, sw, ndʒ

Based on the local Manglish, Maldarin and ChinMalay pronunciation standards, Table 7.1 reflects a generally early completion of the singleton consonantal inventory in the three languages by the multilingual children. About 87% of the English, 73% of the Mandarin, and 90% of the Malay consonantal inventories were completed by 2;06-2;11. Table 7.2 shows that the consonant clusters in English were generally acquired later than the singleton consonants in English. None of the 19 CC-clusters tested was acquired before 3;06-3;11.

Virtually all consonantal variants observed in the adults (see Appendix 4, Chapter 3 & Chapter 5) were also evident in the children's speech data. This was the case for vowels, syllable structures, and Mandarin tones as well (see further discussion in section 7.32, 7.33 & 7.34). Only the consonantal variants used by the children are illustrated below:

1. In English, as mentioned above, /θ/ was frequently replaced by [t] in word initial position, and by [f] in word final position. /θ/ was not tested in word medial position. Only one child from the 3;00-3;05 age group, one child from the 3;06-3;11 age group, and one child from the 4;00-4;05 age group pronounced /θ/ using the standard form in word initial position. Only one child from the 3;06-3;11 age group pronounced /ð/ using the standard form in word initial position, and one child from the 4;00-4;05 age group pronounced /ð/ using the standard form in word medial position. /ð/ was not tested in word final position. /v/ was sometimes replaced by [ʋ] in word initial and word medial positions, and by [f] in word final position. Fricative /z/ was frequentlyly replaced by [s] in word final position. /ɹ/ was occasionally replaced by [ɾ, r]. Plosives /p, b, t, d, k, g/ were frequently unreleased with the preceding vowels glottalised in word final position. In addition, voiced plosives /b, d, g/ were sometimes devoiced as [p, t, k] in word final position. Voiceless plosives and affricates /p, t, k, tʃ/ were often unaspirated in word initial and word medial positions. Lateral approximant /l/ was frequently omitted in word final position. Final consonant cluster /ndʒ/ was always replaced by [ntʃ].

2. In Mandarin, /ɻ/ was sometimes pronounced as [ɹ, dz]. The retroflex fricative and affricates /ʂ, tʂ, tʂʰ/ were frequently replaced by the alveolar fricative and affricates [s, ts, tsʰ]. The palatal fricative and affricates /ɕ, tɕ, tɕʰ/ were also frequently pronounced as alveolar fricative and affricates [s, ts, tsʰ].

3. In Malay, /r/ was sometimes pronounced as [ɹ, ɾ]. The bilabial plosive /p/ was sometimes aspirated in word initial position in loan words from English i.e. PENSEL (pencil). The lateral approximant /l/ and the glottal fricative /h/ were frequently omitted in word final position.

Most of these variants would have been scored as "incorrect" phonological productions had adult input models not been considered. One example of variant in each language is used to illustrate this issue below:

1. Final post-vocalic devoicing in English such as /d/→[t] is traditionally considered as a developmental pattern in monolingual English-speaking children (c.f. Table 2.3 in Chapter 2).

2. Fronting of fricative /ʂ/→[s] is traditionally considered as a developmental pattern in Putonghua-speaking children (c.f. Table 2.10 in Chapter 2).

3. Deletion of final lateral /l/ is traditionally considered as a developmental pattern in native Malay-speaking children (Badrulzaman, Lim & Sandra, 1999).

However all of the above (1)-(3) variants were scored as "correct" phonological productions in the present study, as they are consonantal variants which exist in the adult phonological input model that the children are exposed to in their immediate linguistic environment, and thus not part of the nature of the children's developmental patterns (c.f. Dodd, So & Li, 1996; Holm & Dodd, 1999b; 2006; So & Leung, 2006)(see Chapter 2).

The above sociolinguistic variants have demonstrated how a variety of standard and non-standard phonological forms were used by different children or by the same children, interchangeably and inconsistently, just like the adults, resulting in a wider phonetic repertoire (allophonic variation) for many of the target ambient consonants. For example, the initial fricative /θ/→[f] as well as the initial and medial fricatives /ð/→[d] are prominent features of Manglish, and were used by many children. However, generally five older children pronounced /θ/ and /ð/ in the standard form. The standard forms of virtually all the above variants were also used by the children (see standard realisational forms of these consonants which are indicated in the scoring forms in Appendix 5, plus their frequency of occurrences summarised in the "summary of phonology test" in Appendix 6). For example, of the two examples of final plosive /k/ tested in the English main test, one was released (SNAKE) but the other was not released (CLOCK) by one child; in the consistency of intra-word production sub-test however, the final plosive /k/ was released (CLOCK) by the same child. Likewise, in Mandarin and Malay, the standard and/or non-standard phonological forms were used interchangeably and inconsistently by the children. For example, of the two examples of initial /ɻ/ tested in the Mandarin main test, one was replaced by a [ɹ] variant (RE4), and the other was replaced by a [dz] variant (ROU4) by one child; in the consistency of intra-word production sub-test however, /ɻ/ was replaced by [ɹ] variant in both words by the same child. In Malay, of the two examples of initial /r/ tested in the main test, one was replaced by a [ɹ] variant (RUMAH), the other was replaced by a [ɾ] variant (ROTI) by one child; in the consistency of intra-word production sub-test however, both the non-standard form [l] (LORI) and the standard form [r] (RUMAH) were used by the same child.

This illustration indicates how important it is to look at the local varieties of languages in the studies of bilingual or multilingual children growing up in a bilingual or multilingual learning context, where the adult languages are themselves subject to cross-linguistic influences, giving birth to new language varieties that are different from the original version of the ambient languages. Without this input consideration, misinterpretation of variants as developmental patterns in children is likely to happen (see Chapter 2).

Further, the results of the statistical analysis on age effects in phonological development confirmed that overall there was a general age-improvement in the production accuracy of singleton consonants in the three languages as well as consonant cluster in English (see Chapter 6). Post-hoc analysis however revealed that the acquisition of some singleton consonants in the three languages was actually not improved with age, as they had already been acquired by 2;06-2;11 (see Chapter 6), namely:

1. The Malay plosives.
2. The nasals of all three languages.
3. The lateral approximants of all three languages.
4. The affricates of all three languages.
5. The fricatives of Mandarin and Malay.

In terms of production accuracy, when the three languages were combined, the multilingual children scored the highest overall mean percent correct on the plosive sound class (93.47), followed by nasal (93.15), lateral approximant (89.84), affricate (86.92), fricative (85.29) and approximant and trill (77.40)(see Table 6.3 in Chapter 6).

One might argue that the early acquisition of some of the above consonants can be attributed to the acceptable sociolinguistic variants which happen to correspond with developmental simplification patterns found in the original version of the ambient languages: fricatives of Mandarin and Malay, as well as the lateral approximants of the three languages (e.g. see "list of variants" evident in the present speech data reported earlier in this section). Despite these variants, there is still evidence of an advanced acquisition of consonants in the three languages compared to the monolingual and bilingual children in the previous studies. Detailed cross-linguistic retrospective comparison of the present findings to those of previous studies is given below:

English

Singleton consonants

In English, three singleton consonants were acquired earlier by the multilingual children in the present study than by monolingual children in previous studies, but none was acquired later. These three earlier acquired singleton consonants were: /ʃ, tʃ, dʒ/, all acquired at 2;06-2;11. The earliest ages reported for these in monolingual studies are for example: 3;00 for /ʃ/ (Prather, Hedrick & Kern, 1975), 3;00 for /tʃ/ (Prather et al., 1975), and 4;00 for /dʒ/ (Prather et al., 1975; Dodd, Holm, Zhu & Crosbie, 2003). The apparently early acquisition of two other earlier consonants in the present study namely: /θ/ by 3;00-3;05 and /ð/ by 2;06-2;11 can be disregarded as the local variant forms: /θ/→[t], /ð/→[d] were scored as correct productions.

The most relevant comparison for English consonant acquisition by bilingual children is provided by Holm & Dodd's (2006) cross-sectional study. However, in that study, only details of phonetic acquisition in English by three representative bilingual Cantonese-English children were given (see Chapter 2). According to that study, by 2;06, only eleven singleton consonants of English had been acquired: [b, m, n, ŋ, h, j, l, w, f, t˭, k˭], and by 3;08, four consonants were still not acquired: [ʒ, ð, v, z]. All consonants were finally acquired by 4;10. The rate of singleton consonant acquisition in these bilingual Cantonese-English children thus was apparently slower than the multilingual children in the present study.

The discussion so far suggests that by and large, the multilingual children's rate of singleton consonant acquisition in English was parallel with that of native monolingual children; and was faster than that of bilingual children from a minority immigrant group. The acquisition of two additional languages namely, Mandarin and Malay upon English, seem to have accelerated the early acquisition of a small number of English singleton consonants compared to that of monolingual English-speaking children. In addition, the amount of input exposure and language dominance factors seem to have also resulted in a much more advance phonological acquisition in English by the multilingual children in the present study than that of the bilingual children from a minority immigrant group who had less exposure to English, described by Holm & Dodd (2006).

Consonant clusters

In the present study consonant clusters in English were generally acquired later than the singleton consonants. None of the children from the two youngest age groups had acquired any of the nineteen consonant clusters tested. Six consonant clusters, five containing a plosive (/pl, bl, kl, gl, sp, sw/), had been acquired by 3;06-3;11. Three more consonant clusters containing a fricative (/fɹ, st, sk/) were developed by 4;00-4;06, although a regression of /sp, sw/ occurred at this age. This developmental sequence of the consonant clusters containing stops being acquired before consonant clusters containing fricatives is consistent with the findings of Templin (1957) and Smit, Hand, Freilinger, Bernthal & Bird (1990), the two most relevant cross-sectional studies for comparison of consonant cluster acquisition by monolingual children (see Chapter 2). However, the order of acquisition found in the latter two studies and in the present study is not consistent with the findings of McLeod, Doorn & Reed (2001), a third study reviewed in Chapter 2, which took the form of a longitudinal study of sixteen two-year-old children. McLeod et al. (2001) reported that consonant clusters containing fricatives were acquired earlier than those containing stops. As discussed in Chapter 2, the differences of findings on the order of acquisition for consonant clusters which exist between McLeod et al.'s (2001) longitudinal study and Templin (1957), Smit et al. (1990) (as well as the present cross-sectional study) can be attributed to the methodological differences involved such as: speech sampling procedure, age range studied and mastery criteria. There are no details of consonant cluster acquisition in the studies of bilingual Cantonese-English children conducted by Dodd et al. (1996) and Holm & Dodd (1999b, 2006). The discussion of order of consonant cluster acquisition so far indicates that comparing to the two relevant past cross-sectional studies with comparable age range and methodology, the development of consonant clusters in the multilingual children in the present study is parallel with the monolingual children.

Mandarin

In Mandarin, the multilingual children in the present study acquired seven singleton consonants earlier and one later than the monolingual children described by Zhu & Dodd (2000) (see Chapter 2). The seven earlier acquired singleton consonants were: /k, kʰ, pʰ, l, s, ts, tsʰ/. Amongst these, three were acquired half a year in advance of the monolingual children: /k, kʰ/ (2;06-2;11 vs. 3;01-3;06), /pʰ/ (3;00-3;05 vs. 3;07-4;00). Three were acquired one and a half years in advance: /l, s/ (2;06-2;11 vs. 4;01-4;06) and /tsʰ/ (3;00-3;05 vs. >4;06). One was acquired two years in advance: /ts/ (2;06-2;11 vs. >4;06). The late acquired /tʰ/ lagged half a year behind the monolingual children: (2;07-3;00 vs. 3;00-3;05). The apparently early acquisition of the retroflex series /ʂ, tʂ, tʂʰ/ (2;06-3;05) and the alveolo-palatals /tɕ, tɕʰ, ɕ/ (2;06-3;05) in the present study can be disregarded, as the children commonly pronounced these in local variant forms: [s, ts, tsʰ] for the former, and [ts, tsʰ, s] for the latter, which were scored as correct productions.

The bilingual Cantonese-Putonghua children in So & Leung's (2006) study acquired eleven singleton consonants including a final consonant by the age of 2;06-2;11: /p, pʰ, t, tʰ, k, f, m, n, -n, -ŋ, kʰ/. Similar to the multilingual children in the present study, the bilingual children showed a significant improvement in their singleton consonant acquisition by 3;00-3;05 where seven consonants were acquired simultaneously: /ɕ, tɕ, tɕʰ, l, s, ts, tsʰ/ (So & Leung, 2006). Compared with the bilingual children in So & Leung's (2006) study, three singleton consonants were acquired earlier in the present study, while two were acquired later. The three earlier singleton consonants were: /l, s, ts/ (2;06-2;11 vs. 3;00-3;05) whist the two later acquired ones were: /pʰ, tʰ/ (2;06-2;11 vs. 3;00-3;05).

Comparing the multilingual children in the present study to the monolingual Putonghua children in Zhu & Dodd's (2000) study and the bilingual Cantonese-Putonghua children in So & Leung' s (2006) study, the main differences are:

1. On /ts, tsʰ, s, l/, the multilingual children were much more advanced than the monolingual children, and except for /tsʰ/, slightly more advanced than the bilingual children.

2. The multilingual children were slightly more advanced than the monolingual children on /k, kʰ, pʰ/.

3. The multilingual children slightly lagged behind both the monolingual and bilingual children on /tʰ, pʰ/.

Overall the multilingual children's singleton consonant acquisition in Mandarin was slightly more advanced than both the monolingual and bilingual children in past studies.

Malay

All Malay singleton consonants were acquired by 2;06-2;11 except for /ɲ, r/. The post-alveolar nasal /ɲ/ was acquired by 3;06-3;11 and the alveolar trill /r/ was only acquired by 4;00-4;06. Unfortunately there is a lack of substantial research on monolingual Malay phonological acquisition with which to compare the present results. A conservative conclusion drawn from the compilation of findings on local Malay phonological acquisition based on several small scale studies (Kartini, 1991; Nor Azizah, 1999; Badrulzaman et al., 1999; Norhaizan, 2005) is that all singleton consonants are acquired by 2;00-2;11 except for, /h, l/ by 3;00-3;11, and /s, r/ only by 4;00 and above (see Table 4.1 in Chapter 4). Some studies, for example Badrulzaman et al. (1999), however have reported a slight earlier acquisition of /h, l/ i.e. by 2;00-2;11. As the scoring criteria used in these studies were not clear, it is hard to determine precise ages for acquisition of some of the singleton consonants. With this reservation, compared to monolingual native Malay-speaking children, the multilingual children in the present study were much more advanced in the acquisition of /s/ (2;06 vs. 4;00) but much further behind on /ɲ/ (2;00 vs. 3;06).

Conclusion

Despite the differences that exist in the methodology used by the present study and the previous studies of monolingual and bilingual children, there is evidence supporting a faster rate of consonantal acquisition by the present multilingual children compared to the monolingual children and bilingual children in previous studies.

7.3.1.2 Error patterns of consonants

In this section, the consonant error patterns in the three languages will be discussed. All consonant (singletons and clusters) simplifications used by a minimum of 2 out of 16 children in each language are presented in Table 7.3-Table 7.5.

Table 7.3: Number of children using simplifications affecting consonant production in English

Simplification \ Age group	2;06-2;11 (n=16)	3;00-3;05 (n=16)	3;06-3;11 (n=16)	4;00-4;05 (n=16)	Whole group (n=64)
1. Deletion	15	14	14	13	56
2. Initial cluster reduction	16	14	9	8	47
3. Gliding	13	13	11	8	45
4. Affrication	12	11	6	7	36
5. Final cluster reduction	10	9	5	6	30
6.ɹ/→[l] substitution	13	6	5	4	28
7. Deaffrication	9	6	8	5	28
8. Backing	10	8	6	3	27
9. Stopping	10	6	6	0	22
10. Consonant harmony	7	7	7	1	22
11. Fronting	5	6	5	3	19
12. Voicing	8	4	2	0	14
13. Frication	5	4	2	0	11
14. Initial syllable deletion	0	4	2	0	6
15. Metathesis	0	2	2	0	4
16. Reduplication	0	4	0	0	4
17. Final glottal replacement	2	0	0	0	2

n=16: sixteen children per age group.

Table 7.4: Number of children using simplifications affecting consonant production in Mandarin

Simplification \ Age group	2;06-2;11 (n=16)	3;00-3;05 (n=16)	3;06-3;11 (n=16)	4;00-4;05 (n=16)	Whole group (n=64)
1. Deaspiration	12	6	6	8	32
2. /ɹ/→[l] substitution	11	8	8	3	30
3. Deletion	8	3	3	2	16
4. Stopping	6	0	2	3	11
5. Affrication	2	5	0	0	7
6. Deaffrication	3	3	0	0	6
7.Consonant harmony	5	0	0	0	5
8. Backing	4	0	0	2	4
9. Gliding	2	0	0	0	2

n=16: sixteen children per age group.

Table 7.5: Number of children using simplifications affecting consonant production in Malay

Simplification \ Age group	2;06-2;11 (n=16)	3;00-3;05 (n=16)	3;06-3;11 (n=16)	4;00-4;05 (n=16)	Whole group (n=64)
1./r/→[l] substitution	13	6	7	0	26
2.Consonant harmony	7	7	7	1	22
3. Backing	7	7	7	0	21
4. Fronting	5	4	3	2	14
5. Deletion	8	2	0	0	10
6. Gliding	5	3	0	0	8
7. Stopping	6	0	0	0	6
8. Metathesis	0	3	0	3	6
9. Affrication	0	2	0	0	2
10. Final plosive release	2	0	0	0	2

n=16: sixteen children per age group.

Table 7.3-Table7.5 show that there was a general decrease with age in the simplifications used in the three languages. Based on Table 7.3-Table 7.5. Table 7.6 summarises simplifications used in one, two, or all three languages:

Table 7.6: Simplifications used in one, two, or all three languages

English (n=64)	Mandarin (n=64)	Malay (n=64)
1. /ɹ/→[l] substitution	1. /ɻ/→[l] substitution	1. /r/→[l] substitution
2. Deletion	2. Deletion	2. Deletion
3. Gliding	3. Gliding	3. Gliding
4. Backing	4. Backing	4. Backing
5. Affrication	5. Affrication	5. Affrication
6. Stopping	6. Stopping	6. Stopping
7. Consonant harmony	7. Consonant harmony	7. Consonant harmony
8. Deaffrication	8. Deaffrication	-
9. Fronting	-	8. Fronting
10. Metathesis	-	9. Metathesis
11. Cluster reduction (initial & medial)	9. Deaspiration	10. Final plosive release
12. Voicing		
13. Frication		
14. Initial syllable deletion		
15. Reduplication		
16. Final glottal replacement		

n=64: sixty four children in total.

Table 7.6 shows that overall sixteen simplifications were used in English, nine in Mandarin, and ten in Malay. Of these, seven were shared by the three languages, three were shared by two of the three languages namely: English & Malay or English & Mandarin. There were no simplifications shared only by Mandarin and Malay. These error patterns suggest that both common tendencies and ambient language characteristics are guiding the developmental pathway. Table 7.7 summarises common simplifications used in either two or all of the three languages by age.

Table 7.7: Simplifications shared by more than one language, by age

Simp \ Age grp	2;06-2;11 (n=16)	3;00-3;05 (n=16)	3;06-3;11 (n=16)	4;00-4;05 (n=16)
1. ɹ/ɻ/r→l				
English				
Mandarin				
Malay				
2. Deletion				
English				
Mandarin				
Malay				
3. Backing				
English				
Mandarin				
Malay				
4. Gliding				
English				
Mandarin				
Malay				
5. Cons. harmony				
English				
Mandarin				
Malay				
6. Fronting				
English				
Mandarin				
Malay				
7. Stopping				
English				
Mandarin				
Malay				
8. Affrication				
English				
Mandarin				
Malay				
9. Deaffrication				
English				
Mandarin				
Malay				
10. Metathesis				
English				
Mandarin				
Malay				

indicates that 12.5% and above of the children of an age group used an error pattern.

Table 7.8 summarises simplifications used in one language only, by age

Table 7.8: Simplifications used in one language only, by age

Age group / Language	2;06-2;11 (n=16)	3;00-3;05 (n=16)	3;06-3;11 (n=16)	4;00-4;05 (n=16)
ENGLISH				
1. Cluster reduction (initial & medial)				
2. Frication				
3. Voicing				
4. Initial syllable deletion				
5. Reduplication				
6. Final glottal replacement				
MANDARIN				
1. Deaspiration				
MALAY				
1. Final plosive release				

indicates that 12.5% and above of the children of an age group used an error pattern.

Detailed analysis of each of the above consonant simplifications will be given after the discussion on "identification and classification of error patterns" in section 7.3.1.3 below.

7.3.1.3 Identification and classification of error patterns

The analysis of error patterns (simplifications), the basic concept of Natural Phonology theory (Stampe, 1969, 1979), was used in the present study as it was simple and economical in describing the mismatched patterns found between children's pronunciations and adult pronunciation (Yavas, 1998). For example, compared to feature analysis, which identifies the characteristic features of individual sounds, error patterns identify sound classes. The error patterns identified can then be targeted for a specific sound class, rather than one sound at a time, in remediation. For example, in the case of final consonant deletion, all target final consonants in general, rather than just a few sounds specifically, can be targeted in remediation (Kenneth & Shipley, 1998). Many contemporary clinical assessment procedures such as the British phonological test- Diagnostic Evaluation of Articulation and Phonology (DEAP)(Dodd, Zhu, Crosbie, Holm & Ozanne, 2002) are still utilising the error pattern analysis (see Chapter 2).

Clearly, more than one process may apply to the child's realisation of a specific word. In the present study, when two simplifications co-occurred e.g. backing and cluster reduction in English (e.g. STAR→[ka])(see Tables 7.15 & 7.29), backing and deaspiration in Mandarin (e.g. TOU2→[k⁼ou2])(see Tables 7.15 & 7.31), backing and stopping in Malay (e.g. ROTI→[dɔki])(see Tables 7.15 & 7.19), both simplifications were included in the error analysis. This approach was useful as it enabled differentiation between a structural simplification and a systemic simplification, as with the example in English above; and the consequences when both co-occurred, plus the phonological consequences when two systemic simplifications co-occurred, as with the examples of Mandarin and Malay above (Grunwell, 1997; Yavas, 1998).

In order to facilitate comparison across the three languages, in this section, only the number of children making "singleton consonant" errors was tabulated under relevant sound classes. The number of children making simplifications involving consonant clusters (e.g. liquid gliding /ɹ/→[w] as in consonant cluster simplification affecting approximant /ɹ/ i.e. /bɹ/→[bw]) will be reported under "simplification used in one language only" in section 7.3.1.5.3.

7.3.1.4 Simplifications shared by all three languages

In this section, the seven simplifications shared by the three languages namely: /ɹ/ɻ/r/→[l] substitution, deletion, gliding, backing, affrication, consonant harmony and stopping will be described in detail.

1. <u>/ɹ/ɻ/r/→[l] substitution</u>

/ɹ/ɻ/r/→[l] substitution was a frequent simplification shared by the three languages. Examples of /ɹ/ɻ/r/→[l] substitution are given in Table 7.9. The number of children using /ɹ/ɻ/r/→[l] substitution is given in Table 7.10.

Table 7.9: Examples of /ɹ/ɻ/r/→[l] substitution in English, Mandarin and Malay

Manner of articulation	Items tested	Word initial position	Word medial position
ENGLISH			
Approximant	8	ɹ→l ɹed˺→led˺ gɹin→glin	ɹ→l ɔɹentʃ→ɔlentʃ
MANDARIN			
Approximant	2	ɻ→l ɻɤ4→lɤ4	ɻ→l tɕilɻou4→tɕillou4
MALAY			
Trill/approximant	3	r→l roti→loti ruma→luma	

Table 7.10: Number of children using /ɹ/ɻ/r/→[l] substitution in different word positions in English, Mandarin and Malay

/ɹ/ɻ/r→[l]	Word initial				Word medial				Initial, medial or both positions[1]				Tot
Substitution	2;6	3;0	3;6	4;0	2;6	3;0	3;6	4;0	2;6	3;0	3;6	4;0	
ENGLISH Approximant	7	5	5	3	12	2	3	2	13	6	5	4	28
MANDARIN Approximant	8	5	7	3	8	6	5	0	11	8	8	3	30
MALAY Trill/app[9]	13	6	7	0	0	0	0	0	13	6	7	0	26

Tot: total number of all children using simplification in all word positions.

[1]*The number of children may* *not* *tally with the total of those involved with the word initial and word medial positions as some children used the simplification in more than one word position.*

Number of children per age group: 16.

2. Deletion

Deletion was a frequent simplification shared by the three languages. Deletion occurred in all manner of articulation classes except for affricates, approximants and the trill. Types of deletion in the different word positions are illustrated in Table 7.11. The target segments that the child deleted are underlined. The number of children using deletion in different word positions is displayed in Table 7.12.

Table 7.11: Examples of deletion in English, Mandarin and Malay

Manner of articulation	Items tested	Word initial position	Word medial position	Word final position
ENGLISH				
Plosive	27			p→ø, b→ø, t→ø, d→ø, g→ø kɑp, web, plet, ɹed, dɔg
Fricative	29		v→ø dɹaiviŋ	[2]v(f)→ø, θ(f)→ø, s→ø, z(s)→ø, ʃ→ø, faif, mauf, ʃus, sizəs, fiʃ
Nasal	23		n→ø pensə	n→ø tʃikən
MANDARIN				
Fricative	12	x→ø xua4xua4	x→ø xua4xua4 ny3xae2tsi3	_[1]
Nasal	14		ŋ→ø kʰoŋlia2	ŋ→ø iaŋ2
Lateral	4	l→ø liʊ4	l→ø tsʰoŋlliaŋ2	_[1]
MALAY				
Fricative	7	h→ø hudʒan		
Nasal	19		n→ø pensə	n→ø, ŋ→ø ikan kutʃeŋ

[1]*Non-legal word position.*

[2] *Consonant in bracket: consonant based on Manglish pronunciation.*

Table 7.12: Number of children using deletion in different word positions in English, Mandarin and Malay

	Word initial				Word medial				Word final				Initial, medial, final or two or all three positions[1]				T.
el.	2;6	3;0	3;6	4;0	2;6	3;0	3;6	4;0	2;6	3;0	3;6	4;0	2;6	3;0	3;6	4;0	
NG																	
los.	0	0	0	0	0	0	0	0	2	2	2	0	2	2	2	0	6
ric.	0	0	0	0	0	0	0	3	14	14	14	13	14	14	14	13	55
as.	0	0	0	0	2	0	1	0	3	0	2	0	4	0	2	0	6
AN																	
ric.	2	0	0	0	4	0	0	0	0	0	0	0	4	0	0	0	4
as.	0	0	0	0	3	0	0	0	1	0	0	0	4	0	0	0	4
at.	4	1	1	1	7	2	3	2	0	0	0	0	7	3	3	2	15
																O. total	16
AL																	
ric.	5	2	0	0	0	0	0	0	0	0	0	0	5	2	0	0	7
as.	0	0	0	0	3	0	0	0	3	0	0	0	4	0	0	0	4
																O. total	10

Del.: deletion.

ENG: English. MAN: Mandarin. MAL: Malay.

Plos.: plosive. Fric.: fricative. Nas.: nasal. Lat.: lateral approximant.

T.: total number of all children using simplification in all word positions.

O. total: overall total.

[1]*The number of children may not tally with the total of those involved with the word initial, word medial and word final positions as some children used the simplification in more than one word position.*

Number of children per age group: 16.

3. Gliding

Gliding was a frequent simplification shared by the three languages. It is defined as the replacement of liquids /l, ɹ/ɻ/r/ by glides [j, w] in the present study. Examples of gliding are given in Table 7.13. The number of children using gliding in different word positions is displayed in Table 7.14.

Table 7.13: Examples of gliding in English, Mandarin and Malay

Manner of articulation	Items tested	Word initial position	Word medial position
ENGLISH			
Plosive	27		b→w tebə→tewə
Fricative	29	v→w vɛn→wɛn	v→w dɹaiviŋ→dɹaiwiŋ
Lateral approximant	7	l→j lif→jif	
Approximant	8	ɹ→w ɹed˺→wed˺ tɹi→twi	ɹ→w ɔɹentʃ→ɔwentʃ
MANDARIN			
Approximant	2	ɻ→j ɻɤ4→jɤ4	
MALAY			
Lateral approximant	4	l→w lɔri→wɔɹi	
Trill/ approximant	3		r→j lɔri→lɔji

Table 7.14: Number of children using gliding in different word positions in English, Mandarin and Malay

	Word initial				Word medial				Initial, medial or both positions[1]				T
Gliding	2;6	3;0	3;6	4;0	2;6	3;0	3;6	4;0	2;6	3;0	3;6	4;0	
ENGLISH													
Plosive	0	0	0	0	2	0	0	0	2	0	0	0	2
Fricative	9	7	8	7	5	5	0	0	10	11	8	7	36
Lateral app	0	1	0	0	0	1	0	0	0	2	0	0	2
Approx.	3	0	4	0	0	2	1	0	3	2	5	3	13
									Overall total				45
MAND.													
Approx.	2	0	0	0	0	0	0	0	2	0	0	0	2
									Overall total				2
MALAY													
Lateral app	0	3	0	0	0	0	0	0	0	3	0	0	3
Trill/app	0	0	0	0	3	0	0	0	5	0	0	0	5
									Overall total				8

T: total number of all children using simplification in all word positions.

[1]The number of children may not tally with the total of those involved with the word initial and word medial positions as some children used the simplification in more than one word position.

Number of children per age group: 16.

4. Backing

Backing was a frequent simplification shared by the three languages. In the present study, backing is defined as the replacement of alveolars by post-alveolars or velars and, bilabial or labiodentals by alveolars. Examples of backing are given in Table 7.15. The number of children using backing in different word positions is displayed in Table 7.16.

Table 7.15: Examples of backing in English, Mandarin and Malay

Manner of articulation	Items tested	Word initial position	Word medial position	Word final position
ENGLISH				
Plosive	27	t→k stɑ→kɑ	t→k tebə→kebə	t˺→k˺, d˺→g˺ b˺→t˺ plet˺→plek˺ ɹed˺→ɹeg˺ web˺→wet˺
Fricative	29			s→ʃ, f→s hɔs→hɔʃ mauf→maus
Nasal	23		m→n pədʒɑməs→ pədʒɑnə	m→n, n→ŋ dʒɛm→dʒɛn tʃikən→tʃikəŋ
MANDARIN				
Plosive	13	t→k, tʰ→k⁼ ta̠4→ka̠4 tʰoʊ2→k⁼oʊ2	t→k ti4ti0→ki4ki0	_[1]
Nasal	14			n→ŋ tɕʰiɛn2→tɕʰiɛŋ2
MALAY				
Plosive	19	d→g daun→gaun	t→k rɔti→dɔki	
Nasal	19			m→n, n→ŋ dʒɛm→dʒɛn daun→dauŋ

[1]*Non-legal word position.*

Table 7.16: Number of children using backing in different word positions in English, Mandarin and Malay

	Word initial position				Word medial position				Word final position				Initial, medial, final or two or all three positions[1]				T.
Backing	2;6	3;0	3;6	4;0	2;6	3;0	3;6	4;0	2;6	3;0	3;6	4;0	2;6	3;0	3;6	4;0	
ENG.																	
Plos.	0	1	0	0	0	0	0	0	3	2	2	2	3	3	2	2	10
Fric.	0	0	0	0	0	0	0	0	9	3	2	0	9	8	5	0	22
Nas.	0	0	0	0	1	0	0	0	4	2	2	1	4	2	2	1	9
													Overall total				27
MAND.																	
Plos.	4	0	0	0	1	0	0	0	0	0	0	0	4	0	0	0	4
Nas.	0	0	0	0	0	0	0	0	2	0	0	2	2	0	0	2	4
													Overall total				4
MAL.																	
Plos.	4	3	0	0	3	0	0	0	0	0	0	0	4	3	0	0	7
Nas.	0	0	0	0	0	0	0	0	7	7	7	0	7	7	7	0	21
													Overall total				21

ENG.: English. MAND.: Mandarin. MAL.: Malay.

Plos.: plosive. Fric.: fricative. Nas.: nasal.

T.: total number of all children using simplification in all word positions.

[1]The number of children may not tally with the total of those involved with the word initial, word medial and word final positions as some children used the simplification in more than one word position.

Number of children per age group: 16.

5. Affrication

Affrication was a frequent simplification shared by the three languages. Affrication is defined as the replacement of fricatives by affricates in the present study. Examples of affrication in the three languages are given in Table 7.17. The number of children using affrication in different word positions is displayed in Table 7.18.

Table 7.17: Examples of affrication in English, Mandarin and Malay

Manner of articulation	Items tested	Word initial position	Word medial position
ENGLISH			
Fricative	29	s→tʃ, ʃ→tʃ, z→dʒ siŋiŋ→tʃiŋiŋ ʃu→tʃu zu→dʒu	ʃ→tʃ, z→dʒ wɑʃiŋ→wɑtʃiŋ sizəs→sidʒəs
MANDARIN			
Fricative	12	s→ts, ʂ→ts san1→tsan1 ʂuɪ4tɕiɑo4→ tsuɪ4tɕiɑo4	ʂ→ts pʰae1ʂou3→ pʰae1tsou3
MALAY			
Fricative	7	s→tʃ susu→tʃutʃu	s→tʃ susu→tʃutʃu pensə→pentʃə

Table 7.18: Number of children using affrication in different word positions in English, Mandarin and Malay

	Word initial				Word medial				Initial, medial or both positions[1]				T
Affrication	2;6	3;0	3;6	4;0	2;6	3;0	3;6	4;0	2;6	3;0	3;6	4;0	
ENGLISH Fricative	11	10	6	5	6	7	3	4	12	11	6	7	36
MAND. Fricative	2	4	0	0	1	4	0	0	2	5	0	0	7
MALAY Fricative	0	2	0	0	0	2	0	0	0	2	0	0	2

T: total number of all children using simplification in all word positions.

[1]The number of children may <u>not</u> tally with the total of those involved with the word initial and word medial positions as some children used the simplification in more than one word position.

Number of children per age group: 16.

6. Stopping

Stopping was a frequent simplification shared by the three languages. Stopping is defined as the replacement of fricatives, affricates or liquids by stops in the present study. The examples of stopping, and the number of children using stopping in different word positions, are given in Table 7.19 & 7.20:

Table 7.19: Examples of stopping in English, Mandarin and Malay

Manner of artic.	Items tested	Word initial position	Word medial position	Word final position
ENG				
Fric.	29	f→p faif→pai fiʃ→pis	f→p, ð→g, s→t lafiŋ→lapiŋ maðə→magə pensə→pentə	f→p˺, s→t˺, s→t lif→lip˺ hɔs→hɔt˺ hɔs→hɔt
Affric.	4			tʃ→t watʃ→wat
MAND				
Affric.	17	tʂ→t, tsʰ→t˭ tɕ→k tʂan4→tan4 tsʰao3→ t˭ao3 tɕilɻoʊ4→ kilɻoʊ4	ts→t, ts→k, tɕ→t ɕiɛ2tsi̪3→ɕiɛ2ti̪3 ɕiɛ2tsi̪3→ɕiɛ2ki̪3 ʂui4tɕiao4→ ʂui4tiao4	–[1]
MAL.				
Affric.	5	tʃ→t tʃawan→ tawan	tʃ→t kutʃeŋ→kuteŋ	–[1]
Lat. appr.	4	l→d lori→doli	l→d mulut→mudut	
Appr.	5	r→d rɔti→dɔki		–[1]

Manner of artic.: manner of articulation.

ENG: English. MAND: Mandarin. MAL.: Malay.

Fric.: fricative. Affric.: affricate. Lat. appr.: lateral approximant. Appr.: approximant.

[1]*Non-legal word position.*

Table 7.20: Number of children using stopping in different word positions in English, Mandarin and Malay

	Word initial position				Word medial position				Word final position				Initial, medial, final or two or all three positions[1]				T.
topping	2;6	3;0	3;6	4;0	2;6	3;0	3;6	4;0	2;6	3;0	3;6	4;0	2;6	3;0	3;6	4;0	
NG.																	
ric.	2	2	0	0	2	3	2	0	7	0	4	0	9	5	6	0	20
ffr.	0	0	0	0	0	0	0	0	3	3	0	0	3	3	0	0	6
													Overall total				22
AND.																	
ffr.	6	0	2	3	3	0	2	1	0	0	0	0	6	0	2	3	11
													Overall total				11
AL.																	
ffr.	1	0	0	0	2	0	0	0	0	0	0	0	2	0	0	0	2
at app.	1	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	2
ril/app.	2	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2
													Overall total				6

ENG.: English. MAND.: Mandarin. MAL.: Malay.

Fric.: fricative.

Affr.: affricate.

Lat app.: lateral approximant.

Tril/app.: trill/approximant.

T.: total number of all children using simplification in all word positions.

[1]*The number of children may not tally with the total of those involved with the word initial, word medial and word final positions as some children used the simplification in more than one word position.*

Number of children per age group: 16.

7. Consonant harmony

Consonant harmony was a frequent simplification shared by the three languages. In the present study, consonant harmony is defined as the assimilation of non-contiguous consonants where one consonant influences another so that the two consonants become more alike in terms of place or manner of articulation. Examples of consonant harmony, and the number of children using consonant harmony in different word positions, are displayed in the following Table 7.21 & 7.22.

Table 7.21: Examples of consonant harmony in English, Mandarin and Malay

Manner of artic.	Items tested	Word initial position	Word medial position	Word final position
ENG				
Plos.	27	t→k taigə→kaigə	t→k itiŋ→ikiŋ	
Fric.	29		v→m dɹaiviŋ→dɹaimiŋ	
Approx	5	j→l jəlo→lelo		
MAN				
Plos.		tʰ→k tʰɑŋ2kuo3→ k̪ɑŋ2kuo3		
Lat. approx.	4	l→n li3miɛn4→ ni3miɛn4		
MAL				
Plos.	19	t→k taŋan→kaŋan	d→g hidoŋ→higoŋ	
Nas.	19		ŋ→n taŋan→tanan	n→ŋ taŋan→taŋaŋ
Lat. approx.	4	l→ɹ loɹi→ɹoɹi		

Table 7.22: Number of children using consonant harmony in different word positions in English, Mandarin and Malay

Assim. seg.	Word initial position				Word medial position				Word final position				Initial, medial or both positions[1]				Tot
	2;6	3;0	3;6	4;0	2;6	3;0	3;6	4;0	2;6	3;0	3;6	4;0	2;6	3;0	3;6	4;0	
ENG																	
Plos	3	0	0	0	2	0	2	0	0	0	2	0	4	0	2	0	4
Fric	0	0	0	0	0	0	2	0	6	0	0	0	7	7	7	1	22
App	3	3	2	3	0	0	0	0	0	0	0	0	3	3	2	3	11
													Overall total				22
MAN																	
Plos	3	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	3
Lat App	0	0	0	0	3	0	0	0	0	0	0	0	3	0	0	0	3
													Overall total				5
MAL																	
Plos	4	3	0	0	2	0	0	0	0	0	0	0	4	3	0	0	7
Nas	0	0	0	0	0	2	2	0	0	2	2	0	7	7	7	1	22
Lat App	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2	0	2
													Overall total				22

ENG: English. MAN: Mandarin. MAL: Malay.

Plos: plosive. Fric: fricative. Nas: nasal. App: approximant. Lat app: lateral approximant.

Tot: total number of all children using simplification in all word positions.

[1]*The number of children may not tally with the total of those involved with the word initial and word medial positions as some children used the simplification in more than one word position.*

Number of children per age group: 16.

7.3.1.5 Simplifications shared by two of the three languages

In this section, the three simplifications shared by two of the three languages i.e. English and Malay or English and Mandarin will be described in detail. Of the three simplifications, one simplification namely: deaffrication was shared by English and Mandarin. The other two simplifications namely: fronting and metathesis were shared by English and Malay.

7.3.1.5.1 Simplifications shared by English and Mandarin

1. Deaffrication

Deaffrication is the only simplification shared by English and Mandarin. In the present study, deaffrication is defined as the replacement of affricates by fricatives. Examples of deaffrication are given in Table 7.23. The number of children using deaffrication is displayed in Table 7.24.

Table 7.23: Examples of deaffrication in English and Mandarin

Manner of articulation	Items tested	Word initial position	Word medial position	Word final position
ENGLISH				
Affricate	4			tʃ→ʃ, tʃ→s wɑtʃ→wɑʃ wɑtʃ→wɑs
MANDARIN				
Affricate	17	ts→s, tsʰ→s tʂ→s, tɕʰ→ɕ, tɕ→ɕ tsuo4→suo4 tsʰae4→sae4 tʂan4→san4 tɕʰiɛn2→ɕiɛn2 tɕilɹou4→ɕilɹou4	tʂʰ→s ia̠2tʂʰi̠3→ ia̠2si̠3	–[1]

[1]Non-legal word position.

Table 7.24: Number of children using deaffrication in different word positions in English and Mandarin

Deaff. seg.	Word initial				Word medial				Word final				Initial, medial, final or two or all three positions[1]				T.
	2;6	3;0	3;6	4;0	2;6	3;0	3;6	4;0	2;6	3;0	3;6	4;0	2;6	3;0	3;6	4;0	
ENG. Affr.	0	0	0	5	0	0	0	0	9	6	8	0	9	6	8	5	28
MAN. Affr.	2	2	0	0	2	2	0	0	0	0	0	0	3	3	0	0	6

Deaff. seg.: deaffricated segment.

ENG.=English. MAN.=Mandarin.

Affr.: affricate.

T.: total number of all children using simplification in all word positions.

[1]*The number of children may not tally with the total of those involved with the word initial, word medial and word final positions as some children used the simplification in more than one word position.*

Number of children per age group: 16.

7.3.1.5.2 Simplifications shared by English and Malay

1. Fronting

Fronting, a simplification shared by English and Malay is defined as the replacement of post-alveolars by alveolars, velars by alveolars or bilabials, dentals by labiodentals in the present study. Examples of fronting in different word positions are given in Table 7.25. The number of children using fronting is displayed in Table 7.26.

Table 7.25: Examples of fronting in English and Malay

Manner of articulation	Items tested	Word initial position	Word medial position	Word final position
ENGLISH				
Plosive	27			k→p˺ klɔk→klɔp˺
Fricative	29	ʃ→s, θ→f ʃus→sus θin→fin	ʃ→s waʃiŋ→wasiŋ	ʃ→s fiʃ→fis
MALAY				
Nasal	19	ɲ→n ɲaɲi→ niani	ɲ→n ɲaɲi→niani ɲaɲi→ɲani	ŋ→n, ŋ→m hidoŋ→hidon hidoŋ→hidom

Table 7.26: Number of children using fronting in different word positions in English and Malay

	Word initial				Word medial				Word final				Initial, medial, final or two or all three positions[1]				T.
Front.	2;6	3;0	3;6	4;0	2;6	3;0	3;6	4;0	2;6	3;0	3;6	4;0	2;6	3;0	3;6	4;0	
ENG.																	
Plos.	0	0	0	0	0	0	0	0	3	0	0	0	3	0	0	0	3
Fric.	3	4	3	3	2	2	3	1	3	3	0	1	5	6	5	3	19
													Overall total				19
MAL.																	
Nas.	5	3	0	2	5	3	0	2	4	2	3	2	5	4	3	2	14

Front.: fronting.

ENG.: English. MAL.: Malay.

Plos.: plosive. Fric.: fricative. Nas.: nasal.

T.: total number of all children using simplification in all word positions.

[1]*The number of children may not tally with the total of those involved with the word initial, word medial and word final positions as some children used the simplification in more than one word position.*

Number of children per age group: 16.

2. Metathesis

Metathesis, a simplification shared by English and Malay is defined as the reversal of two segments in a word in the present study. Examples of metathesis are given in Table 7.27. The number of children using metathesis is displayed in Table 7.28.

Table 7.27: Examples of metathesis in English and Malay

Manner of articulation	Items tested	Word initial position
ENGLISH		
/s/ + cluster	7	spun→puns stɑ→tɑs skai→kais smɔ→mɔs
MALAY		
Lateral approximant	4	loɹi→ɹoli

Table 7.28: Number of children using metathesis in different word positions in English and Malay

Reversed segment	Word initial				Total
ENGLISH	2;6	3;0	3;6	4;0	
/s/ + cluster	0	2	2	0	4
MALAY					
Lateral app	0	3	0	3	6

Number of children per age group: 16.

7.3.1.5.3 Simplifications used in one language only

In this section, the simplifications used in one language only will be described in detail. There were six in English, and one each in Mandarin and Malay.

Simplifications used in English only

Examples of simplifications used in English only are given in Table 7.29. The number of children using English simplifications is given in Table 7.30.

Table 7.29: Examples of simplification used in English only

ENGLISH	Word initial position	Word medial position	Word final position
Initial cluster reduction + Final cluster reduction	Syllable initial Consonant + /-l/ clusters pl→p, bl→b, kl→k, gl→g fl→f, sl→s, sl→l plet→pet, blu→bu, klɔk→kɔʔ, glɑs→gɑs, flawə→fawə slipiŋ→sipiŋ, slipiŋ→lipiŋ Consonant + /-ɹ/ clusters bɹ→b, tɹ→t, dɹ→d, kɹ→k gɹ→g, fɹ→f bɹed→bed tɹi→ti dɹaiviŋ→daiviŋ kɹejɔn→kejɔn gɹin→gin fɹɔg→fɔg /s-/ + nasal clusters sm→m, sn→n smɔ→mɔ, snek→nek	_	Syllable final /n-/ + clusters ntʃ[2]→nʃ, ntʃ→n ntʃ→ʃ ɔɹentʃ→ɔɹenʃ ɔɹentʃ→ɔɹen ɔɹentʃ→ɔleʃ

ENGLISH	Word initial position	Word medial position	Word final position
Initial cluster reduction + Final cluster reduction	<u>Syllable initial</u> /s-/ + stop clusters sp→p, st→t, st→s, st→k sk→k spun→pun stɑ→tɑ stɑ→sɑ stɑ→kɑ skai→kai	_[1]	<u>Syllable final</u>
Voicing	z→s, v→f, g→k zu→su vɛn→fɛn glɑs→kɑs	z→s sizəs→sisə	
Frication			t→s, k→s plet→ples snek→nes
Final glottal replacement			p→ʔ kap→kaʔ
Initial syllable deletion	pə→Ø pədʒaməs→dʒaməs		
Reduplication			smɔ→smɔs

[1] *Non-legal word position.*

[2] *Received Pronunciation (RP) /ndʒ/.*

Table 7.30: Number of children using English simplifications in different word positions

ENGLISH	Word initial position				Word medial position				Word final position				Initial, medial, final or two or al l three positions[1]				T.
	2;6	3;0	3;6	4;0	2;6	3;0	3;6	4;0	2;6	3;0	3;6	4;0	2;6	3;0	3;6	4;0	
Cluster reduction																	
Syllable ini.																	
Reduced cluster																	
/s-/ + plosive (sp, st, sk)	8	8	4	4					8	8	4	4	8	8	4	4	24
/s-/ + nasal (sm, sn)	12	8	6	6					12	8	6	6	12	8	6	6	32
Cons. + /-l/ (pl, bl, kl, gl, fl, sl)	9	11	4	3					9	11	4	3	9	11	4	3	27
Cons. + /-ɹ/ (bɹ, tɹ, dɹ, kɹ, gɹ, fɹ)	11	10	5	4					11	10	5	4	11	10	5	4	30
Total	16	14	9	8									16	14	9	8	47
Syllable final																	
ntʃ[2]→nʃ									3	4	0	0	3	4	0	0	7
ntʃ→n									3	5	5	6	3	5	5	6	19
ntʃ→ʃ									4	0	0	0	4	0	0	0	4
Total									10	9	5	6	10	9	5	6	30
Subs.																	
Voicing	5	2	2	0	6	2	0	0	0	0	0	0	8	4	2	0	14
Frication	0	0	0	0	0	0	0	0	5	4	2	0	5	4	2	0	11
Initial syllable deletion	0	4	2	0	0	0	0	0	0	0	0	0	0	4	2	0	6
Reduplicat.	0	0	0	0	0	3	0	0	0	2	0	0	0	4	0	0	4
Final glottal replacement	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	2

Subs.: substitution. Reduplicat.: reduplication.

T.: total number of all children using simplification in all word positions.

[1]*The number of children may not tally with the total of those involved with the word initial, word medial and word final positions as some children used the simplification in more than one word position.*

[2]*Received Pronunciation (RP) /ndʒ/.*

Number of children per age group: 16.

Simplifications used in Mandarin only

For Mandarin, only one language-specific simplification was found namely: deaspiration (see Table 7.31). The number of children using Mandarin simplifications is given in Table 7.32.

Table 7.31: Examples of simplification used in Mandarin only

MANDARIN	Word initial position
Deaspiration	Affricate ts^h→ts$^=$, tʂ^h→tʂ$^=$, tɕ^h→tɕ$^=$ ts^h→t$^=$, tʂ^h→t$^=$, tɕ^h→t$^=$ ts^{h}ae4→ts$^=$ae4 tʂ^{h}oŋ1l̲iaŋ2→tʂ$^=$oŋ1l̲iaŋ2 tɕ^{h}iɛn2→tɕ$^=$iɛn2 ts^{h}ae4→t$^=$ae4 tʂ^{h}oŋ1l̲iaŋ2→t$^=$oŋ1l̲iaŋ2 tɕ^{h}iɛn2→t$^=$iɛn2 Plosive p^h→p$^=$, t^h→t$^=$, k^h→k$^=$, t^h→k$^=$ p^{h}ae1ʂoʊ3→p$^=$ae1ʂoʊ3 t^{h}oʊ2→t$^=$oʊ2 k^{h}uae4→k$^=$uae4 t^{h}ɑŋ2kuo3→k$^=$ɑŋ2kuo3 t^{h}oʊ2→k$^=$oʊ2

Table 7.32: Number of children using Mandarin simplifications in different word positions

	Word initial				Word medial				Initial, medial or both positions[1]				T.
MANDARIN	2;6	3;0	3;6	4;0	2;6	3;0	3;6	4;0	2;6	3;0	3;6	4;0	
Deaspiration	8	2	3	2	7	6	4	8	12	6	6	8	32

T.:total number of all children using simplification in all word positions.

[1]*The number of children may* not *tally with the total of those involved with the word initial and word medial positions as some children used the simplification in more than one word position.*

Number of children per age group: 16.

Simplifications used in Malay only

Examples of simplifications used in Malay only are given in Table 7.33. The number of children using the Malay simplifications is displayed in Table 7.34.

Table 7.33: Examples of simplification used in Malay only

MALAY	Word final position
Final plosive release	t˺→t mulut˺→mulut

[1]*Non-legal word position.*

Table 7.34: Number of children using Malay simplifications in different word positions

	Word initial				Word medial				Word final				Initial, medial, final or two or all three positions[1]				T.
MAL.	2;6	3;0	3;6	4;0	2;6	3;0	3;6	4;0	2;6	3;0	3;6	4;0	2;6	3;0	3;6	4;0	
Subs.																	
Plos. rel.	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	2

MAL.: Malay.

Subs.: substitution.

Plos. rel.: plosive release.

T.: total number of all children using simplification in all word positions.

[1]*The number of children may not tally with the total of those involved with the word initial, word medial and word final positions as some children used the simplification in more than one word position.*

Number of children per age group: 16.

In summary, both structural and systemic simplifications were evident in the three developing consonantal systems, which were congruent with previous studies of English, Mandarin and Malay (see Chapter 2 & 4). Both the simplifications shared by two, or all three languages, plus the independent language-specific simplifications evident in each language, suggest that both common tendency and ambient language effects were governing the multilingual children's phonological pathway.

7.3.1.6 Acquisition of sound class

Plosives were generally acquired the earliest compared to other sound classes in the three languages, with a highest production accuracy in terms of overall mean percent consonant correct (see Table 7.1 & Table 6.3 in Chapter 6). Plosives posed most challenges to English, but least to Malay. Apart from backing, only final plosive release /t˺/→[t] was observed in Malay, only by two children from the youngest age group.

There were seven error patterns for English plosives: backing, frication, deletion, fronting, final glottal replacement, consonant cluster reduction and consonant harmony, and two for Mandarin: backing and consonant harmony. Backing was shared by the three languages. Backing of alveolar plosives /t/→[k] is commonly reported in studies of monolingual acquisition of English (Grunwell, 1987). However it is not reported in studies of monolingual acquisition of Mandarin (Putonghua) or Malay. These developmental patterns of plosives by children of different populations acquiring similar languages indicate some qualitative differences which are found in the children's simplification strategies. Final plosives in English were challenging for the multilingual children (e.g. substitutions of /t/→[s] (frication) and final plosive deletion e.g. /p/→[ø], /t/→[ø], /g/→[ø]).

In Mandarin, apart from backing, plosives were sometimes deaspirated (e.g. TOU2→[k̄ oʊ2]). Plosive deaspiration was associated with stopping and backing. Plosive deaspiration (17%) was less frequent than affricate deaspiration (47%). This finding is consistent with the findings for Putonghua-speaking children, albeit with some variations: for example, plosive deaspiration was often associated with deaffrication, stopping and fronting in Putonghua (Zhu & Dodd, 2000; Zhu, 2006b).

Nasals were generally acquired the second earliest compared to other sound classes in the three languages, with a second highest production accuracy in terms of overall mean percent consonant correct (see Table 7.1 & Table 6.3 in Chapter 6). In the present study, nasal was the only sound class that is available in all three positions across the three languages. There are no local socio-linguistic variants for nasals (see Chapter 3). This allows comparison among the three languages and beyond the three languages without many confounding effects. In contrast to plosives, nasals posed more challenges in Malay than in the other two languages, as evident in the four error patterns for Malay nasals: consonant harmony, backing, gliding, fronting, compared to three for English: deletion, backing and consonant cluster reduction, and two for Mandarin: deletion and backing. Amongst others, backing and deletion were shared by the three languages. Nasals were backed and deleted in word final position in the three languages. In the present study, nasal fronting in Malay was less frequent (22%) than nasal backing (33%). Nasal backing /n/→[ŋ] is not reported in native Malay-speaking children, instead nasal fronting /ŋ/→[n] is sometimes reported (e.g. Kartini, 1991). This pattern of findings reflects a qualitative difference in the developmental patterns of nasals by different populations acquiring similar languages.

Likewise, only 6% of children backed final /n/ to [ŋ] in Mandarin, and the reverse pattern of fronting of /ŋ/ to [n] was not found. Final /n/→[ŋ] backing has been reported to be prevalent in Putonghua-speaking children (55%), whilst fronting of final /ŋ/→[n] is less frequent (3%)(Zhu & Dodd, 2000). Details of final nasal error patterns are not reported in the bilingual Cantonese-Putonghua children in So & Leung's (2006) study. The description so far indicates that in general, the multilingual children exhibited fewer errors on Mandarin final consonants /n, ŋ/ in terms of number of children involved, compared to Putonghua-speaking children, reflecting both qualitative and quantitative differences in the developmental patterns of nasals by two different populations of children acquiring similar languages. It is interesting to note that nasal backing in word final position was more prevalent in Malay (33%) than in English (14%) and Mandarin (3%). When final /ɲ/ in Malay, plus final /m/ shared by English and Malay only, were disregarded, there were still more final nasal errors relating to /n, ŋ/, in terms of error pattern varieties and error frequency of occurrences in Malay, compared to English and Mandarin, with backing and consonant harmony as the prime developmental patterns. This finding of Malay nasals is probably due to the influences of two additional languages on Malay.

Turning to final consonant deletion, final /n/ deletion evident in both English and Malay, was not evident in Mandarin in the present study. Only one child exhibited final /ŋ/ deletion. In comparison, final /ŋ/ deletion (29%) and final /n/ deletion (57%) are more prevalent in monolingual Putonghua-speaking children (Zhu & Dodd, 2000). This indicates that both qualitative and quantitative differences are found in the developmental pattern of Mandarin nasals by the two populations of children acquiring similar languages.

Lateral approximant and approximant/trill are discussed together in order to facilitate discussion on inter-relation among the simplifications of /ɹ/ɻ/r/→[l] substitution and liquid gliding /ɹ/→[w] and /l/→[j]. The lateral approximant was generally the third earliest acquired sound class, whereas the approximant/trill is the last acquired sound class, in terms of overall mean percent consonant correct (see Table 7.1 & Table 6.3 in Chapter 6) across the three languages. /ɹ/ɻ/r/→[l] substitution was the most frequent developmental pattern for liquids in the three languages by the multilingual children. /ɹ/ɻ/r/→[l] substitution was scored as an "incorrect" production in the present study for several reasons, including the fact that a general improvement in production of these consonants could be observed over time (see Chapter 5) . However, as standard and non-standard forms of a target consonant are frequently present in local speakers of Manglish, Maldarin and ChinMalay, the pervasive usage of /ɹ/ɻ/r/→[l] substitution in the multilingual children might be treated as a product of socio-linguistic variants. It reflects also how children generally exhibit a more sophisticated pronunciation pattern, from non-standard variant form towards the standard form, with age.

/ɹ/→[l] substitution is not commonly reported in English (see Table 2.3 in Chapter 2), nor in bilingual Cantonese-English (Dodd et al., 1996; Holm & Dodd, 1999b, 2006); instead liquid gliding /ɹ/→[w] is more common in these populations. /ɹ/→[w] was also observed in the present study, though /ɹ/→[l] errors (44%) were more prevalent than /ɹ/→[w] errors (20%). This shows that some quantitative differences exist in the developmental patterns of approximants by different populations of children acquiring similar languages. Nevertheless, when the consonant clusters containing an approximant as the second element were also taken into account, the number of children using /ɹ/→[w] increased from 20% to 53%. /ɹ/→[w] was suppressed slightly earlier, i.e. after 3;00-3;06, consistent with previous studies in English (c.f. Table 2.3 in Chapter 2). It is interesting to note that three children in the youngest age group, and one child from the second youngest age group, used a mixture of both /ɹ/→[l] and /ɹ/→[w]. Liquid gliding /l/→[j] was relatively rare, only evident in two children. The most common developmental pattern for /l/ was consonant cluster reduction, with the second element /-l/ in the cluster being deleted (/pl, bl, kl, gl, fl, sl/).

In their Malaysian studies of Mandarin phonological acquisition, Oo (2001) and Lim (2004) reported /ɹ/→[l] substitution as a frequent simplification. In Putonghua however, /ɹ/→[l] substitution is reported as an infrequent simplification, used by only 4% of children, instead liquid gliding /ɹ/→[j] is a more frequent simplification (28%) (Zhu & Dodd, 2000). /ɹ/→[l] substitution is not reported in bilingual Cantonese-Putonghua (So & Leung, 2006), though a late acquisition of /ɹ/ (or /ʐ/) is reported. In the present study, /ɹ/→[l] was virtually the only developmental error observed for /r/, evident in 47% of children. /ɹ/→[j], evident in two youngest children (3%), was the only other infrequent error observed for /r/. Even in these two children, a mixture of /ɹ/→[j] and /ɹ/→[l] was used for the target word RE4, reflecting some quantitative differences in the use of simplifications for Mandarin approximant by the two populations of children.
There were no liquid gliding errors for /l/ in the present study and the previous study of Putonghua by Zhu & Dodd (2000). The most frequent developmental pattern for /l/ in the present study was deletion. Syllable initial-consonant deletion is reported in Putonghua (16%) (Zhu & Dodd, 2000), Cantonese (So & Dodd, 1995), bilingual Cantonese-English (Dodd et al., 1996; Holm & Dodd, 2006) and bilingual Cantonese-Putonghua (So & Leung, 2006). In Putonghua, syllable initial-consonant deletion often occurs before the vowels /i, u, y/ (37%). This syllable initial-consonant deletion before /i, u, y/ has been claimed to be consistent with Ying (1989) and Wangs' (1989) position i.e. that /i, u, y/ should be considered as part of the initial consonant clusters, and syllable initial-consonant deletion should be regarded as a consonant cluster reduction (Zhu & Dodd, 2000). In the present study, /l/ was only tested before four vowel /-i/ words namely: LIU4, LI3MIAN4, CHONG1LIANG2 and YUE4LIANG4. /l/ deletion was the most frequent and most persistent syllable-initial consonant deletion in the present study, which was evident in 23% of children, and was still not suppressed by 4;00-4;06. /x/ and /ŋ/ deletions were also present in a few of the youngest children. Nevertheless, syllable-initial consonant deletion did not occur before vowels /i, u, (y)/ in any other target words, which was consistent with the findings of bilingual Cantonese-English (Holm & Dodd, 2006) and bilingual Cantonese-Putonghua (So & Leung, 2006). /y/ was often realised with the local socio-linguistic variant form [i] in the present study, and hence was discounted, moreover it was irrelevant in this context as it was only tested once in word initial position. Thus whether or not /i, u, y/ should form part of the initial consonant clusters in Mandarin is inconclusive and require further validation. In the present

study, the complexities of both vowels and consonants or a combination of both (i.e. syllable structure) were responsible for the challenges of acquisition of words containing these medial glides /i, u, y/ (see further discussion on "vowels" and "syllable structures" in section 7.3.2 & 7.3.3).

One infrequent error affecting /l/ was consonant harmony, which was evident in only three children (5%). In studies of Malay phonological acquisition by native Malay-speaking children, /r/→[l] substitution is also reported as an infrequent simplification, used sporadically by a few children (Nor Azizah, 1999; Norhaizan, 2005). Liquid gliding /r/→[j/w] is a more frequent simplification instead (Kartini, 1991, Badulzaman et al., 1999; Nor Azizah, 1999). In the present study, as with English, both /r/→[l] and /r/→[j/w] were present in Malay. However. /r/→[l] substitution (41%) was a much more frequent developmental pattern for /r/ than liquid gliding /r/→[j/w] (13%), and it was still not suppressed by 4;00-4;06. This finding indicates a quantitative difference in the simplification strategies used for /r/ by the two populations of children acquiring similar languages.
In the past Malaysian studies of Malay-speaking children, erroneous productions for /l/ are less pervasive compared to /r/. Deletion of final /l/ is commonly reported (e.g. Badrulzaman et al., 1999). Glottal replacement i.e. [l→ʔ] in word initial position is sometimes reported in native Malay-speaking children (Kartini, 1991). In the present study, four developmental patterns of /l/ were evident in Malay namely: metathesis (13%), liquid gliding (5%), stopping (3%), and consonant harmony (3%). Overall the number of children exhibiting these error patterns was small.

Glottal replacement i.e. /l/→[ʔ] was not found. This shows that qualitative differences are found in the developmental patterns of /l/ by both populations of children acquiring the same language, which can be rooted in the influences of the two additional languages i.e. English and Mandarin on Malay.

Affricates were generally acquired as the fourth earliest sounds compared to the other sound classes in the three languages, with a fourth highest production accuracy in terms of overall mean percent consonant correct (see Table 7.1 & Table 6.3 in Chapter 6). In the present study, affricates were acquired relatively earlier in Malay than in English and Mandarin, in terms of overall mean percent of correct production accuracy across all age groups (see Table 6.3 in Chapter 6). Stopping of /tʃ/→[t] by two of the youngest children was the only developmental error observed on Malay affricates in the present study. It disappeared fairly early i.e. after 2;06-2;11. This early development of affricates is consistent with past studies in Malay (Kartini, 1991), implicating a language-specific factor.

Three simplifications were used for both English and Mandarin affricates: deaffrication, stopping and cluster reduction for English, and deaspiration, stopping and deaffrication for Mandarin. Thus, stopping of affricates was shared by the three languages, whereas deaffrication was only shared by English and Mandarin. This pattern of affricate acquisition suggests that both common tendencies and ambient language characteristics are playing a role. Deaffrication, e.g. /tʃ/→[ʃ], is reported in English (see Table 2.3 in Chapter 2). In the present study, deaffrication occurred only in word final position, used by a total of 44% children across all age groups. Deaffrication was also used on the only target final consonant cluster /ntʃ/ (RP /ndʒ/) i.e. /ntʃ/→[nʃ], by a total of 11% of children from two youngest age groups. It was observed that children who used /tʃ/→[ʃ] for singleton consonants might not necessarily repeat the same error in the final consonant cluster. Most children (30%) deleted /tʃ/ completely in final consonant cluster i.e. /ntʃ/→[n] (ORANGE→[ɔɹen]), others (6%) deleted /n/ and deaffricated /tʃ/ at the same time i.e. /ntʃ/→[ʃ] (ORANGE→[ɔleʃ]). This last error pattern was used by children from the youngest age group only. These observations indicate that affricates in final consonant clusters are more challenging for the children than singleton affricates.

The replacement of an early-acquired consonant by a later-acquired consonant in deaffrication has resulted in it sometimes being called an unusual simplification in English, whereas stopping of affricates (e.g. /tʃ/→[t]) is common (Grunwell, 1987 & 1997). In the present study, affricate stopping occurred only in word final position i.e. WATCH→[wɑt] in 31% of children. Affricate stopping /tʃ/→[t] was suppressed earlier than deaffrication /tʃ/→[ʃ], i.e. after 3;06-3;11. Thus in the present study, deaffrication was generally more prevalent and persistent than affricate stopping. Grunwell (1987:223) proposed a gradual developmental route for affricates, from stopping to eventual phonetic mastery of the affricate: "[t]→[ts]→[ts̪]→[tʃ]→[tʃ]". In the present study however, in addition to affricate stopping, deaffrication was also evident in the youngest children. While affricate stopping disappeared at 3;00-3;06, deaffrication was still evident by 4;00-4;06. Affricate stopping and deaffrication are also reported in the longitudinal study of bilingual Cantonese-English (Holm & Dodd, 1999b, 2006): however, in that study, deaffrication become evident only after stopping is suppressed. Thus compared with the monolingual and bilingual children, the multilingual children exhibit qualitatively and quantitatively different developmental patterns for English affricates.

Deaspiration (47%), (e.g. /tsʰ/→[ts⁼]), affricate stopping (17%) (e.g. /ts/→[t]), and deaffrication (9%), (e.g. /ts/→[s]), were observed for Mandarin affricates in the present study. Deaspiration of affricates was more prevalent than deaspiration of plosives, consistent with the findings for Putonghua (Zhu & Dodd. 2000). Whilst affricate stopping is reported in Putonghua, deaffrication is not. In the present study, /s/ was acquired relatively earlier by the multilingual children in both Mandarin and Malay compared to Putonghua-speaking children and native Malay-speaking children, and [s] was used to replace affricates (see previous discussion on "age of acquisition for consonants" in section 7.3.1.1). Deaffrication of Mandarin is also reported for bilingual Cantonese-Putonghua children (So & Leung, 2006), which implicates a potential influence by a second and/or a third language on Mandarin.

Fronting of alveolo-palatal affricates to post-alveolar i.e. /tɕ/→[tʃ], backing of alveolar affricates to post-alveolar i.e. /ts/→[tʃ/dʒ], and aspiration of affricates i.e. /tɕ/→[tɕʰ] are reported in Putonghua (Zhu & Dodd, 2000). These three simplifications were absent in the present study. Moreover, the English and Malay affricates [tʃ, dʒ] were never used to replace the Mandarin affricates in the present study. Further, aspiration was not evident on affricates. These findings indicate a qualitative difference in the developmental patterns of Mandarin affricates by the two populations of children acquiring similar languages, as a result of the potential influences of two additional languages (English and Malay) on Mandarin in the multilingual children.

Fricatives were generally acquired the second last when compared with other sound classes in the three languages, with a second last highest production accuracy in terms of overall mean percent consonant correct (see Table 7.1 & Table 6.3 in Chapter 6). In the present study, fricatives were acquired relatively later in English than in Mandarin and Malay, in terms of overall mean percent correct production accuracy (see Table 6.3 in Chapter 6). There were more developmental pattern varieties for fricatives in English than in Mandarin and Malay. One probable reason is that the number of fricatives in Mandarin and Malay is smaller, i.e. five and two respectively, compared to nine in English.

Only two developmental patterns of fricatives were found in Mandarin and Malay: deletion and affrication. Deletion and affrication were also evident in English, which means they were shared by the three languages. In previous studies, stopping is reported to be the most frequent developmental pattern for fricatives in English, and is normally suppressed after 3;00 (see Table 2.4 in Chapter 2). The subsequent phonetic mastery of fricatives is claimed to be gradual (Grunwell, 1987). In the present study however, fricative stopping was the third most frequent developmental pattern for English fricatives (31%), and was suppressed after 3;00-3;06, indicating a quantitative difference in the developmental patterns compared with the previous studies on English-speaking children.

The most frequent developmental pattern for fricatives in the present study was deletion (86%), particularly in word final position (e.g. /f/→[ø], /ʃ/→[ø], s→[ø]). This final fricative deletion was still not suppressed by 4;00-4;06. In past studies of English, deletion of fricatives or other consonants is generally suppressed by 3;00 (c.f. Table 2.3 in Chapter 2). Initial consonant clusters containing a fricative /fl, fɹ, sp, st, sk, sm, sn, sl, sw/ posed even more challenges to the multilingual children in the present study. The fricative in the first element of these CC-clusters was commonly deleted (e.g. SPOON→[pun], SKY→[kai]).

In the present study, the second most frequent developmental patterns for fricatives were affrication (/s/ʃ/→[tʃ], /s/z/→[dʒ])(56%), and gliding (v/→[w])(56%); both were still evident by 4;00-4;06. This finding for affrication is not consistent with past studies in English (c.f, Table 2.3 in Chapter 2), in which affrication is classified as an unusual simplification (Grunwell, 1997), but it is consistent with past studies on bilingual Cantonese-English (Dodd et al., 1996; Holm & Dodd, 2006), indicating a consequence of the effects of bilingual and multilingual acquisition. However, in the longitudinal study of bilingual Cantonese-English, English affrication (as well as deaffrication) become evident only following the disappearance of stopping (Holm & Dodd, 1999b, 2006). In the present study, both stopping and affrication were evident in the youngest children, though stopping disappeared slightly earlier i.e. after 3;00-3;06, whilst affrication was still evident at 4;00-4;06, indicating a quantitative difference in fricative development between the two populations. In the present study, affrication was even more pervasive than in past studies of bilingual Cantonese-English. It is interesting to note that in the present study, English deaffrication (44%) was as pervasive as English affrication (56%).

Fricative gliding /v/→[w] (56%) occurred in both word initial and word medial positions. Fricative gliding /v/→[w] is described as an unusual simplification in English (Grunwell, 1987), but is sometimes described as a feature of Manglish (see chapter 3). /v/→[w] was scored as an incorrect production in the present study based on several reasons, including a general improvement in the production of /v/ in the children by age (see Chapter 5). However, as standard and non-standard forms of a target are frequently present in the speakers of Manglish, the pervasive usage of /v/→[w] in the present study may be an influence of local socio-linguistic variants. The emergence of correct [v] reflects how children demonstrated a more sophisticated pronunciation with age.

Backing of /s/→[ʃ] (34%) and consonant harmony (34%) were the third most frequent developmental patterns of fricatives. Fronting of post-alveolar /ʃ/→[s] (Stoel-Gammon & Dunn, 1985) was the fourth most frequent developmental pattern of English fricatives (30%) in the present study. Post-alveolar fronting was evident in all three word positions, and was still evident at 4;00-4,06. This developmental pattern is reported in past studies of English as well (see Tables 2.3 in Chapter 2), indicating a common pattern shared by different populations acquiring similar languages.

The three least frequent developmental patterns for English fricatives in the present study were: devoicing (22%), metathesis (6%) and reduplication (6%). Pre-vocalic devoicing of fricatives occurred in both word initial and word medial positions. In past studies of English, devoicing typically occurred in post-vocalic positions, whilst voicing typically occurred in pre-vocalic positions (c.f. Table 2.3 in Chapter 2). This pre-vocalic devoicing in English is also observed in bilingual Cantonese-English speaking children (Holm & Dodd, 2006), indicating the bilingual and multilingual effects on pre-vocalic devoicing which is not found in monolingual population.

For Mandarin, only two types of fricative developmental patterns were evident in the present study, namely: affrication (11%) and deletion (6%). Affrication of Mandarin fricatives was evident in the youngest children only. Deletion of fricative /x/ occurred on only two target words: HUA4HUA4 (xua̠4xua̠4) and NU3HAI2ZI3 (ny3xae2tsi̠3) in four of the youngest children (see also above discussion on "lateral approximant and approximant/trill"). For comparison, in previous studies of Putonghua, the following main developmental patterns of fricatives are identified (examples cited from Zhu & Dodd, 2000:24-5):

1. Fronting of retroflex fricatives to alveolars /ʂ/→[s], /tʂ/→[ts], /tʂʰ/→[tʂ], and alveolo-palatal fricatives to post-alveolar /ɕ/→[ʃ].

2. Backing of alveolar fricative to post-alveolar /s/→[ʃ], and fricatives generally to glottal fricative /f/→[h], /ʂ/→[h], /x/→[h].

3. X-velarisation (a form of backing): A velar fricative [x] was used to replace other fricatives, occurring mostly before the high vowels /i, u, y/ (e.g. SHU1→[xu]).

4. Affrication /s/ʂ/ɕ/→[tʃ/dʒ], /ɕ/→[tɕ/tɕʰ].

Target retroflex fricatives realized as alveolars (/ʂ/→[s], /tʂ/→[ts], /tʂʰ/→[tʂ]) were scored as correct productions in the present study as they are local socio-linguistic variants (see Chapter 3). The alveolo-palatal fricative /ɕ/ was always pronounced in the local socio-linguistic variant form [s] in the present study. Backing of /s/ to [ʃ] and /f/→[h], /ʂ/→[h], /x/→[h] were not found in the present study. X-velarisation which is prevalent in Putonghua-speaking children, was not found in the present study, but deletion of /x/ was. Only Mandarin affricates were used as a substitution for fricatives in affrication in the present study, not English and Malay affricates [tʃ, dʒ]. The comparative analysis above shows that there are some similarities as well as differences in the developmental patterns of fricatives by both populations which can be attributed to the effects of multilingual acquisition.

As with Mandarin, only deletion (11%) and affrication (3%) were used for Malay fricatives. Affrication /s/→[tʃ] was only used by two children in the present study. In virtually all past local studies of Malay phonological acquisition, affrication /s/→[tʃ] is reported (see Chapter 4), which indicates that affrication is a frequent simplification in Malay. Deletion of fricative /h/ only occurred on the target word HUJAN. The developmental patterns for fricatives were generally suppressed early i.e. after 3;00-3;05, and the mastery of /s, h/ was quick i.e. even earlier than the native Malay-speaking children.

Conclusion

A retrospective comparison of the present findings of multilingual children acquiring English, Mandarin and Malay with previous research findings regarding monolingual populations acquiring each of the three languages, as well as bilingual Cantonese-English and bilingual Cantonese-Putonghua populations acquiring English and Mandarin, revealed both qualitative and quantitative differences in the developmental patterns of consonants. These findings can be attributed to the effects of multilingual acquisition i.e. the acquisition of two additional languages upon the individual language. The implications of these findings will be discussed in Chapter 8.

7.3.2 Vowel acquisition

7.3.2.1 Age of acquisition for vowels

Turning to vowel acquisition in the three languages, the results are demonstrated in Table 7.35:

Table 7.35: Age of acquisition for vowels in English, Mandarin and Malay

Vowel / Age group	English (n=12)	Mandarin (n=19)	Malay (n=8)
2;06-2;11 (n=16) Acquired	i, e, ɛ, ə, ɑ, u, o, ɔ ai, au, ɔi, iə	i, y, a̱, ɤ, u, o ae, ɑo, ei, oʊ, ia̱, iɛ, ua̱, uo, yɛ iɑo, ioʊ, uei	i, e, a, ə, u, o, ɛ au
Not acquired	Nil.	uae	Nil.
3;00-3;05 (n=16) Acquired	All as above.	i, y, a̱, ɤ, u, o ae, ɑo, ei, oʊ, ia̱, iɛ, ua̱, uo, yɛ iɑo, ioʊ, uei, uae	All as above.
Not acquired	Nil.	Nil.	Nil.
3;06-3;11 (n=16) Acquired	All as above.	i, y, a̱, ɤ, u, o ae, ɑo, ei, oʊ, ia̱, iɛ, ua̱, uo iɑo, ioʊ, uei, uae	All as above.
Not acquired	Nil.	Nil.	Nil.
4;00-4;05 (n=16) Acquired	All as above.	i, y, a̱, ɤ, u, o ae, ɑo, ei, oʊ, ia̱, iɛ, ua̱, uo, yɛ iɑo, ioʊ, uei, uae	All as above.
Not acquired	Nil.	Nil.	Nil.

Table 7.35 shows that vowels were generally acquired before singleton consonants and consonant clusters in the three languages (c.f. Table 7.1 & Table 7.2 in section 7.3.1.1). By 2;06-2;11, all vowels in the three languages were acquired except for the triphthong /uae/ in Mandarin. Though there were slight improvements with age in vowel production accuracy in the three languages, statistical analysis confirmed that there were no significant age effects on vowel

production accuracy in English and Malay, but there was a significant age effect on vowel production accuracy in Mandarin. This pattern of age effects in vowel production acquisition may be attributed to ceiling effects: even the youngest children scored over 96% production accuracy in all three languages (see Chapter 6).

As with consonants, the children's pronunciation of the above vowels was scored based on Manglish, Maldarin and ChinMalay pronunciations reported in the literature alongside the two nursery teachers' pronunciation analysed in the present study (see Appendix 4, Chapter 3 & Chapter 5). Virtually all the vowel variants observed in the adults were also evident in the children's speech data:

1. In English, as with the adults, the eleven RP monophthongs were simplified to eight monophthongs: /i, u, e, o, ə, ɛ, ɔ, ɑ/, whereas the eight RP diphthongs were simplified to five: /ai, ɔi, au, uə, iə/. The five RP triphthongs were non-existent. Some of the RP open vowels were raised, for instance: /ɒ/→[ɔ], /æ/→[ɛ]. The medial and final unstressed schwa vowel /ə/ had several realizations. It was replaced by [o] or [ɑ] interchangeably and inconsistently: /ə/→[ɑ] or [ə]. Though more children pronounced BAN<u>A</u>N<u>A</u> as [bənan<u>ɑ</u>] than [bənanə] or [banana]. RP long vowels were always shortened, for instance: /iː/→[i], /ɜː/→[ə], /uː/→[u], /ɔː/→[ɔ], /ɑː/→[ɑ]. RP diphthongs were always monophthongised, for instance: /eɪ/→[e] , /əʊ/→[o]. RP triphthongs were always splited into two chunks with the second element /ɪ, ʊ/ being replaced by semi-vowel [j, w], for instance: /aʊə/→[ɑwə], /eɪə/→[ejɔ].

2. In Mandarin, /y/ was often pronounced as [i]. /uo/ was often realized as [ᵘo], [u<u>a</u>] and occasionally as [ɔ]. /ei/ was often realised as [eⁱ] and occasionally as [ɛⁱ]. /ueɪ/ was often realized as [ueⁱ] or [ui] and occasionally as [ue]. /oʊ/ was often realised as [oᵘ] and occasionally as [ɔᵘ]. /ioʊ/ was often realised as [iu] in any tones. /ʊŋ/ was often realised as [oŋ].

3. In Malay, /o/ was often replaced by [ɔ] after alveolar trill /r/ and alveolar lateral approximant /l/. [ʔ] was sometimes inserted after /o/ in the word ROTI. Literary Malay vowel /i/ was sometimes used in the word KUCING (KUCING→[kutʃiŋ]). Literary Malay vowel /a/ was sometimes used in the word MEJA (MEJA→[medʒa]) and occasionally used in the word EPAL (EPAL→[epal]).

As with the above consonantal variants, the above (1)-(3) vowel variants were all scored as "correct" phonological productions, as they are the variants exist in the input model that the children had received, and thus not part of the nature of the children's developmental patterns (c.f. Dodd et al., 1996; Holm & Dodd, 1999b, 2006; So & Leung, 2006)(see Chapter 2). Most of these variants would have been scored as "incorrect" phonological productions had adult input models not been considered. In each language, as an example for illustration: 1. Mophthongisation of diphthong /eɪ/→[e] is considered as a developmental pattern in monolingual English-speaking children. 2. Substitution of Mandarin [i] for /y/ is considered as a developmental pattern in (Mandarin) Putonghua-speaking children. 3. Glottalisation of /o/ is considered as a developmental pattern in native Malay-speaking children.

7.3.2.2 Error patterns of vowels

The vowel errors of English, Mandarin and Malay are given in Table 7.36. The number of children making vowel errors is displayed in Table 7.37:

Table 7.36: Examples of vowel error in English, Mandarin and Malay

ENGLISH	(n=12)	MANDARIN	(n=19)	MALAY	(n=8)
Errors	Examples	Errors	Examples	Errors	Examples
Substitution 1. e→ɛ̝	 ɹed˺→ɹɛ̝d˺ ɔlentʃ→ɔlɛ̝ntʃ	Substitution 1. i̪→i	 si̪4→si4 tsʰi̪1fan4→tsʰi4fan4	Substit. 1. ɛ→ə	 dʒɛm→dʒəm
2. o→ɔ	jojo→jɔjɔ jəlo→jəjɔ			2. o→ɔ	jojo→jɔjɔ dudoʔ→dudɔʔ
3. ɔ→ɑ	klɔk→klɑp˺				
4. e→i	ɔɹentʃ→ɔliŋs				
Addition 1. e→ie	 plet˺→pliet˺ bɹed˺→bied˺			Addition 1. a→ia	 ɲaɲi→niani
Reduction 1. ai→ɑ	 fai→pɑ dɹaiviŋ→gɑwiŋ	Reduction 1. yɛ→y 2. iɑo→ɑo	 yɛ4liɑŋ4→y4iɑ4 suɪ4tɕiɑo4→suɪ4tɕɑo4		
2. ɔi→ɔ	bɔi→bɔ	2. uae→ae	kʰuae4→k⁼ae4		
		3.*ueɪ→eɪ	tsueɪ3pa̠l→tseɪ3pa̠l		
		4. ueɪ→ɪ	tsueɪ3pa̠l→tsɪ3pa̠l		

**This can also be interpreted as "substitution" when the second variant /uɪ/ (for /ueɪ/) is considered, i.e. /uɪ/ →[eɪ] (see Chapter 3).*

n: number of target items for vowel.

Table 7.37: Number of children making vowel errors in English, Mandarin and Malay

Age group / Simplification	2;06-2;11 (n=16)	3;00-3;05 (n=16)	3;06-3;11 (n=16)	4;00-4;05 (n=16)	Whole group (n=64)
ENGLISH					
Substitution 1. e→ɛ̞	7	6	3	2	18
2. o→ɔ	5	4	9	6	24
3. ɔ→ɑ	3	-	-	-	3
4. e→i	-	3	3	2	8
Total[1]	10	9	10	6	35
Addition 1. e→ie	2	-	-	-	2
Reduction 1. ai→ɑ	2	-	-	-	2
2. ɔi→ɔ	2	-	-	-	2
Total	4	-	-	-	4
MANDARIN					
Substitution 1. i̪→i	4	2	-	-	6
Reduction					
1. iɑo→ɑo	2	-	-	-	2
2. uae→ae	2	-	-	-	2
3. ueɪ→eɪ	2	-	-	-	2
4. ueɪ→ɪ	3	-	-	-	3
Total	5	-	-	-	5
MALAY					
Substitution 1. ɛ→ə	2	-	-	-	2
2. o→ɔ	8	-	7	5	20
Total	9	-	7	5	21
Addition 1. a→ia	-	2	-	-	2

[1]*The number of children may not tally with the total of those involved with different sub-types of vowel error as some children used more than one sub-type of vowel error.*

n=16: sixteen children per age group.

In summary, in the present study, both systemic and structural simplifications are evident in the vowel acquisition of the three languages namely: substitution, addition and reduction. Substitution was the pattern used by the largest number of children in all three languages (see Table 7.37), and was shared by the three languages. This pattern of vowel acquisition reflects the effects of both general tendencies and ambient language characteristics on multilingual phonological acquisition.

Both the vowel substitutions found in English: /e/→[ɛ̞] (e.g. RED→ [ɹɛ̞d̚]) and /o/→[ɔ] (e.g. YOYO→[jɔjɔ]) involved lowering. In the present study the /o/→[ɔ] substitution in English (38%) and Malay (31%) was the most prevalent vowel error in the entire vowel corpus of the three languages, followed by /e/→[ɛ̞] in English (28%). /o/→[ɔ], occurring in the shared target word of English and Malay YOYO, was evident in all age groups in English, with a slight increase in terms of number of children involved in the two oldest age groups, whereas in Malay, there was a general decrease in terms of number of children involved, except for the second youngest age group where no children exhibited this error. /o/→[ɔ] is not a feature in Manglish. In Malay however, instead of [o] and [e], the open-mid back and front vowels [ɔ] and [ɛ] are said to be favoured by some speakers (Yunus, 1980). In the present study, this potential variant was scored as "incorrect" based on several reasons including lowering of /e/ to [ɛ̞] (28%) and /ɔ/ to [ɑ] (5%) were also present in English which indicates lowering is a general form of simplification in the present study. Lowering of vowels is also a feature found in English-speaking children (see Chapter 2). Lowering of vowels with or without omission of the medial for instance (e.g. /uo/→[ua̠], /uŋ/→[oŋ], /iuŋ/→[ioŋ]), are well cited in the literature of Southern Chinese languages/dialects, such as Singaporean Mandarin (Chen, 1986), Malaysian Mandarin (Maldarin)(Yao, 1999; Yew, 1999)(see Chapter 3), and Cantonese (Stokes & Wong, 2002)(see Chapter 2). These features of vowel lowering were also evident in the present analysis of the nursery teachers' vowel productions (see Chapter 3). The non-developmental trend evident in English YOYO→[jɔjɔ] plus the non-usage of /o/→[ɔ] in English and Malay in the nursery teachers (with the exception of /o/→[ɔ] after /l, r/ which is more lexically-based)(see Chapter 3) suggest that /o/→[ɔ] may be an influence of Maldarin.

In contrast, the vowel substitution /e/→[i] in English (13%), which involves raising, was only evident in the target word ORANGE (ORANGE→[ɔliŋs]). Raising of vowels is also a feature found in English-speaking children (see Chapter 2). In Mandarin, only one vowel substitution was evident: /i̠/→[i] (9%), where the apical vowel was replaced by non-apical high front vowel (e.g.

/si̯/→[si4] in SI4)(see Chapter 3). /i̯/→[i] was only evident in children from the two youngest age groups. One other infrequent vowel substitution observed in Malay was /ɛ/→[ə] ([dʒɛm→dʒəm] in JAM)(3%).

Reduction of vowels (e.g. /ai/→[ɑ])(6%) and addition of vowels (/e/→[ie])(3%) were less frequent error patterns evident in English. Reduction of vowels and addition of vowels are also found in English-speaking children (see Chapter 2). However some qualitative and quantitative differences are also found in the developing vowel features of the present multilingual population and the monolingual English-speaking population described in Chapter 2. For instance, the substitution of neutral unrounded vowels [ʌ, ə] accounted for 30.9% of the vowel errors in English-speaking children, and the lengthening and/or rounding of vowels before final consonant deletion (e.g. BELT→[beə]) accounted for 26.4% of the vowel errors (Dodd, 1995a) are absent in the present multilingual children's English vowels data. Other less frequent error patterns evident in Malay and Mandarin were: addition of vowels (/a/→[ia]) in Malay (3%) and reduction of vowels (triphthongs) in Mandarin (8%). Three of the four triphthongs in Mandarin were reduced to diphthong (/iɑo/→[ɑo], /uae/→[ae], /ueɪ/→[eɪ]), with the middle main vowel and the last element retained. There are some similarities and differences in the vowel acquisition patterns of the multilingual children and the Putonghua-speaking children in the previous studies. Rather similar with the present findings, triphthong reductions in Putonghua involved deletion of either the first or last element, with the main vowel retained (e.g. /iɑo/→[iɑ] or [ɑo])(Zhu, 2002). In Putonghua, /iɑo/ reduction was most prevalent i.e. /iɑo/→[iɑ] (29%) and /iɑo/→[ɑo] (8%). The second most prevalent triphthong reduction involved /ueɪ/, with /ueɪ/→[eɪ] (7%) being the most frequent error pattern. Diphthong reductions were also evident, frequently with the less sonorant element being deleted (e.g. /ua/→[a̠]). In the present study, triphthong reductions were less prevalent (less than 4%)(see Table 7.39) compared to Putonghua. Diphthong reductions were not evident in the present study. This is probably because diphthongs were often simplified in local socio-linguistic variant forms (Maldarin): /uo/→[ᵘo/ua̠/ɔ], /ei/→[eⁱ/ɛⁱ], or /oʊ/→[oᵘ/ɔᵘ])(see Chapter 3). The discussion so far suggests that both qualitative and quantitative differences are found in the developmental patterns of vowels by two different populations acquiring Mandarin.

In conclusion, the multilingual children in the present study exhibited both structural and systemic vowel simplifications which are in common with past studies of English and Mandarin. On the whole, the multilingual children's vowel acquisition parallels that of monolingual and bilingual children described in most earlier studies. The early development of vowels in the present study is congruent with past studies in English (e.g. Selby, Robb & Gilbert, 2000) and Mandarin (Putonghua)(Zhu & Dodd, 2000; Zhu, 2002), as described in Chapter 2. There is not yet any study on vowel acquisition in Malay (see Chapter 5).

However, the finding of early vowel acquisition in the three languages in the present study is inconsistent with the previous studies of bilingual Cantonese-English (Holm & Dodd, 1999b, 2006) and bilingual Cantonese-Putonghua children (So & Leung, 2006). The bilingual Cantonese-Putonghua children in So & Leung's study for instance were found to acquire Cantonese vowels at a similar rate to that of monolingual Cantonese peers. However, their vowel acquisition in Putonghua was surprisingly late: four triphthongs were only acquired at 3;05, and vowel errors were still persisting beyond 5;00. One weakness of So & Leung's study was the non-consideration of the input model, manifested by ill-defined scoring criteria (see Chapter 2). The Southern Putonghua accent used by Chinese speakers of Cantonese background was not considered in their test scoring criteria (see Chapter 3), in contrast to the present study. The stringent scoring criteria used by So & Leung (2006) might have affected the results for Putonghua vowel acquisition in their study.

7.3.3 Syllable structure acquisition

7.3.3.1 Age of acquisition and error patterns of syllable structures

Turning to syllable structure acquisition in the three languages, the results of syllable structure acquisition in the three languages are demonstrated in Table 7.38-Table7.40:

Table 7.38: Age of acquisition for monosyllable structures in English, Mandarin and Malay

Monosyllable / Age group	English (n=8)	Mandarin (n=9)	Malay (n=1)
2;06-2;11 (n=16) Acquired	VV CV CVV CVC CCV CVVC	CGVG CVC CVG CGV CV GVC GV V	CVC
Not acquired	CCVV CCVC	CGVC	Nil.
3;00-3;05 (n=16) Acquired	As above + CCVC	As above + CGVC	As above.
Not acquired	CCVV	Nil.	Nil.
3;06-3;11 (n=16) Acquired	As above 3;00-3;05.	As above 3;00-3;05.	As above.
Not acquired	CCVV	Nil.	Nil.
4;00-4;05 (n=16)			
Acquired	As above 3;00-3;05 + CCVV	As above 3;00-3;05.	As above.
Not acquired	Nil.	Nil.	Nil.

n=16: sixteen children per age group.

n in the monosyllable row: number of target items for monosyllable structure.

Table 7.39: Age of acquisition for disyllable structures in English, Mandarin and Malay

Disyllable / Age group	English (n=9)	Mandarin (n=14)	Malay (n=6)
2;06-2;11 (n=16) Acquired	V-CVC CV-CV CV-CVC CVV-CV CCV-CVC	GV-CV CV-CV CV-CVG CVG-CV CVG-CVG CGV-CV	V-CV V-CVC CV-VC CV-CV CV-CVC
Not acquired	V-CVCC CCV(-C)V CVC-CV(C) CCVV-CVC	GV-CGVC CV-CGVC CV-CVC CVC-CGV CVC-CGVC CGV-CGV CGVG-CV CGVG-CGVG	CVC-CV(C)
3;00-3;05 (n=16) Acquired	As above + CVC-CV(C)	As above + CV-CGVC CV-CVC CVC-CGV CGV-CGV CGVG-CV CGVG-CGVG	As above + CVC-CV(C)
Not acquired	V-CVCC CCV(-C)V CCVV-CVC	GV-CGVC CVC-CGVC	Nil.
3;06-3;11 (n=16) Acquired	As above 3;00-3;05.	As above 3;00-3;05 + CVC-CGVC	As above 3;00-3;05 – CV-VC
Not acquired	V-CVCC CCV(-C)V CCVV-CVC	GV-CGVC	CV-VC
4;00-4;05 (n=16) Acquired	As above 3;00-3;05 + CCV(-C)V	As above 3;06-3;11.	As above 3;06-3;11 + CV-VC
Not acquired	V-CVCC CCVV-CVC	GV-CGVC	Nil.

n=16: sixteen children per age group.

n in the disyllable row: number of target items for disyllable structure.

Table 7.40: Age of acquisition for trisyllable structures in English and Mandarin

Trisyllable / Age group	English (n=2)	Mandarin (n=1)
2;06-2;11 (n=16) Acquired	CV-CV-CV	Nil.
Not acquired	CV-CV-CVC	CV-CVG-CV
3;00-3;05 (n=16) Acquired	As above.	CV-CVG-CV
Not acquired	CV-CV-CVC	Nil.
3;06-3;11 (n=16) Acquired	As above.	As above 3;00-3;05.
Not acquired	CV-CV-CVC	Nil.
4;00-4;05 (n=16) Acquired	As above.	As above 3;00-3;05.
Not acquired	CV-CV-CVC	Nil.

n=16: sixteen children per age group.

n in the trisyllable row: number of target items for trisyllable structure.

Though Table 7.38-Table 7.40 show that overall there was an improvement with age in the acquisition of syllable structure in the three languages, statistical analysis however confirmed that there was a significant developmental trend in the acquisition of syllable structures in English and Mandarin but not in Malay (see Chapter 6).

As with consonants and vowels, the children's production of the above syllable structures was scored based on the Manglish, Maldarin and ChinMalay syllable structures reported in the literature, alongside the two nursery teacher's syllable structures analysed in the present study (see Appendix 4, Chapter 3 & Chapter 5). Virtually all the syllable structure variants observed in the adults were also evident in the children's speech data. These syllable structure variants were all scored as "correct" phonological productions:

1) In English, CCV was substituted for CCVC for the test word SMALL associated with omissions of /l/ in word final position. Likewise, CVC-CV was substituted for CVC-CVC for PENCIL in both English and Malay, and V-CV was substituted for V-CVC for EPAL in Malay.

2) In English, CCV-CV was substituted for CCVVV for FLOWER, and CCV-CVC was substituted for CCVVVC for CRAYON. Both cases were associated with splitting triphthongs into two syllables with the second element /ɪu/ being replaced by semi-vowel [j, w].

The acquisition of monosyllable structures, disyllable structures and trisyllable structures was closely associated with the acquisition of consonants and vowels discussed in section 7.3.1 & section 7.3.2. Table 7.38 shows that overall, monosyllable structures were acquired earlier than disyllable structures in the three languages, except for two in English (CCVV, CCVC) and one in Mandarin (CGVC). CCVV was tested in the target word SKY while CCVC was tested in the target word SMALL. Both were acquired late presumably because of the complexities of both the initial CC-cluster and/or the diphthong involved. In Mandarin, CGVC, tested only in the target word QIAN2, was acquired late presumably because of the complexities of the final C plus the diphthong involved: two children deleted the final C and one child deleted the G. This error pattern does not support the claim that there is frequent deletion of initial C before a high vowel such as /i/ in Putonghua (see previous discussion on "lateral approximant and approximant/trill" in section 7.3.1.5.3).

In English, two disyllable structures were acquired late i.e. V-CVCC and CCVV-CVC. The late acquisition of V-CVCC was probably because of the final CC-cluster /ntʃ/ (RP /ndʒ/) in ORANGE, whereas the late acquisition of CCVV-CVC was probably because of the initial CC-cluster coupled with the diphthong in DRIVING. In Mandarin, eight disyllable structures were acquired late; all except one contained a GV (e.g. GV-CGVC, CV-CGVC, CGVG-CGVG). The last acquired one was GV-CGVC, tested only in the target word YUE4LIANG4. Errors of GV-CGVC include deletion or substitution of initial G, deletion of medial C, and deletion of final C. In Malay, CVC-CVC in shared target word of English and Malay i.e. PENSEL, was the only disyllable structure acquired late. The syllable final-within word (word medial) C has obviously posed challenges to the acquisition of CVC-CVC in Malay as well as in English. This has also been reported in a past study of Malay (Kartini, 1991). Another disyllable structure in Malay which posed challenges in the present study was CV-VC in DAUN, containing a vowel sequence. CV-VC was reduced to CV-V by two of the youngest children but was increased to CV-CVC with an insertion of a medial C by two older children from the 3;06-3;11 age group.

In English, of the two trisyllables tested, CV-CV-CVC in PYJAMAS was acquired late. CV-CV-CVC errors include final C deletion and initial syllable CV deletion. As the word PYJAMAS was frequently stressed at the final syllable in Manglish (see Chapter 3), the term "initial syllable deletion" is preferred to the term "weak syllable deletion" in the present study. This has also been reported in past studies of English (see Table 2.3 in Chapter 2). This initial syllable deletion was the only syllable deletion observed in the three languages. The only trisyllable structure CV-CVG-CV tested in Mandarin on the target word NU3HAI2ZI3 was associated with consonant simplifications i.e. deletion of medial C.

Based on the 90% age of acquisition criterion, Table 7.41 summarises the acquisition of syllable structures common to all three languages:

Table 7.41: Age of acquisition for common syllable structures in English, Mandarin and Malay

Syllable structure	Language		
Monosyllable	English (n=8)	Mandarin (n=9)	Malay (n=1)
CVC	2;06-2;11 and above	2;06-2;11 and above	2;06-2;11 and above
Disyllable	English (n=9)	Mandarin (n=14)	Malay (n=6)
V-CVC	2;06-2;11 and above	N/A	2;06-2;11 and above
CV-CV	2;06-2;11 and above	2;06-2;11 and above	2;06-2;11 and above
CV-CVC	2;06-2;11 and above	3;00-3;05 and above	2;06-2;11 and above
CV-CV(C)	3;00-3;05 and above	N/A	3;00-3;05 and above

N/A: not available.
n: number of target items for common syllable structure.
sixteen children per age group.

Table 7.41 shows that generally syllable structures shared by all three languages were acquired at the same age, except for CV-CVC which was acquired later in Mandarin. The challenge of CV-CVC acquisition in Mandarin was associated with final consonant deletion (see also previous discussion in section 7.3.1.5.3).

In conclusion, syllable structure acquisition was closely associated with consonant and vowel acquisition. Monosyllable structures were generally acquired before disyllable and trisyllable structures. Syllable structures shared by the three languages were acquired at the same age. This pattern of acquisition reflects the common tendencies found across the three languages. It also reflects the general tendency for an earlier acquisition of unmarked syllable structure before marked syllable structure (Yavas, 1998; Zhu & Dodd, 2006c). For example, within the monosyllable structures, CV, the most unmarked syllable structure was acquired before the more marked CCVV, CCVC and CGVC (see Chapter 2). The implication of this finding will be discussed in Chapter 9.

7.3.4 TONE ACQUISITION

7.3.4.1 Age of acquisition for tones

Based on the 90% age of acquisition criterion, all target basic tones and tone sandhi were acquired by 2;06-2;11. Tone production accuracy for all age groups was high i.e. approaching 100% (see Chapter 6). Statistical analysis confirmed that there were no significant age effect on tone production accuracy in Mandarin (see Chapter 6)

The children's acquisition of tones was scored based on Maldarin tones reported in the literature, alongside the two nursery teachers' tonal production data analysed in the present study (see Appendix 4, Chapter 3 & Chapter 5). The local tonal variants reported in Maldarin were also present in the children's tonal production. For example, substitution of high level tone (T1) by high falling tone (T4) in the following words: KU1 (to cry), CHI (to eat), YA1 (duck), QI1 (seven), and PA1 (eight). This substitution of T4 for T1 is traditionally considered as a developmental pattern in monolingual Putonghua-speaking children (c.f. Table 2.11 in Chapter 2). However, they were all scored as "correct" productions in the present study. Further, generally all four basic tones appeared "lower", "shorter" and "more tensed" than that of Mandarin (Putonghua) (see Chapter 3). Neutral tone (T0) was used occasionally for the two kinship terms: MA1MA0 (mother), DI4DI0 (younger brother).

7.3.4.2 Error patterns of tones

Tone errors were rare. There were only a total of seven tone errors in the entire tonal corpus. These seven tone errors were produced by seven different children (11%) as shown in Table 7.42. Only one child made a tone sandhi error i.e. T2T3 (rising/falling-rising)→T3T3 (falling-rising/falling-rising) where T3 preceded by another T3 was supposed to change to T2 but did not.

Table 7.42: Tone errors in Mandarin

Tone (n=56) \ Age group	2;06-2;11 (n=16)	3;00-3;05 (n=16)	3;06-3;11 (n=16)	4;00-4;05 (n=16)
Tone 1 (n=15)	T1→T2 (tsə2iaŋ1) (p⁼ae2sou3)			
Tone 2 (n=8)	T2→T4 (iaŋ4)			
Tone 3 + Tone Sandhi 3 (n=13 + n=1)		T3→T2 (kou2) (u2) *T2T3→T3T3 (tɕʰi3tsʰou3)		T3→T2 (tsʰao2)
Tone 4 (n=19)	T4→T2 (lɛ4liaŋ2)		T4→T2 (yɛ4liaŋ2)	Nil.

**Third tone sandhi.*
n in the tone column: number of target items for tone.
n=16: sixteen children per age group.

These seven tonal errors can be summarized in four main types:

1. High level (T1)→ Rising (T2).
2. Rising (T2)→High falling (T4).
3. Falling-rising (T3)→Rising (T2).
4. High falling (T4)→Rising (T2).

In comparison, in Zhu's (2002) longitudinal study, the most common tonal error patterns were (see Table 2.11 in Chapter 2):

1. High level (T1)→ High falling (T4).
2. Rising (T2)→ High level (T1).
3. Falling-rising (T3)→ High level (T1)/Rising (T2).
4. High falling (T4)→ High level (T1).

In general, rising (T2) was the most common substitute for other tones in the present study, whereas in Zhu's (2002) study, high level (T1) was the most common substitute. This discrepancy of findings may be attributed to age differences of the children in the two studies. The implication of these findings will be discussed in Chapter 9.

In conclusion, tones are acquired relatively early i.e. by 2;06-2;11. This finding is congruent with past studies of Putonghua (Zhu & Dodd, 2000; Zhu, 2002) and Cantonese (So & Dodd, 1995), as well as bilingual Cantonese-English (Holm & Dodd, 2006), albeit with some qualitative differences in the tonal error patterns used by the multilingual children.

7.4 DEVELOPMENT OF WORD PRODUCTION CONSISTENCY

7.4.1 Children's score in consistency of word production sub-test

Results for the consistency of word production sub-test in the three languages are presented in Table 7.43:

Table 7.43: Number of children per score out of five on the consistency of word production sub-test in English, Mandarin and Malay

Age group	2;06-2;11 (n=16)			3;00-3;05 (n=16)			3;06-3;11 (n=16)			4;00-4;05 (n=16)		
Lang. / Tot score	Eng	Man	Mal	Eng	Man	Mal	Eng	Man	Mal	Eng	Man	Mal
0	0	0	0	0	0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	1	0	0	0	1	0	0	0	0	0
3	4	3	3	4	2	1	4	0	2	2	0	0
4	10	3	7	7	1	5	3	6	6	5	1	6
5	1	10	5	5	13	10	8	10	8	9	15	10

Lang.: language.
Eng: English. Man: Mandarin. Mal: Malay.
Tot score: total score.
n=16: sixteen children per age group.

Table 7.43 shows that there was a developmental trend in the consistency of word production between 2;06 and 4;05 in the three languages. The older children generally were more consistent in their word production than the younger children. By 4;00-4;05, all children were fairly consistent in their word production.

The statistical analysis presented in Chapter 6 however showed that the developmental trend in improved consistency was only significant for *correct* production of target words (e.g. [bənɑnɑ-bənɑnɑ] for BANANA). When both consistency of correct production of target words and consistency of wrong production of target words (e.g. [wɛn-wɛn] for VAN) were combined, such developmental trend was found not significant. This was because consistent but *incorrect* production of target words was prevalent among the younger children.

7.4.2 Error patterns of consistency of word production (inconsistency)

As discussed in Chapter 6, consistency of production (a combination of consistently correct production and consistently wrong production) was generally more frequent than inconsistency of production. The children's inconsistency of word production over the two trials in each language was caused by the following:

1. Consonant variations (e.g. [dwaiwiŋ vs. dɹaiʋiŋ] in English; [ɕi2soʊ3 vs. hi2soʊ3] in Mandarin; [ɲaɲi vs.jaɲi] in Malay).

2. A combination of consonant and vowel variations (e.g. [dɹaifiŋ vs. dwaufiŋ] in English; [tsʰi̠4fan4 vs. tsʰi4fa4] in Mandarin; [jaji vs. diaji] in Malay).

3. Syllable structure variations (e.g. [bənɑnɑ vs. bənɑnɑs], [vɛn vs. wɛnt], [bənɑnɑ vs. bənɑlɑl] in English; [lɔli vs. lɔlis] in Malay).

4. Vowel variations (e.g. [ni3ae2tsi̠3] vs. [ni3ae2tsi3] in Mandarin).

The number of children exhibiting each of these types of inconsistency in each language is presented in Table 7.44:

Table 7.44: Number of children exhibiting inconsistency of word production in English, Mandarin and Malay, by inconsistency type

Age group	2;06-2;11 (n=16)			3;00-3;05 (n=16)			3;06-3;11 (n=16)			4;00-4;05 (n=16)		
Lang. / Incons. Type	Eng	Man	Mal	Eng	Man	Mal	Eng	Man	Mal	Eng	Man	Mal
Consonant	14	5	10	11	3	5	5	3	7	5	1	4
Consonant + vowel	1		1					2	1	1		1
Syllable structure						1	3			1		
Vowel		1						1				

Lang.: language.
Eng: English.   Man: Mandarin.   Mal: Malay.
Incons. type: inconsistency type.
n=16: sixteen children per age group.

Table 7.44 shows that overall consonant variations were the major cause for inconsistency of word production in the three languages. Syllable structure variations were predominantly present in the English language. Vowel variations were only present in the Mandarin language. This pattern of findings reflects the individual language effects on inconsistency of word production.

The present findings are congruent with previous studies in English that have claimed that consistency of word production in English increased with age (c.f. e.g. Teitzel & Ozzane, 1999; Williams & Stackhouse, 2000; Holm, Crosbie & Dodd, 2007). The majority of the children under study were consistent and accurate in their word production (Holm et al., 2007). There is a lack of substantial research on developmental word production consistency in Mandarin and Malay, or in bilingual and multilingual development in the two or three respective languages with which to compare the present findings. One cross-sectional study on bilingual Maltese-English (Holm & Dodd, 2008) also found that consistency of word production improved with age in both languages, congruent with the present findings. In this cross-sectional bilingual study, the bilingual Maltese-English children are said to outperform monolingual Maltese and monolingual English children in terms of consistency of word production, owing to a better phonological knowledge (see Chapter 2).

In conclusion, overall the children were more likely to be consistent than inconsistent in their responses. Consistent but inaccurate productions were found mainly in younger children, while older children were more likely to be both consistent and accurate. In each language, inconsistency of word production was mainly attributable to consonantal variations, reflecting common tendencies in word production consistency across the three languages.

7.4 Conclusion

In this chapter, a qualitative analysis was carried out in order to answer specifically the two research questions stated in the beginning of this chapter, concerning the general patterns of phonological development in the three languages: English, Mandarin and Malay being acquired by the multilingual Malaysian Chinese children. The children's consonants, vowels, syllable structures, and tones (Mandarin only), as well as word consistency production were analysed in terms of age of acquisition and error patterns (simplifications). Where appropriate, the present findings were also compared to the previous findings of monolingual and bilingual populations described in the literature.

By and large, both cross-linguistic similarities and language specific factors were evident in the multilingual children's phonological acquisition of the three languages. There was a general developmental trend in the children's phonological acquisition in the three languages with increasing production accuracy and decreasing production errors with age. All ambient singleton consonants in the three languages were acquired by 4;00-4;05. Consonant clusters in English were acquired later than singleton consonants i.e. by 3;06, and were not completed by 4;05. Seven consonant error patterns were shared by the three languages namely: /ɹ/ɻ/r/→[l] substitution, deletion, gliding, backing, affrication, consonant harmony and stopping. Other simplifications shared by two of the three languages were: deaffrication by English and Mandarin; and fronting and metathesis by English and Malay. There were no consonant simplifications shared only by Mandarin and Malay. Further, six language-specific consonant simplifications were discerned in English, and one was discerned each in Mandarin and Malay respectively.

Vowels in the three languages were generally acquired earlier than consonants. All ambient vowels in the three languages were acquired by 3;00-3;05. Three main vowel error patterns were identified namely: substitution, addition and reduction, amongst which only substitution was shared by the three languages.

The acquisition of syllable structures in the three languages was closely associated with the acquisition of consonants and vowels. There was a general improvement in the acquisition of syllable structures in all three languages. All monosyllable structures in the three languages were acquired by 4;00-4;05. Disyllable structures and trisyllable structures were generally acquired later than monosyllable structures. The late acquired syllable structures i.e. not acquired even by 4;00-4;05 include three disyllable structures and one trisyllable structures: V-CVCC, CCVV-CVC in English, GV-CGVC in Mandarin, and CV-CV-CVC in English. The late acquisition of the two English disyllable structures was associated with final consonant cluster in one, and initial consonant cluster coupled with diphthong in the other. The late acquisition of Mandarin disyllable structure was associated with deletion of initial /l/ before vowel /i/ alongside other consonant and vowel simplifications.

There was a general developmental trend in consistency for consistently correct word production in the three languages. Consistent but inaccurate word productions were found mainly in younger children while older children were observed to be both more consistent and accurate in word production. Overall the children were more consistent than inconsistent in their responses. The children's inconsistency in word productions over two trials in the three languages was mainly caused by consonantal variations. Other contributing factors to inconsistency of word production in the three languages were: a combination of consonant and vowel variations, syllable structure variations and vowel variations.

Tone in Mandarin was acquired early. Tonal errors were rare. All four basic tones and the most common third tone sandhi were acquired by 2;06-2;11.

Overall, the multilingual children's phonological development is commensurate with the monolingual and bilingual children described in the literature: all essential phonological milestones are reached at about the same ages, albeit with some qualitative and quantitative differences in the developmental patterns used. The implications of these results of acquisition of consonants, vowels, syllable structures and Mandarin tones, as well as consistency of word production will be discussed in Chapter 9.

CHAPTER 8

INTONATION DEVELOPMENT

8.0 INTRODUCTION

In Chapter 6 and Chapter 7, it has been shown that the word-level phonological patterns used by the multilingual children, like those used by monolingual and bilingual children, reflect complex underlying strategies and processes that include an interaction between common tendencies and individual language effects. In this chapter, the investigation is extended to intonation. Intonation involves "sentence" phonology, as opposed to word level phonology which has been covered in the single-word phonology naming test battery. Thus a test of intonation will help to provide a more comprehensive picture of phonological development in multilingual children. In general, the development of intonation patterns has been less well described than the development of segmental phonological patterns (Snow & Balog, 2002). The study aims to contribute knowledge about intonation development in children of this age range, and to throw light on possible factors underlying their intonation error patterns, particularly with regards to interactions between language-specific factors and general tendencies across the three languages. The chapter comprises a literature review of cross-linguistic studies on intonation development, a preliminary analysis of the intonation of the three language varieties under study, the methodology, the quantitative and qualitative analysis and discussion of the results, as well as the limitations of the study.

8.1 CROSS-LINGUISTIC STUDIES ON INTONATION DEVELOPMENT

Research on intonation acquisition in English in the first year of life shows that the falling pitch contour is the single most commonly used pitch contour by infants at this age (Delack & Fowlow, 1978; Kent & Murray, 1982; Kent & Bauer, 1985). The rising pitch contour has been described as more difficult to produce than the falling pitch contour (Snow, 1998) and thus is thought to be acquired later than the falling pitch contour (Crystal, 1986). Moreover, the rate of acquisition of the rising pitch contour has been shown to be slower than that of falling pitch contour. In a study conducted by Snow (2002) for instance, no significant development was observed in the acquisition of rising pitch contour in children aged between 1;00 and 4;00, the rising pitch contour was claimed to continue to develop throughout the pre-school years.

These studies focusing on the acquisition of falling and rising pitch contours have contributed to several theories about the developmental pattern of pitch contours. The breath group theory (Lieberman, 1967) explains intonation patterns in physiological terms. Regardless of the language, the rising pitch contour is held to be more difficult than the falling pitch contour because it is more effortful to produce- it involves an increase in vocal fold tension or sub-glottal pressure. The emotional theory (Marcos, 1987; D'Odorico, 1984) explains the intonation patterns based on psychological terms. The falling and rising pitch contours are associated with the emotional level of the communicative functions. The rising pitch contour is more frequently used in communicative functions requiring a response (i.e. requests and protests) than those that do not (i.e. comments). The former is associated with a higher fundamental frequency (F0) than the latter (Flax, Lahey, Harris & Boothroyd, 1991). On the other hand, Cruttenden (1981) posited that the rising pitch contour is more difficult than the falling pitch contour because of the complexity of the underlying forms and meanings. In rising contours, the accent range interacts with the pitch height to a greater degree (Snow & Balog, 2002). Furrow (1984) linked intonation development with language development in terms of mean length of utterances (MLU). Snow (1998) reported as part of his research findings that intonation patterns were also sentence position-dependent. Final-rise and non-final fall were "marked" and hence were more difficult than non-final rise and final fall ("unmarked"), which were claimed to be universal tendencies (Cruttenden, 1986).

However, the intonational characteristics of individual languages have to be taken into account when studying intonation development. A cross-linguistic study conducted by Halle, Boysson-Bardies & Vihman (1991) aimed to compare the intonation patterns of disyllabic words and babbles in French and Japanese children when they had about fifty items in their expressive lexicon. The results for the French children revealed a common usage of rising pitch contour, the typical characteristic of adult French intonation patterns, plus lengthening of final syllable. Conversely, the common use of falling pitch contour plus abrupt glottalised final syllable endings were observed in the Japanese children. Thus the different developmental intonation patterns exhibited in the two languages were reflections of typical characteristics of the adult intonation patterns in the ambient language. The implications of this study challenge the notion of a universal bias towards the falling pitch contour and lengthening of final syllables. instead supporting language specific influences. However, cross-linguistic research on intonation development is limited. Intonation development in Mandarin and Malay for instance is under-explored, as is the interaction between tone development and intonation development in Mandarin. Studies of intonation development in bilingual and multilingual children are rare. Research is needed to find out whether bilingual and multilingual children are following language specific patterns or universal tendencies.

8.2 INTONATION DEVELOPMENT IN MULTILINGUAL CHILDREN

Alongside the main study of phonological development reported in Chapter 5-Chapter 7, an exploratory study of intonation was conducted to investigate the following questions:

1. Does intonation accuracy in multilingual children develop with age, between 2;06-4;05, in each of the three languages?

2. Is there a difference in children's accuracy in realising statement intonation vs. question intonation?

3. Do children make similar intonation errors across the three languages they are acquiring?

By addressing these questions, it is hoped to contribute to the debate as to whether children's intonation development is influenced primarily by language specific factors or by universal (e.g. physiological) factors.

8.3 A PRELIMINARY ANALYSIS OF THE INTONATION OF THE LOCAL VARIETIES OF MALAY, MANDARIN AND ENGLISH

As there is not yet any substantial research on the intonation of Malaysian English (Manglish), Malaysian Mandarin (Maldarin) and Chinese Malay (ChinMalay), the researcher's own pronunciation, as a native speaker of these varieties, has been used as the basis for the following description, which served as the baseline for scoring the intonation imitation sub-test described in this chapter. The researcher's own pronunciation of intonation was used instead of the two nursery teachers', whose pronunciation was used as the baseline for phonological test scoring in the main study on the children (see Chapter 5), because of the nature of the intonation testing procedure (see section 8.7.3).

The researcher's productions of matched stimuli were recorded. The stimuli consisted of a statement: "Baby is drinking milk" and a question: "Did baby drink milk?" in Manglish, and their translation equivalents in the other two languages (see Table 8. 1). The stimuli were subsequently used as items for the intonation development test battery described later in this chapter. The sentences were based on local lexical and verbal expressions familiar to Malaysian Chinese children. For instance, NE2NE2 was used in lieu of NIU2NAI3 (milk) in the Mandarin test. The test sentences are deemed to be age appropriate and culturally appropriate.

Table 8.1: Intonation test stimuli in English, Mandarin and Malay

	Statement
English	Baby is drinking milk.
Mandarin	Meimei he nene.
Malay	Adik minum susu.
	Question
English	Did baby drink milk?
Mandarin	Meimei he nene ma?
Malay	Adik minum susu tak?

The researcher's productions of the above sentences were notated using a 4-point pitch scale, as conventionally employed in the Malay intonation literature. In these works, the pitch of intonation in Malay is indicated by digit i.e. 1, 2, 3, and 4. Digit 1 indicates the lowest pitch, digit 4 the highest. The scale therefore corresponds to the conventional description of pitch levels as follows:

1= low, i.e. base of the speaker's normal range
2= mid-low
3= mid-high
4= high, i.e. top of the speaker's normal range.

Notation was done on the basis of impressionistic consensus transcription by the author and by an experienced intonation specialist. As a further check, fundamental frequency (F0) contours were extracted from the recorded stimuli using Praat software (Boersma, 2001). The displays of the F0 contours of the utterances, aided decisions as to relative pitch height, direction and extent of movement. In this way, comparison of pitch contours of both types of intonation (i.e. statement and question) across the three languages was possible. A preliminary description of intonation of Manglish, Maldarin and ChinMalay based on this analysis is presented below. Where relevant, past studies on intonation of Malay, Mandarin (Putonghua) and English (Manglish and Singaporean English/Singlish) will be referred to.

8.4 INTONATION OF MALAY AND CHINESE MALAY (CHINMALAY)

As the approach adopted in the present analysis was initially motivated by one that has been used in the Malay intonation literature, the discussion in this section begins with Malay intonation. Intonation in Malay serves as the division marker for subject and predicate in sentences. The description of intonation of Malay in this section is mainly based on Asraf (1981) and Nik Safiah, Farid, Hashim & Abdul Hamid (1997).

In general, pitch 2 is used in the beginning of an utterance while pitch 3 is used for stress purposes. The basic intonation pattern of a declarative sentence (statement) is 2-4-2-3:

4

3

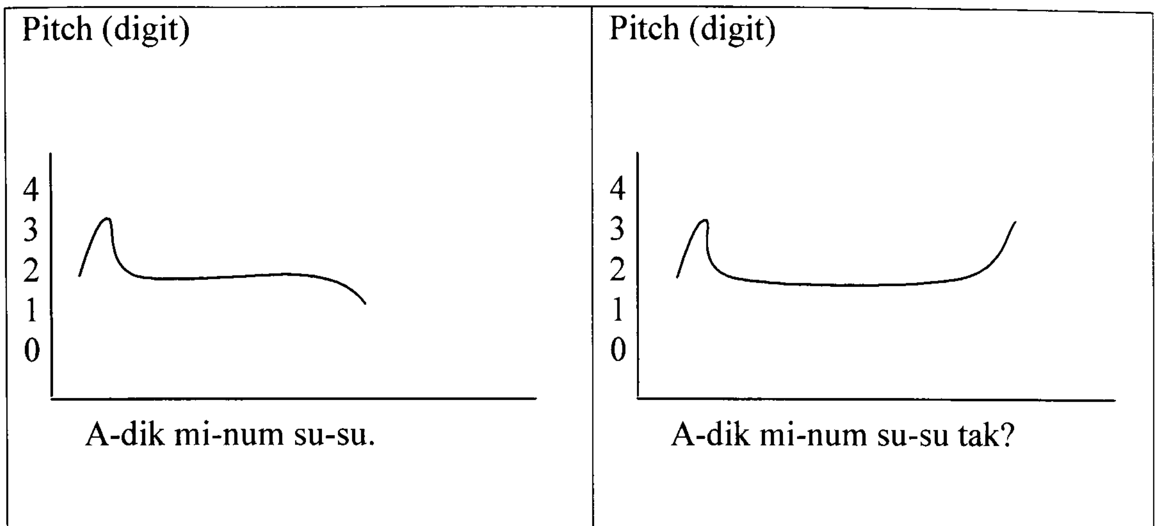
e.g. *Perempuan itu kerani* *(The woman is a clerk)*

2 2

The subject *perempuan itu (the woman)* is indicated by pitch 2-4 while the predicate *kerani (clerk)* is indicated by pitch 2-3. The division of subject and predicate is indicated by the falling of pitch 4 at the end of the subject to pitch 2 at the beginning of the predicate. The interrogative sentences carry different types of intonation pattern. When serving as a form of question requiring an answer from the conversational partner, it carries an intonation pattern of 2-4-3-4 *e.g. Perempuan itu kerani? (The woman is a clerk?).*

The intonation of ChinMalay (CM) has not been described before. This section serves as a preliminary description. It is mainly based on the analysis of the intonation of the researcher, using the method described in section 8.3 above. As with the intonation of Malay described above, in the present study the intonation of CM will be described in terms of 4-point pitch scale. In terms of the 4-point pitch scale, the statement in CM carries an intonation pattern of 2-3-2-2-2-1, where a pitch level is assigned to each syllable. This can be mapped onto subject and predicate as 2-3 // 2-1 (c.f. 2-4 // 2-3 in Malay, described above). The question carries an intonation pattern of 2-3-2-2-2-2-3. This can be mapped onto subject and predicate as 2-3 // 2-3 (c.f. 2-4 // 3-4 for the unmarked question in Malay). The pitch contours of these basic intonation patterns are illustrated in Figure 8.1:

Figure 8.1: Basic intonation patterns of Chinese Malay (ChinMalay)



a. Statement b. Question

Congruent with studies by Asraf (1981) and Nik Safiah et al. (1990), pitch 2 is used at the onset of an utterance while pitch 3 is used for stress purposes in CM. On the other hand, apart from the pitch used at the onset of the utterance, the overall pitch register in CM reported here is slightly lower than that of Malay reported by Asraf (1981) and Nik Safiah et al. (1990), notably with non-usage of the highest pitch 4. The present finding is closer to a previous study by Ramish (1969), who reported that statement in Malay is composed of a succession of level tones with a falling tone on the final syllable immediately preceded by a higher tone, whilst yes-no questions have the same intonation pattern as statements, apart from being marked by a rising intonation on the final syllable.

8.5 INTONATION OF MANDARIN (PUTONGHUA) AND MALAYSIAN MANDARIN (MALDARIN)

Research on Mandarin intonation is relatively scarce, most studies having focused on the interaction between tone and intonation. Chao (1968:39) described the interaction of Mandarin tone and intonation as “small ripples riding on large waves (though occasionally the ripples many be “larger” than the waves)”. Zhu (2002) claimed that in Mandarin (Putonghua) intonation is realised on the tail, not the head or the nucleus. There are four main types of intonation patterns in Mandarin (Putonghua)(Zhu, 2002:39):

1. Falling: use to express confirmation, exclamation etc.

2. Rising: used in questions, calling for attention etc.

3. Flat: used in statements, description and ordinary conversations etc.

4. Curve: use to express complicated emotion, exaggeration, surprise etc.

Shen (1990) studied the basic intonation patterns of statement and question in Mandarin (Putonghua). She recorded six types of utterances consisting of five different types of interrogative sentences and one type of declarative sentence. Each of these six types of sentences contained twelve sentences made up of three types of grammatical structure (i.e. 4 syllable-SV; 5 syllable-SVO; & 9 syllable-SVO) each bearing all four tones in Mandarin. In this study, six educated Chinese participants were asked to repeat target sentences read by the investigator using appropriate intonations (e.g. a question intonation or a statement intonation for a target declarative or interrogative sentence provided). She argued that, unlike English, in Mandarin it is the overall pitch level rather than the pitch contour that distinguishes intonation patterns. According to her, in general, the yes-no questions exhibit an overall higher pitch register than the statements. Based on acoustic analysis in terms of fundamental frequency (F0), she classified her data into three basic tunes:

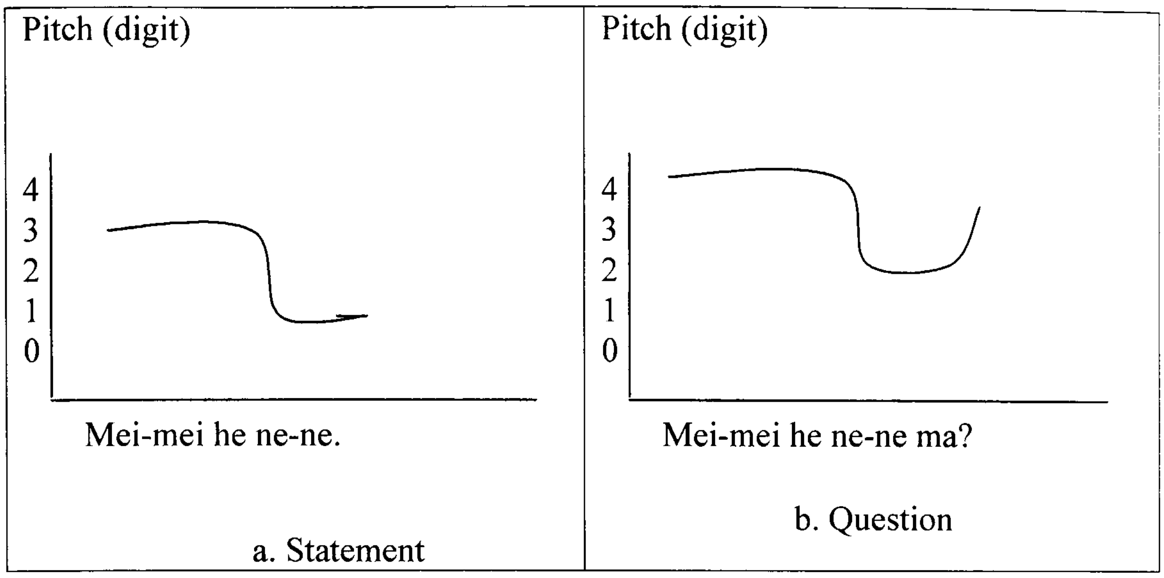
1. Tune I: starting with a mid key, moving upward to a mid-high key at the highest peak, falling to a low register at the ending point (= 2-3-1). Used for declarative sentences.

2. Tune II: starting with a mid-high key, moving upward to a high key at the highest peak, dropping but not too low, ending in the high or mid-high register (= 3-4-3/4). Used for both marked and unmarked yes-no questions.

3. Tune III: starting with a mid-high key, moving upward to a high key at the highest peak, stepping down and ending with a low key (= 3-4-1). Used for disjunctives (A-not-A questions and alternative questions) and WH-questions.

Studies of the intonation of Maldarin (MM) are even rarer than ChinMalay (CM). There is not yet any study done on MM intonation. As such, the discussion in this section serves as a preliminary description of intonation in MM literature. The description of MM intonation in this section is mainly based on an analysis of the researcher's intonation (see section 8.3). Since only one item was tested each for statement intonation and question intonation, tones and grammatical structures were not manipulated in the test. The pitch contours of the basic intonation patterns of MM are illustrated in Figure 8.2:

Figure 8.2: Basic intonation patterns of Malaysian Mandarin (Maldarin)



Based on the 4-point pitch scale, in general, congruent with Shen's (1990) study, the yes-no particle *–ma* question in the present study shows an overall higher pitch register when compared to the declarative sentence (statement). The statement shows an intonation pattern of 3-3-3-1-1 whereas the yes-no particle *–ma* question shows an intonation pattern of 4-4-4-2-2-3.

8.6 INTONATION OF ENGLISH AND MALAYSIAN ENGLISH (MANGLISH)

The intonation systems of indigenous varieties of English, such as British, American and Australian English, have been thoroughly described, as have some regional varieties, particularly of British English (Cruttenden, 1997). Across these varieties, there is considerable variation. For example in some varieties, statements are typically realized with a falling contour, whereas in other varieties, such as Northern Irish English, statements are typically realized with a rising contour.

Research on the intonation of non-native varieties of English, such as Malaysian English (Manglish), is less common. Wang (1987) studied Manglish spoken by all three major ethnic groups in Malaysia (i.e. Chinese, Malay and Indian). She reported amongst others, the following types of Manglish intonation:

1. Falling: used in statements and to convey new information.
2. High-rising: used in questions including both WH- and yes-no forms.
3. Low-rising: used in unfinished statements including information known to the conversational partner.

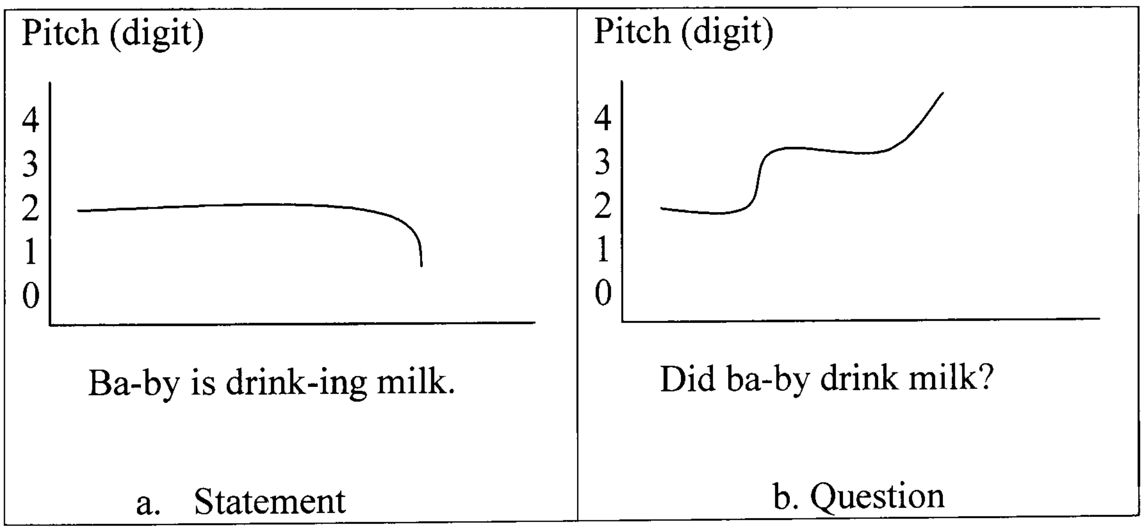
Singaporean English (Singlish) intonation, which is close to Manglish intonation, has been the subject of recent research (e.g. Deterding, 1994; Chang & Lim. 2000). Chang & Lim (2000) for example, based on their data recorded from subjects of the same three major ethnic groups as in Malaysia, reported amongst others, the following prosodic patterns in Singlish:

1. Rising intonation (overall and final): used for questions. non-threatening attitudes e.g. friendliness.

2. Overall falling intonation: used for statements and commands.

In the present study, as with the ChinMalay and Maldarin intonations, the Manglish statement intonation and question intonation were produced by the researcher (a native speaker of Manglish)(see section 8.3). In general, the Manglish intonation patterns yielded from the present analysis shows similar findings to past studies on Manglish and Singlish intonation. Statement intonation is 2-2-2-2-2-1 (low-mid level, with final fall to low) while question intonation is 2-2-3-3-4 (low-mid level, to high-mid level, with final rise to high). The basic intonation patterns expressed are illustrated in Figure 8.3:

Figure 8.3: Basic intonation patterns of Malaysian English (Manglish)



8.7 METHODOLOGY

8.7.1 Participants

The participants have been described in Chapter 5.

8.7.2 Test materials

The present study aimed to provide some preliminary information on intonation development in multilingual Malaysian Chinese children. Two basic intonation patterns, for statement and question, were tested. Because of constraints of time and child fatigue (the intonation test had to be carried out at the same time as the main phonology testing) just one item for each pattern was tested (see Appendix 5-6). The meanings of the test sentences were similar across the three languages. The audio-recorded intonation test stimuli were based on the production of the researcher, a native speaker of ChinMalay, Maldarin and Manglish, as described in section 8.3. The researcher's productions were then used as a baseline for scoring.

Two pilot studies were conducted prior to the main intonation study to confirm the suitability of the test items and pictures. The participants of these pilot studies have been described in Chapter 5 (Section 5.3). Originally the test items for question intonation in the English and Malay were longer:

English: Did baby drink milk?
Mandarin: Meimei you he nene ma?
Malay: Adik ada minum susu tak?

In the first set of pilot study, two children (one from the youngest age group and the other form the oldest age group) were asked to imitate the two intonation test sentences. Both children couldn't imitate the sentences fully: in Mandarin the word "you" (literally "has") was omitted, and, in Malay either "ada" ("has") or "tak" (negation "not") was omitted.

These two test sentences were then shortened to:

Mandarin: Meimei he nene ma?
Malay: Adik minum susu tak?

These revised test sentences proved to be easier for the children to imitate. All four children (one from each age group) in the second pilot study were able to imitate the sentences in full.

The statement and question intonation stimuli for Chinese Malay (ChinMalay), Malaysian Mandarin (Maldarin) and Malaysian English (Manglish) are illustrated in Figure 8.4:

Figure 8.4: Intonation stimuli: Chinese Malay (ChinMalay), Malaysian Mandarin (Maldarin) and Malaysian English (Manglish)

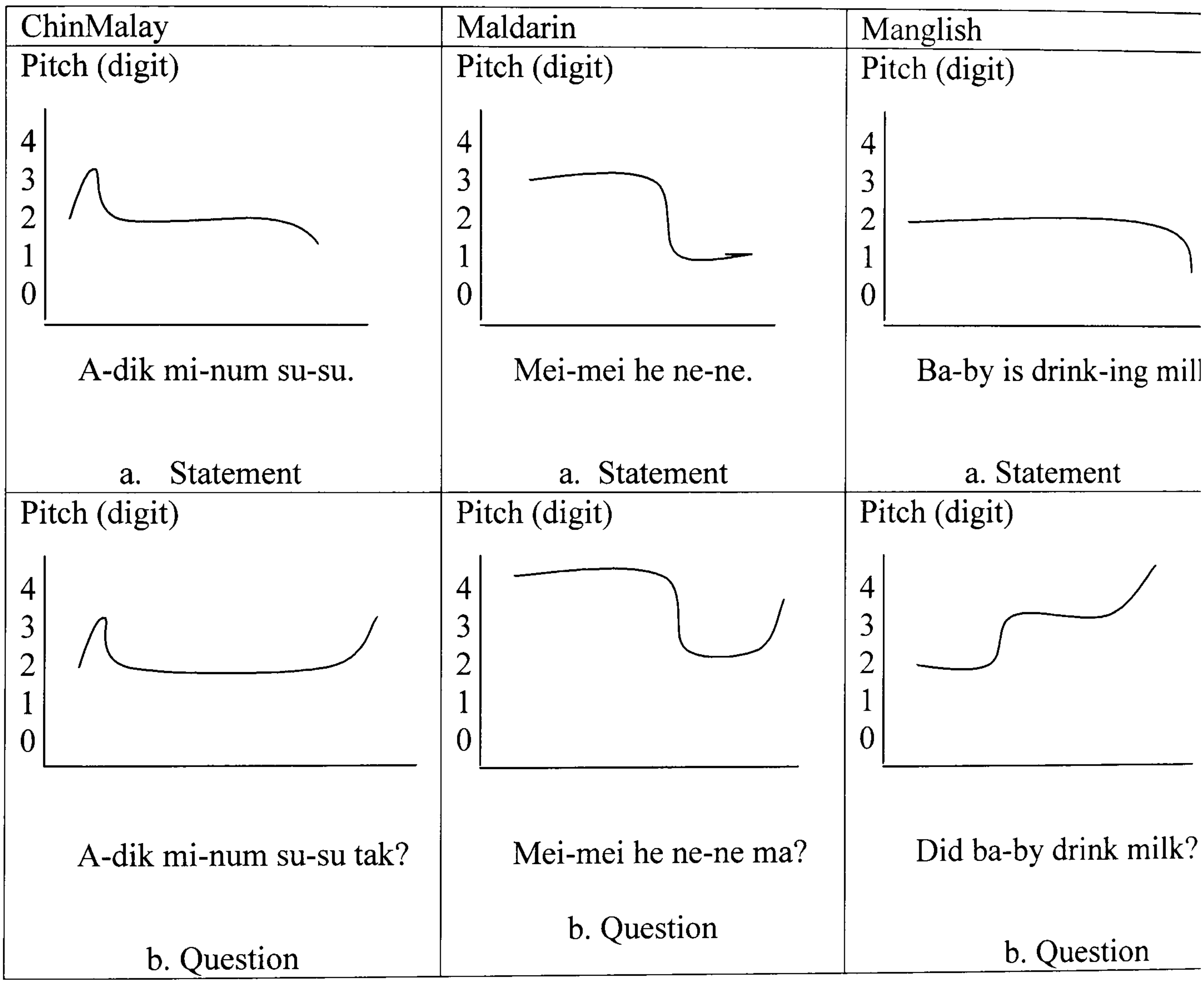


Figure 8.2 shows that the contrast between statement and question intonations is different for each language. In Manglish, the final tone namely: "final fall" and "final rise" is important in distinguishing statement intonation from question intonation. In Maldarin, in addition to the "final fall" and "final rise" to distinguish the two types of intonation, an overall "higher pitch register" in question intonation is also required. In ChinMalay, as with English and Maldarin, the "final fall" and "final rise" is important in distinguishing statement intonation

from question intonation. These contrasts, summarized in Table 8.2, were used as the main scoring criteria (see 8.7.4):

Table 8.2: Description of adult target pitch contours for statement and question intonations in English, Mandarin and Malay

	Adult target pitch contours
MANGLISH	
Statement	Level-fall, end with a final fall.
Question	Overall rising, end with a final rise.
MANDARIN	
Statement	Level-fall, end with a final fall
Question	Level-fall-rise, end with a final rise. Overall pitch register is higher than that of statement.
MALAY	
Statement	Rise-fall-level-fall, end with a final fall.
Question	Rise-fall-level-rise, end with a final rise.

8.7.3 Scoring procedure

Scoring, which was carried out by the researcher, focused on accuracy of reproduction of the pitch pattern of the stimulus: loudness, tempo, grammatical errors and segmental phonological errors were excluded from the scoring criteria. Perceptual scoring in terms of a numbered pitch level for each syllable proved to be more fine-grained than was needed to capture the key phonological contrasts in each language, and for that reason potentially unreliable. The notation using the 4-point pitch scale had been adopted to provide an objective description or precise picture on adult target pitch contours. However, this pitch scale was over sophisticated for capturing the pitch contour, e.g. a child who has a higher pitch level, may produce the English statement 2-2-2-2-2-1 as 3-3-3-3-3-2. Instead a simpler scoring criterion was used: has the child accurately reproduced the appropriate adult pitch contour as described in Table 8.2?

8.7.4 Testing procedure

The children were asked to imitate two audio-recorded test sentences, one for statement intonation, and the other for question intonation, in each of the three languages. Both test sentences were represented in picture form in order to aid understanding (see Appendix 8). The child was asked to imitate the stimulus while looking at the test picture. The test stimuli were audio-recorded in order to maintain consistency across participants. The child was asked to imitate the audio-recording; if he did not respond or hesitated, due to uncertainty about the nature of imitation task or inattention, the test stimulus would be repeated with live voice, for up to two attempts, to avoid delay in replaying the audio-recordings. Thus a maximum of three attempts was permitted. Repeated attempts were indicated on the test scoring form. One mark was given for a correct response and a zero mark was given for an inaccurate or nil response. The intonation test took approximately five minutes. Clear instruction with trial items was given in the beginning of the intonation test, and a reward was given at the end of the test.

8.7.5 Inter-transcriber reliability

The information about the transcriber and the transcription procedure has been described in Chapter 5. The transcription reliability for intonation was high, at 88%.

8.8 QUANTITATIVE AND QUALITATIVE ANALYSIS OF THE RESULTS

Age effects

Mean percent correct and standard deviation for each age group for intonation production accuracy was calculated to determine if there was an age effect on children's intonation acquisition (see Table 8.3).

Table 8.3: Intonation production accuracy (mean percent correct & standard deviation) by age in English, Mandarin and Malay

Age group / Intonation	2;06-2;11 (n=16)	3;00-3;05 (n=16)	3;06-3;11 (n=16)	4;00-4;05 (n=16)	Whole group (n=64)
ENGLISH					
Statement (n=1)	87.50 (34.15)	93.75 (25.00)	93.75 (25.00)	87.50 (34.15)	90.62 (29.37)
Question (n=1)	50.00 (51.63)	68.75 (47.87)	68.75 (47.87)	75.00 (44.72)	65.62 (47.87)
All intonation (n=2)	68.75 (35.93)	81.25 (30.95)	81.25 (30.95)	81.25 (25.00)	78.12 (30.69)
MANDARIN					
Statement (n=1)	100.0 (.00)	100.0 (.00)	100.0 (.00)	100.0 (.00)	100.0 (.00)
Question (n=1)	56.25 (51.23)	81.25 (40.31)	81.25 (40.31)	68.75 (47.87)	71.87 (45.31)
All intonation (n=2)	78.12 (25.61)	90.62 (20.15)	90.62 (20.15)	84.37 (23.93)	85.93 (22.65)
MALAY					
Statement (n=1)	93.75 (25.00)	100.0 (.00)	100.0 (.00)	100.0 (.00)	98.43 (12.50)
Question (n=1)	75.00 (44.72)	75.00 (44.72)	81.25 (40.31)	68.75 (47.87)	75.00 (43.64)
All intonation (n=2)	84.37 (30.10)	87.50 (22.36)	90.62 (20.15)	84.37 (23.93)	86.71 (23.97)

n=16: sixteen children per age group.
n=1: number of target items for statement and question intonations.

Table 8.3 shows an apparent improvement in intonation production accuracy with age in all three languages, though only when comparing the youngest age group with the other three older age groups. Kruskal-Wallis confirmed that there were no statistically significant age effects on acquisition of intonation in the three languages *(chi^2=1.772, p=0.621 for English; chi^2=3.348, p=0.341 for Mandarin; chi^2 =0.648, p=0.885 for Malay).* Hence, there is no statistical evidence for an effect of age on the acquisition of intonation. However, this result should be treated with caution due to the small sample size and the ceiling effects for statements in Malay and Mandarin.

The number of children making intonation errors is presented in Table 8.4:

Table 8.4: Number of children making intonation errors in English, Mandarin and Malay

Intonation \ Age group	2;06-2;11 (n=16)	3;00-3;05 (n=16)	3;06-3;11 (n=16)	4;00-4;05 (n=16)	Whole group (n=64)
ENGLISH					
Statement (n=1)	0	0	1	1	2
Question (n=1)	8	5	5	4	22
MANDARIN					
Statement (n=1)	0	0	0	0	0
Question (n=1)	7	3	3	5	18
MALAY					
Statement (n=1)	1	0	0	0	1
Question (n=1)	3	4	3	5	15
Total	**11**	**6**	**8**	**8**	**33**

n=16: sixteen children per age group.
n=1: number of target items for statement and question intonations.

Table 8.4 shows that altogether 33 children (52%) made intonation errors. In general, children performed better on statement intonation than question intonation.

8.8.1 Statement intonation errors

Only three children (5%), made statement intonation errors. Of the three statement intonation errors, two were for English and one was for Malay. No statement intonation errors were found for Mandarin. The three errors are shown in Table 8.5:

Table 8.5: Statement intonation errors in English and Malay

Adult target intonation		Child intonation production
ENGLISH		
Level-Fall, end with a final fall.	C1	Level-Rise, end with a final rise.
	C2	Fall-Rise-Fall-Rise, end with a final rise.
MALAY		
Rise-Fall-Level-Fall, end with a final fall.	C3	Incomplete response.

C: child.

C1's main mistake was to produce a final rise. C2 made two rises across the whole sentence which ended with a rise. C3 gave an incomplete response namely: "Adik minum susu"→[susu] (a fall).

8.8.2 Question intonation errors

22 children (34%) made question intonation errors in English, 18 (28%) in Mandarin and 15 (23%) in Malay (see Table 8.7). Examples of the most typical question intonation errors, in descending order of frequency, are presented in Table 8.6. The number of children exhibiting each error type is presented in Table 8.7:

Table 8.6: Question intonation errors in English, Mandarin and Malay

Adult target intonation	Error type	Child's intonation production
ENGLISH		
Overall Rising, end with a final rise.	1	Level-Fall, end with a final fall; particle "Did-" was preserved, sound like a statement.
	2	Level-Fall, end with a final fall; particle "Did-" was omitted, making it sound like a statement.
	3	Fall-Rise-Fall, end with a fall.
	4	Incomplete/non-response.
MANDARIN		
Level-Fall-Rise, end with a final rise. Overall pitch register is higher than that of statement	1	Level-Fall as in statement, end with a final fall, omitting final particle "-ma". Pitch register is low, very close to that of statement.
	2	Level-Fall-Rise, end with a final rise. Pitch register is low, very close to that of statement; sounds like a statement with an added final rising particle "-ma".
	3	Level-Fall as in statement, end with a final fall on particle "-ma". Pitch register is low, very close to that of statement.
	4	Level-Fall-Rise, end with a final rise. Pitch register is even lower than that of statement.
MALAY		
Rise-Fall-Level-Rise, end with a final rise.	1	Rise-Fall-Level-Fall, end with a final fall. sound like a statement.
	2	Overall flat, include final, sound like a statement.
	3	Incomplete/non-response.

Table 8.7 Number of children making question intonation errors in English, Mandarin and Malay

Age group / Question intonation error type	2;06-2;11 (n=16)	3;00-3;05 (n=16)	3;06-3;11 (n=16)	4;00-4;05 (n=16)	Whole group (n=64)
ENGLISH					
Type 1	2	1	3	3	9
Type 2	5	4	0	0	9
Type 3	0	0	1	1	2
Type 4	1	0	1	0	2
Overall total					**22**
MANDARIN					
Type 1	5	2	0	0	7
Type 2	2	1	1	2	6
Type 3	0	0	1	2	3
Type 4	0	0	1	1	2
Overall total					**18**
MALAY					
Type 1	0	1	1	5	7
Type 2	0	3	2	0	5
Type 3	3	0	0	0	3
Overall total					**15**

n=16: sixteen children per age group.

In the most common errors for English questions, English (i.e. Type 1 and Type 2), the target overall rising pitch contour was realized as an overall flat contour ending with a final fall, making it sound more like a statement (see Table 8.6). The difference between Type 1 and Type 2 was only on whether the initial question marker "Did-" was preserved. Type 1 error was used by all age groups, whereas Type 2 error was commonly used by the two youngest age groups. In the less common Type 3 error, the overall rising pitch contour in question intonation is realized as a fall-rise-fall. Only two children (3%) gave incomplete/non-response (Type 4 error).

Mandarin question intonation errors were divided into four main types (see Table 8.6). Type 1 errors were most commonly used by the two younger age groups particularly the youngest 2;06-2;11 age group (see Table 8.7). Type 2 error was very similar to that of Type 1 error except the final question marker "-ma" was preserved, the pitch contour was intact but the pitch register was as low as that of statement (see Table 8.6). Type 2 error was the only error type that was used by all age groups (see Table 8.7). In Type 3 error, the level-fall-rise pitch contour in the question intonation was replaced by a level-fall pitch contour ending with a final fall on the particle "-ma", making it sound like a statement. The main mistake in Type 4 error was on the overall lower pitch register than that of statement in the children. However, this type of error was rare, it was only used by 2 children (3%) (see Table 8.7) and therefore was treated as incidental error.

In Malay, three major error types were discerned. In Type 1 errors, the rise-fall-level-rise pitch contour in question intonation was replaced by a rise-fall-level-fall pitch contour, making it sound like a statement (see Table 8.6). Seven children (10.94%) were found to exhibit this error type (see Table 8.7). Type 2 errors were very close to Type 1 error, the only difference between the two was Type 2 ended with a slight higher pitch, making it all-level throughout (see Table 8.6). Five children (8%) were observed to exhibit this error type (see Table 8.7). Only three children (5%) gave incomplete/non-responses (Type 3 error).

In conclusion, in this section, children's acquisition of intonation for statement and question in English, Mandarin and Malay was analysed in terms of pitch contour and pitch register (for Mandarin). Statistical analysis indicated that acquisition of intonation in the three languages was not affected by the age range studied here, though this result may be influenced by ceiling effects as well as small sample size. Overall, statement intonation was acquired before question intonation in all three languages. Statement intonation errors were rare. Further analysis of question intonation errors showed that in most cases the target rising pattern was replaced by a falling pattern.

8.9 DISCUSSION

A study was conducted to investigate three questions relating to the development of intonation by multilingual children. In addressing these questions, it is hoped to contribute to the debate as to whether children's intonation development is influenced primarily by language specific factors or by universal factors.

1. Does intonation accuracy in multilingual children develop with age, between 2;06-4;05, in each of the three languages?

   There was no statistically significant age effect on intonation development, as measured in this study.

2. Is there a difference in children's accuracy in realising statement intonation vs. question intonation?

   The children made very few errors with statement intonations across the three languages, while question intonation errors were quite common. The pattern of results may indicate that questions are pragmatically more complex, perhaps more cognitively demanding, than statements, hence the greater number of errors. However, in each language, statement intonation is typically a falling contour, while question intonation has a rising contour. There therefore may also be a phonetic basis to the pattern of errors, namely that rising contours are harder to produce than falling contours. This would conform to the breath group theory (Lieberman, 1967) which explains production of pitch contour in physiological terms: regardless of the language, rising pitch is more difficult to express than falling pitch because it involves an increase in vocal fold tension or sub-glottal pressure (see section 8.1).

3. Do children make similar intonation errors across the three languages they are acquiring?

   Of the two intonation patterns tested, question intonation was more challenging than statement intonation in all three languages. Statement intonation errors were rare: only three children made statement intonation errors, two on English and one on Malay. No statement errors were found in Mandarin. For question intonation, four main types of error patterns were identified each in English and Mandarin, and three main types of error patterns were identified in Malay. In the most common errors for English questions, i.e. Type 1 and Type 2, the target overall rising pitch contour was realized as an overall flat contour ending with a final fall, making it sound more like a statement. In the less common Type 3 error, the overall rising pitch contour in question intonation is realized as a fall-rise-fall. These findings of statement and question intonation patterns in the present study are generally consistent with past studies in English, where falling pitch contour was acquired before rising pitch contour (Crystal, 1986).

In the most common errors for Mandarin questions (i.e. Type 1), the target overall rising pitch contour was realized as an overall flat contour end with a final fall by dropping particle "-ma", making it sound like a statement. The overall pitch register was as low as that of statement. In Type 2 error, pitch contour was preserved i.e. level-fall-rise but the overall pitch register was low, making it sound like a statement. Type 3 error was similar to Type 1 error, except the particle "-ma" was preserved. Type 4 was similar to Type 2 error, except the overall pitch register was even lower than that of statement. These developmental patterns of intonation reflect a language specific tendency: in Mandarin, overall pitch register is an important distinguishing tool in differentiating statement intonation and question intonation (Shen, 1990). While intonation development in Mandarin has not apparently been studied before, research on lexical tones in Mandarin (Putonghua) has shown that high falling tone is acquired before rising tone (Li & Thompson, 1977; Zhu, 2002)(see Chapter 2 & further discussion in Chapter 9). This finding for lexical tone is thus in line with the present results for intonation, in showing earlier use of falling pitch contours than rising contours.

In Malay, the main error for questions was the final fall in lieu of final rise, making the utterance sound like a statement. In the second most common error type, the adult target pitch contour of rise-fall-level-rise was realised as an overall flat contour including the final, making it sound like a statement.

Due to the restrictions that come with the nature of an imitation task, it is not possible to take account of various factors that have been proposed in relation to intonation development, e.g. linguistic factors such as grammatical complexities involved in questions as opposed to statements (Cruttenden, 1981), linguistic development such as mean length of utterances (MLU) (Furrow, 1984), sentence position (Snow, 1998) and emotional factors (D'Odorico, 1984; Marcos, 1987). Nevertheless, the findings of the present study for both English and Mandarin seem to lend support to the breath group theory (Lieberman, 1967) which explains production of pitch contour in physiological terms: regardless of the language, rising pitch is more difficult to express than falling pitch because it involves an increase in vocal fold tension or sub-glottal pressure.

8.10 CONCLUSION

Statement intonation (with falling pitch contour) was acquired before question intonation (with rising pitch contour). This is consistent with past studies in other languages, including English. The developmental patterns of statement intonation and question intonation in the three languages reflect both language specific factors and cross-linguistic tendency.

Given the restriction that comes with the nature of an imitation task adopted by the present study, the present results cannot be used to address some of the theories of intonation development found in the literature. However, it does offer some support for the breath group theory (Lieberman, 1967) which compared rising pitch with falling pitch in physiological terms i.e. regardless of the language, rising pitch was more effortful in production than falling pitch, and hence was acquired after falling pitch.

CHAPTER 9

DISCUSSION

9.0 INTRODUCTION

In this chapter, the results of the qualitative and quantitative analysis reported in the previous Chapter 6 & Chapter 7 will be discussed in terms of cross-linguistic similarities and differences as well as cross-linguistic influences. The plausible underlying contributing factors responsible for the phonological patterns as reviewed in Chapter 2 will be discussed. The theoretical implications of the findings will be discussed at the end of this chapter. In this way, the eighth to eleventh research questions set out in Chapter 1 (see section 9.1 below) will be answered.

9.1 RESEARCH QUESTIONS

8. What cross-linguistic similarities and differences are evident in the multilingual children's phonological acquisition?

9. Is there any evidence of cross-linguistic influences in the multilingual children's phonological production?

10. What other factors may affect multilingual children's phonological acquisition?

11. What are the theoretical implications of these results for the understanding of multilingual phonological acquisition?

9.2 CROSS-LINGUISTIC COMPARISON

In this section, the age of acquisition and the error patterns (simplifications) of consonants, vowels, syllable structures, tones (Mandarin only) and word production consistency developed from 2;06 to 4;05, as reported in Chapter 7 will be scrutinized for cross-linguistic similarities and differences. Where relevant, the results of the retrospective comparison of the present findings with those of the previous findings of monolingual and bilingual populations as discussed in Chapter 7 will also be incorporated.

9.2.1 Age of acquisition for consonants, vowels, syllable structures and tones

In general, there was a statistically significant developmental trend in the acquisition of consonants, vowels and syllable structures: see Chapter 6. The statistical finding of positive age effects is consistent with the significant age effects reported in many past studies including the bilingual Cantonese-English phonological acquisition study (Holm & Dodd, 2006): see Chapter 2. A cross-linguistic comparison among the three languages shows that the acquisition of all phonological components under study was completed by 4;00-4:05 except for English consonant clusters, English and Mandarin disyllable structures and English trisyllable structures. Singleton consonants in the three languages were acquired before consonant clusters in English. Vowels were acquired before consonants across the three languages. These findings are generally congruent with the past studies of English and Mandarin. There is a lack of studies of vowels in Malay. One theory is that vowels are acquired before consonants because they are more sonorant and ranked highest in the sonority scale compared with consonants (Hogg &McCully, 1987): see Table 2.1 in Chapter 2. Monosyllabic structures were generally acquired before disyllabic and trisyllabic structures. These findings are in support of the concept of markedness (Yavas, 1998): see Chapter 2 and further discussion in section 9.4. Tones in Mandarin were acquired fairly early i.e. 2;06-2;11, congruent with the past studies of Putonghua (Zhu & Dodd, 2000; Zhu 2002) and Cantonese (So & Dodd, 1995): see Chapter 2. The relatively early acquisition of tones compared to segments can be attributed to phonological saliency factors (Zhu & Dodd; Zhu, 2002): tones are more salient than consonants and vowels in Mandarin because tones are compulsory in a syllable to distinguish lexical meaning. Moreover there are only four tonal items compared to 21 consonants and 21 vowels. This saliency explained why tones are acquired before segments (c.f. Vihman, 1996). Tones are also perceptually more salient than segments (Quigley & Paul, 1984) hence tones are acquired before segments.

9.2.2 Error patterns of consonants, vowels, syllable structures and tones

A cross-linguistic comparison among the three languages under study shows that both structural and systemic simplifications were evident in the consonant and vowel production in the three languages. These findings are consistent with the previous studies of the same languages. There was a common tendency to replace a marked feature with an unmarked feature such as to replace the aspirated consonant with an unaspirated consonant in Mandarin i.e. deaspiration, and to replace an affricate with a fricative in both English and Mandarin i.e. deaffrication. Contrary to Putonghua (Zhu & Dodd, 2000), the reverse. i.e. marked pattern of Mandarin aspiration is not found in the present study. The replacement of a marked feature with an unmarked feature is also evidenced in vowels e.g. /i̱/→[i] in Mandarin, where /i/ is claimed to be unmarked (Yavas, 1998).

Many error patterns in the three languages reflect simplification strategies to create an unmarked CV syllable structure: deletion of medial and final consonants plus initial and final cluster reductions in English; deletion of medial and final consonants in Mandarin and Malay; triphthong reduction in Mandarin. There was a common tendency to simplify the syllable structures, involving a replacement of a more marked syllable structure (with a longer string of consonants) with a less marked one (with a shorter string of consonants).

Some of the consonant errors were shared by the three languages: /ɹ/ɻ/r/→[l] substitution, deletion, gliding, backing, affrication, stopping and consonant harmony. Only one simplification was shared by English and Mandarin i.e. deaffrication. Two simplifications were shared by English and Malay: fronting and metathesis. However, no simplifications were shared only by Mandarin and Malay, reflecting specific-language effects. For instance, metathesis was shared by English and Malay but not Mandarin presumably because Mandarin comprises mostly open-syllable words compared to English and Malay, which both have more closed-syllable words. Other language-specific consonant errors were: initial and final cluster reduction, voicing, frication, initial syllable deletion, reduplication, final glottal replacement in English; deaspiration in Mandarin; final plosive release in Malay. These developmental patterns generally reflect the interaction of general tendencies across the three languages and specific-language effects. As for vowels, three main vowel simplifications were identified: substitution, addition and reduction. Only substitution was shared by the three languages. The number of consonant errors is roughly the same as the past studies of Mandarin and Malay. However, this is not the case for English: there were sixteen English simplification patterns in the present study compared to seven in Dodd, Holm, Zhu & Crosbie (2003). The wider repertoire of English consonantal errors in the present study might be due to the usage of standard and non-standard forms of English pronunciation by children growing up in a multilingual learning context. Obvious examples are the pervasive usage of the /ɹ/ɻ/r/→[l] substitution, /v/→[w] gliding, and lowering of vowel /o/→[ɔ] which all might be sociolinguistic variants rather than developmental errors (see Chapter 5).

Tonal errors were rare in the present study. In the entire tonal corpus, only a total of seven tonal errors were found. This finding is congruent with the previous findings of Putonghua (Zhu & Dodd, 2000; Zhu, 2002) and Cantonese (So & Dodd, 1995)(see Chapter 2). In the present study, the rising tone (T2) was commonly used to substitute for all other tones including the third tone sandhi, whereas in Zhu's (2002) longitudinal study, the high level tone (T1) is the most common substitute for other tones. This discrepancy of findings may be due to the age differences of the children in the two studies. Zhu's (2002) children were younger i.e. between 1;00 and 2:00, whereas the children in the present study were older i.e. between 2;06-4:05. The high level tone (T1) is acquired before the rising tone (T2) presumably because it has a less complicated pitch contour/change compared with the rising tone (T2)(Zhu 2002). It is therefore not surprising that the high level tone (T1) is frequently used as a substitute for all other tones in Zhu's younger children.

A retrospective comparison of the multilingual children in the present study with the monolingual and bilingual children described in the literature shows that though most of the developmental patterns used by the multilingual children are commensurate with those used by the monolingual and bilingual children acquiring the same languages, nevertheless some qualitative and quantitative differences can be noted. The rate of acquisition of certain consonants by the multilingual children in the present study was quicker than that of monolingual and bilingual children. Such consonants include: English /ʃ,tʃ, dʒ/, Mandarin /ts, s, l, k, k^h, p^h, ts^h/ and Malay /s/. On the other hand, only three consonants were found to be acquired later than by monolingual and bilingual children: Mandarin /t^h, p^h/ and Malay /ɲ/. Table 9.1-Table 9.3 summarise the types of error patterns used in English, Mandarin and Malay by the multilingual children in the present study and the bilingual Cantonese-English children (Dodd, So & Li, 1996; Holm & Dodd, 1999b, 2006), bilingual Cantonese-Putonghua children (So & Leung, 2006; Law & So, 2006), and the native Malay-speaking children (see a compilation of past studies summarized in section 4.2.1 in Chapter 4) in the previous studies respectively.

Table 9.1-Table 9.3 show that there are some qualitative differences in the types of error patterns used by the two populations and some quantitative differences in the number of error patterns used by the two populations (see also Chapter 7). These differences implicate the plausible underlying interacting effects of the specific multilingual language combination and the specific bilingual language pair. Alternatively, these differences implicate the plausible influences of two different additional languages on the individual language of English, Mandarin and Malay namely: Mandarin and Malay on English, English and Malay on Mandarin, and English and Mandarin on Malay, compared to either only English or Mandarin on Cantonese in the bilingual Chinese children, or English on Malay in the native Malay-speaking children (see further discussion on "atypical errors" in section 9.3).

Table 9.1 Typical English consonant errors used by the bilingual Cantonese-English and multilingual English-Mandarin-Malay children

English	
In multilingual English-Mandarin-Malay children (the present study)	In bilingual Cantonese-English children (Dodd et al, 1996; Holm & Dodd, 1999b, 2006)
1. /ɹ/→[l] substitution	
2. Deletion	
3. Gliding	Gliding
4. Backing	
5. Affrication	
6. Stopping	Stopping
7. Consonant harmony	Consonant harmony
8. Deaffrication	Deaffrication
9. Fronting	Fronting
10. Metathesis	
11. Cluster reduction (initial & final)	Cluster reduction (initial & final)
12. Voicing	Voicing
13. Frication	
14. Initial syllable deletion	Initial/weak syllable deletion
15. Reduplication	
16. *Final glottal replacement	

**used by two children only.*

Table 9.2 Typical Mandarin consonant errors used by the bilingual Cantonese-Putonghua and multilingual English-Mandarin-Malay children

Mandarin	
In multilingual English-Mandarin-Malay children (the present study)	In bilingual Cantonese-Putonghua children (So & Leung, 2006; Law & So, 2006)
1. /ɹ/→[l] substitution	
2. Deletion	Deletion
3. Gliding	Gliding
4. Backing	Backing
5. Affrication	Affrication
6. Stopping	Stopping
7. Consonant harmony	Consonant harmony
8. Deaffrication	
9. Deaspiration	Deaspiration
	Aspiration
	Fronting
	x-velaristaion

Table 9.3 Typical Malay consonant errors used by the native Malay-speaking and multilingual English-Mandarin-Malay children

Malay	
In multilingual English-Mandarin-Malay children (the present study)	In native Malay-speaking children (a compilation of past studies summarized in section 4.2.1 in Chapter 4)
1. /r/→[l] substitution	**/r/→[l] substitution
2. Deletion	Deletion
3. Gliding	Gliding
4. Backing	Backing
5. Affrication	Affrication
6. Stopping	Stopping
7. Consonant harmony	Consonant harmony
8. Fronting	Fronting
9. Metathesis	**Metathesis
10. *Final plosive release	
	**Addition

**used by two children only.*

***used sporadically by only a few children (see section 4.2.1 in Chapter 4 & the discussion in Chapter 7).*

9.2.3 Consistency and inconsistency of word production

In the present study, consistency of intra-word production over two trials (one in the main test and one repeated at the end of the main test) was found to develop with age. Children were generally more consistent (either correctly or incorrectly) than inconsistent in word production. Consistently correct responses generally increased with age, whilst consistently incorrect responses generally decreased with age (see Chapter 6). Statistical analysis confirmed that there was an age-improvement of word production consistency when consistently correct responses alone were counted, but when consistently incorrect responses were also incorporated, this developmental trend was not found. This reflects that the youngest multilingual children (2;06) in the present study were more likely than the older children to produce consistently inaccurate realizations of target words. By 4;00, the multilingual children were highly consistent in their word production. This finding is congruent with previous findings for English (Holm, Crosbie & Dodd, 2007), as reviewed in Chapter 2. The inconsistency of word production is thought to reflect a reorganization of the linguistic system (Vihman, 1996) moving towards a more sophisticated production i.e. from word-based learning towards rule-based learning (Bleile, 1995, 1996)(see Chapter 2).

Inconsistency of word production was mainly due to "consonant variations" (e.g. [dwaiwiŋ vs. dɹaiʊiŋ] in English)(see Chapter 7). This is not surprising as the accurate production of consonants generally posed more challenges to the children than that of vowels and syllable structure. Less common inconsistencies involved "a combination of consonant and vowel variations" (e.g. [dɹaifiŋ vs. dwaufiŋ] in English), "syllable structure variations" (e.g. [bənana vs. bənanas] in English) and "vowel variations" (e.g. [ni3ae2tsi̯3 vs. [ni3ae2tsi3] in Mandarin). Syllable structure inconsistencies only occurred in English and Malay. This is not surprising as Mandarin comprises many simple open-syllable words. On the other hand, vowel inconsistencies only occurred in Mandarin. This can be attributed to a slightly more complex vowel system in Maldarin, than in Manglish and ChinMalay, where triphthongs are not found (see Chapter 3). This pattern of inconsistency of word production in the three languages thus reflects the influence of individual languages.

9.3 CROSS-LINGUISTIC INFLUENCES

In this section, the cross-linguistic influences found in the multilingual children's phonological acquisition will be discussed. As reviewed in Chapter 2, several forms of cross-linguistic influences have been reported in the literature (Paradis & Genesee, 1996; Dodd et al., 1996; Holm & Dodd, 1999b, 2006; Yang & Zhu, in press). These cross-linguistic influences are summarized below:

1. *Acceleration.* A shared feature (usually an early acquired one) in one language is acquired earlier than expected owing to the influence of the other language(s).

2. *Delay.* A feature in one language is acquired later than expected owing to the influence of the other language(s).

3. *Transfer.* A language-specific feature is used in the wrong language resulting in a deviant pattern; in other words, a feature in one language is showing up in the other language. Usually a feature of the dominant language transfers to the weaker language.

4. *Phonotactic overgeneralization.* Shared features used in the wrong phonotactic position in one of the languages.

5. Occurrence of error patterns that are atypical for monolingual children learning the language. *Atypical errors* are defined as error patterns which are used by less than 10% of the monolingual children, that are associated with phonological disorder in monolingual children acquiring a similar language.

There are several factors which have contributed to the above cross-linguistic influences. These factors will now be discussed.

Acceleration

In the present study, the acquisition of the following consonants seemed to be faster than that of monolingual and bilingual children in the past studies: English /ʃ, tʃ, dʒ/, Mandarin /ts, tsʰ, s, l, k, kʰ, pʰ/ and Malay /s/ (see Chapter 7). Except for English /ʃ/ and Mandarin /ts, tsʰ, kʰ, pʰ/, these consonants are shared by the three languages. The higher amount of exposure to these shared consonants as a result of an acquisition of one or two additional languages, seemed to have accelerated the acquisition of these consonants.

Delay

Conversely, the multilingual Malaysian children's acquisition of Mandarin /pʰ, tʰ/ and Malay /ɲ/ lagged behind that of both monolingual and bilingual children and native Malay-speaking children (see Chapter 7). The delayed acquisition of these consonants could be attributed to the burden of having to learn two additional languages (Genesee & Nicoladis, 2008) (see Chapter 2). The delayed acquisition of Mandarin /pʰ, tʰ/ may be due to interference from Malay, since in Malay, /p, t, k/ are always unaspirated. Even in the adult English (Manglish), /p, t, k, tʃ/ are often unaspirated in the non-final word position (see Chapter 3).

Transfer

In the present study, cross-linguistic interference or transfer is non-existent. Lowering of the vowel /o/→[ɔ] in English and Malay shared target word YOYO is said to be a transfer from Mandarin (Maldarin). However, as the lower variety of vowel /o/ namely [ɔ] is said to be favoured by some speakers of Malay, the conclusion of a transfer from Mandarin [ɔ] to English and Malay requires further validation (see Chapter 7).

Phonotactic overgeneralisation

In the present study, shared features were never used in the wrong phonotactic position.

Atypical error patterns

In the present study, congruent with the previous findings for bilingual Chinese children (Dodd et al., 1996; Holm & Dodd, 1999b, 2006; So & Leung, 2006), the multilingual Chinese children exhibited error patterns that are not typical for the monolingual and bilingual children described in the literature (see Chapter 2). The list of atypical error patterns evident in the present study is presented in Table 9.4:

Table 9.4: Atypical English, Mandarin and Malay consonant errors used by the multilingual English-Mandarin-Malay children

English	Mandarin	Malay
1. /ɹ/→[l] substitution	/ɻ/→[l] substitution	*Final plosive release
2. Within word consonant deletion	Deaffrication	
3. Backing		
4. Affrication		
5. Frication		
6. *Final glottal replacement		
7. *Gliding of medial stop		

**used by two children only.*

As with the findings of the above mentioned past studies of bilingual Cantonese-English (Dodd et al., 1996; Holm & Dodd, 1999b, 2006) and bilingual Cantonese-Putonghua (So & Leung, 2006), in the present study, atypical errors involved mainly consonants. The above Table 9.4 is derived from a qualitative comparison with the typical error patterns commonly reported in the literature of the three languages (c.f. Table 2.3 in Chapter 2 alongside Grunwell, 1987 & 1997 for English; Table 2.10 in Chapter 2 for Mandarin; a compilation of past studies summarized in section 4.2.1 in Chapter 4 for Malay). The list of atypical English error patterns of bilingual Cantonese-English (Dodd et al., 1996; Holm & Dodd, 1999b, 2006) and, the list of atypical Putonghua error patterns of bilingual Cantonese-Putonghua (So & Leung, 2006) are summarized in Table 9.5. There are no previous studies reporting the disordered phonological error patterns in Malay with which to compare the present findings.

Table 9.5: Atypical English and Putonghua consonant errors used by the bilingual Cantonese-English and bilingual Cantonese-Putonghua children

English	Putonghua
In bilingual Cantonese-English children (Dodd et al., 1996; Holm & Dodd, 1999b, 2006)	In bilingual Cantonese-Putonghua children (So & Leung, 2006)
1.Backing	1. Final consonant deletion
2.Initial consonant deletion	2. Deaffrication
3.Voicing	3. Nasalization
4. Affrication	
5. Addition	
6. Nasalization	
7. Frication	
8. Transposition	
9. Unreleasing of final consonant	
10. Deaspiration	
11. Deaffrication	

Compared to the bilingual Cantonese-English children (Dodd et al., 1996; Holm & Dodd, 1999b, 2006) and bilingual Cantonese-Putonghua children (So & Leung, 2006), there are clearly more differences than similarities in the specific types of atypical error patterns used by the present multilingual children (Table 9.4 vs. Table 9.5). These differences can be taken as the consequence of the effects of multilingual acquisition i.e. the effects of the specific language combination of English, Mandarin and Malay compared to the specific language combination of the language pair in bilingual children: Cantonese and Putonghua, and Cantonese and English. Alternatively, the effect of the acquisition of two different additional languages upon English and Mandarin respectively is possibly responsible for the differences: Mandarin and Malay upon English, and English and Malay upon Mandarin (c.f. either only English or Mandarin upon Cantonese in the bilingual children). On the other hand, the similarities in the specific types of atypical errors used by the two populations: backing, affrication and frication in English, and deaffrication in Mandarin (Table 9.4 vs. Table 9.5) implicate the consequence of language-based effects irrespective of the potential interacting effects of additional languages. All the atypical error patterns listed in Table 9.4 should be considered as the "normal multilingual error patterns" not found in the monolingual Chinese children acquiring the same languages, but are found in the phonological disordered children acquiring the same languages as described in the literature (see Chapter 2). Final plosive release, the atypical Malay pattern reported in the present study (see Table 9.4) is not found in the native-Malay speaking children in Malaysia. No research has been done on phonological disorder in Malay, and therefore whether this atypical Malay error pattern is also used by Malay children with phonological disorders is not known. Some of the atypical error patterns used by the bilingual Cantonese-English and bilingual Cantonese-Putonghua children listed in Table 9.5, namely non-release of final consonants and deaspiration in English are doubtful, as they are frequently used by the adult Chinese speakers of English with a Southern Chinese dialect background (see Chapter 2). Nasalization in Mandarin (Putonghua) is also a common Southern Mandarin (Putonghua) phonological feature (see Chapter 2). It is inappropriate to treat these sociolinguistic variants as a cross-linguistic transfer pattern in the bilingual children since this transfer has already occurred in the adult phonologies (input models)(see Chapter 3). In addition, deaffrication in English is sometimes reported as a typical error pattern (c.f. Table 2.3 in Chapter 2). It has been treated as such in the present study. Likewise, final consonant deletion is sometimes reported as a typical error pattern in other studies of Putonghua-speaking children (c.f. Zhu, 2002)(see Chapter 2).

In summary, in the present study, cross-linguistic influences are mainly manifested in the atypical error patterns exhibited by the multilingual children, congruent with the previous findings for bilingual Cantonese-English (Holm & Dodd, 1999b, 2006) and bilingual Cantonese-Putonghua (So & Leung, 2006) children. The present study is the first study reporting the atypical error patterns in Malay, having been influenced by two additional languages, English and Mandarin. It is however worth mentioning that in the present study, there are only very few atypical error patterns in Mandarin and Malay. This finding of a small number of Mandarin atypical errors is consistent with the previous findings for Putonghua by both Cantonese-Putonghua children in the above study by So & Leung (2006)(see Table 9.5), and also the other study by Law & So (2006), in which cross-linguistic influences are claimed to be non-existent in Law & So's study (see Chapter 2). In the present study, the number of the atypical error types in English, namely seven, is comparable with that of bilingual Cantonese-English children (Table 9.4 vs. Table 9.5). This pattern of findings reflects the influence of the nature of an individual language on atypical errors (c.f. Zhu & Dodd, 2006c). English has a much bigger consonantal inventory compared with Mandarin and Malay, and so it is not surprising that English has the largest number of errors including atypical errors. The qualitative differences that exist between the atypical error types found in the present study with those of the above past studies (Table 9.4 vs. Table 9.5) can be attributed to the effects of multilingual acquisition, having been influenced by two different additional languages. Despite these atypical errors, the multilingual children have clearly developed three phonological systems that are somehow interacting. Law & So (2006) claimed that the absence of cross-linguistic interference in the speech data of their bilingual Cantonese-Putonghua children can be attributed to the close-language relatedness i.e. both Cantonese and Putonghua are tonal languages (see Chapter 2). The present finding rejects this claim. In the present study, little cross-linguistic influences are found in Mandarin and Malay, even though Mandarin, a Sino-Tibetan language, is not related to Malay, an Austronesian language. Moreover, both languages are also interacting with English, another non-related Germanic language, at the same time. As such, close-language relatedness is not the sole factor affecting cross-linguistic interaction, other underlying factors such as chronological age, unequal amount of input exposure and extent of use, language dominance, input model, linguistic and psycholinguistic factors as reviewed in Chapter 2 must also be playing a role (see section 9.4 below).

9.4 CONTRIBUTING FACTORS

In this section, the plausible factors underlying multilingual phonological acquisition other than cross-linguistic influences as reviewed in Chapter 2 will be discussed.

Chronological age

The discussion in section 9.2 and section 9.3 has pointed to the significant age effects in multilingual phonological acquisition. It is therefore essential to include the age norms in the phonological test for English, Mandarin and Malay targeted for the local multilingual population. This finding of age effects has supported the methodology employed by the present research that is, the young age range i.e. 2;04-4;05 under study is an important one for phonological development.

Unequal amount of input exposure and extent of use & language dominance

The multilingual children's phonological milestones in all respects, consonants, vowels, syllable structures, tones and consistency of word production are largely comparable with the monolingual population or bilingual population acquiring the same languages (see Chapter 7). Their consonantal acquisition is slightly more advanced than that of bilingual children from a minority immigrant group (Holm & Dodd, 2006)(see Chapter 7). These findings speak to an equal capability of the multilingual population and the monolingual and bilingual populations in phonological acquisition, and that the amount of input influences phonological performance (see Chapter 7).

The multilingual children growing up in a multilingual language learning context have all clearly received a sufficient amount of language input for their three languages, both of the absolute and relative frequency of input to the three languages. The results of the statistical analysis of partial correlation showed a tendency for children to have a comparable level of performance in the three languages, for virtually all phonological components (see Chapter 6): children who were phonologically advanced were advanced in all three languages, and vice versa. This suggests that the children in the study were exposed to each of the three languages in similar proportions. These results which were yielded from the partial correlation analysis have also supported the valid methodology used in the present study namely, by not distinguishing L1/L2 (most dominant language/second dominant language)- a convention commonly used in the studies of bilingual acquisition in ethnic Chinese children growing up in a multilingual Southeast Asia country (see Chapter 2).

Input model

The present study has opened up a new dimension in approaching the multilingual phonological acquisition in a multilingual language learning context namely, by including the adult phonological input model in the data analysis. Even though the phonological variants (simplifications occurring in the adult phonological systems) in the three languages have resulted in a few simplified target segments, the present statistical findings illustrated that this approach is reliable and valid (see chapter 6), and that the developmental milestones of the multilingual children are largely commensurate with the monolingual and bilingual populations acquiring the same languages (see Chapter 7). The present findings challenge the previous findings of delayed phonological development in bilingual Cantonese-Putonghua (So & Leung, 2006) and bilingual Cantonese-English (Dodd et al., 1996; Holm & Dodd, 1999b, 2006) children. These studies suffer from methodological problems, as described in Chapter 2, which may have led to an underestimate of the children's phonological development particularly in the "second" language.

Linguistic factors

Turning to the underlying linguistic processes that may contribute to multilingual phonological development, the present findings deriving from both the qualitative and quantitative analyses, provide evidence that is relevant to linguistic theories reviewed in Chapter 2. The theory of *markedness* states that nasals and glides are unmarked early acquired sounds, whereas liquids are more challenging and marked (Yavas, 1998) and thus, are late acquired sounds. The late acquisition of the marked features of aspiration, affrication and retroflexion have been reported in Mandarin (Putonghua), though whether or not affrication is a marked feature is debatable, as early acquisition of affricates have been reported for Japanese, Italian (Zhu & Dodd, 2000) and Malay (see Table 4.1 in Chapter 4). The markedness and feature theories do not fully explain the present findings. In the present study, the nasals and glides were generally acquired before the liquid /r/, as predicted by markedness, however the liquid /l/ in all three languages were acquired early whereas the Malay nasal /ɲ/ was acquired late. In addition, the affricates were acquired early by 2;06-2;11 in all three languages: /tʃ. dʒ/ in English and Malay; /ts, (tʂ), (tɕ)/ in Mandarin (the bracketed ones being less conclusive as they were sometimes replaced by the [ts] variant, though [ts] is itself an affricate). However, as predicted by the feature theory, the other three Mandarin aspirated affricates /tsʰ, (tʂʰ), (tɕʰ)/ were acquired later than the non-aspirated counterparts, i.e. by 3;00-3;05, indicating a tendency for a late acquisition of the aspiration feature compared to the non-aspiration feature. In fact, five out of the six aspirated consonants, the above three aspirated affricates and the other two aspirated velar stops /pʰ, tʰ/ were all acquired by 3;00-3;05. Compared to the early acquisition of virtually all other consonants in Mandarin by 2;06-2;11 (see Table 7.1 in Chapter 7), the acquisition of these aspirated consonants by 3;00-3;05 is considered relatively late. The late acquisition of the liquid /r/ in the present study seems to support the "biological model" (Locke, 1980, 1983) and the "articulatory complexity model" (Kent (1992) which claimed that the liquids /l, r/ are difficult to articulate and perceive. However, though /r/ was acquired late in all three languages, /l/ was acquired early in all three languages (see Table 7.1 in Chapter 7). Moreover, these two models failed to explain the early acquisition of the affricates, and the regression of the English /ʃ, sp, sw/ where sounds which are acquired earlier were not used consistently until 3;06-3;11 for /ʃ/, and not even by 4;00-4;05 for English /sp, sw/.

The *sonority sequencing principle* (SSP), another aspect of markedness that is claimed to account for the occurrence of consonant clusters (Selkirk, 1984), has been supported by monolingual and bilingual phonological acquisition studies (Yavas, 2003; Yavas & Goldstein, 2006). The 10-point sonority scale devised by Hogg & McCully (1987)(see Table 2.1 in Chapter 2) enables evaluation of the sonority distance of the two segments in a cluster, in which a cluster with a higher sonority distance is said to be unmarked compared to another cluster with a lower sonority distance. In the present study, the sonority distance value of the six earliest consonant clusters /pl, kl, bl, gl, sp, sw/ by 3;06-3;11 are: 5 for /pl, kl/, 4 for /bl, gl/, 2 for /sp/ and 5 for /sw/ (see Table 2.1 in Chapter 2). The sonority distance value of the late acquired clusters /fɹ, st, sk/ by 4;00-4;05 are: 4 for /fɹ/ and 2 for /st, sk/, whereas the sonority distance value of the late acquired clusters which were still not acquired by 4;00-4;05 /sm, sn, sl, fl, bɹ, gɹ, tɹ, kɹ, ntʒ(tʃ)/ are: 2 for /sm, sn/, 2.5 for /ntʒ(tʃ)/, 3 for /sl/, 4 for /fl/, 5 for /bɹ, gɹ/, 6 for /tɹ, kɹ/. These patterns of finding provide mixed results, some supporting but others disconfirming the SSP (see also conflicting results reported in Barlow, 2001). For instance, consistent with the prediction of SSP, /pl, kl/, both having a sonority distance value of 5, were acquired before /st, sk/, which have the same sonority distance value of 2. However, inconsistent with the prediction of SSP, /tɹ, kɹ/ both having a sonority distance value of 6, were acquired after /fɹ/, which has a lower sonority distance value of 4. The only final cluster tested in the present study, /ntʒ(tʃ)/, was acquired late, i.e. not acquired by even 4;00-4-05. This finding of a late acquisition of final clusters compared with initial clusters is consistent with McLeod, Doorn & Reed (2001) (see Chapter 2). In the present study all can be said about clusters is that clusters containing stops (/p/b/k/g/ + /l/) are generally acquired before clusters containing fricatives (e.g. /sm, sn, sl, fl/) congruent with the previous findings of Templin (1957) and Smit, Hand, Freilinger, Bernthal & Bird (1990)(c.f. Stoel-Gammon & Dunn, 1985)(see Chapter 7).

Jakobson (1941/68) predicts that nasals, front consonants and stops will be acquired before orals, back consonants and fricatives. In the present study, stops, nasals /m, n, ŋ/ and front consonants (/p, b, m, f/) in the three languages tend to be acquired early, whereas English fricatives (/θ, v/) tend to be acquired late, consistent with Jakobson's prediction (see Table 7.1 in Chapter 7). However, the Malay nasal /ɲ/ was acquired later than the back consonants (/k, g, ŋ/) and the fricatives (/s, h/). The late acquisition of Malay nasal /ɲ/ suggests that the linguistic factor is not solely responsible for the multilingual phonological patterns, other factors such as the language input as discussed above are clearly playing a role. The multilingual children have generally acquired their Malay at pre-school rather than at home, the Malay nasal /ɲ/ is not available in the English and Mandarin phonological systems, /ɲ/ is not a high frequency consonant in Malay, so it is likely that the limited amount of exposure to /ɲ/ is responsible for its late acquisition compared to all the other nasals in Malay. Further, contrary to Jakobson's prediction, the Mandarin fricatives (/f, s, (ʂ), (ɕ), x/) were acquired at the around the same time as stops (/p, t, k, kʰ/) and nasals (/m, n, ŋ/), though the bracketed fricatives /ʂ/ and /ɕ/ were less conclusive as they were sometimes replaced by the [s] variant. Moreover, contrary to Jakobson's prediction, front consonants were generally acquired at around the same time as back consonants in the three languages: /p, b, f/= /k, ŋ/ in English; /p, (pʰ), m, f/= /k, kʰ, x, ŋ/ with the exception of /pʰ/ in Mandarin; and /p, b, m/= /k, ŋ/ in Malay.

Further, there are also some differences in the order of acquisition by different populations of children acquiring the same ambient languages i.e. the multilingual children of the present study compared to the monolingual and bilingual children in the previous studies (c.f. Table 7.1 & Table 7.2 in Chapter 7). For example, the English /ʃ, tʃ, dʒ/ were acquired earlier by the multilingual children in the present study than by monolingual children in previous studies (Prather, Hedrick & Kern, 1975; Dodd et. al, 2003). In Mandarin, /ts, tsʰ, s, l, k, kʰ, pʰ/ were acquired earlier, but /pʰ, tʰ/ were acquired later in the present study compared to past studies (Zhu & Dodd, 2000). In Malay, /s/ was acquired earlier, but /ɲ/ was acquired later in the present study compared to the past studies (c.f. Table 4.1. in Chapter 4). These findings present a challenge for the innate universal phonological acquisition patterns proposed by both Jakobson's (1941/68) "law of irreversible solidarity" theory and Stampe's (1969, 1979) natural phonology theory. These theories of phonological universals do not account for the cross-language variation in the acquisition of the same consonants (see Chapter 2). This indicates that phonological acquisition is probably also affected by individual language-based effects (see further discussion below).

Functional load (Pye, Ingram & List, 1987; Ingram, 2008), which focuses on language specific factors, does not fully explain the present findings either. For example, the nasal /m/ is claimed to have a higher functional load than /ŋ/ in English (Pye et al., 1987), however, in the present study, both /m/ and /ŋ/ are acquired at around the same time i.e. 2;06-2;11. Also, contrary to the prediction of Pye et al. (1987), the Mandarin (Putonghua) nasal /n/, which has a greater functional load than /ŋ/, is acquired later than /ŋ/ (Zhu & Dodd, 2000). /ŋ/ is said to have a lower functional load than /n/ in Mandarin because it does not occur in the word initially position. In the present study, as with all other consonants, occurrences of /n/ in different word positions are combined for the calculation of "age of acquisition". /n/ was tested in word initial and word final position (see Chapter 7). However, there is evidence from the present data that the multilingual children are doing better in /ŋ/ than /n/, in that /ŋ/ has a slight lower percentage of errors than /n/. Thus, the present findings are consistent with the findings of Mandarin (Putonghua)(Zhu & Dodd, 2000) that challenged the prediction of functional load. However, functional load is accountable for the patterns of nasal acquisition in Malay in the present study. The nasal /ɲ/, which was acquired after the other Malay nasals /m, n, ŋ/, has a lower functional load as it does not occur word finally.

Zhu & Dodd (2000) refined the concept of *phonological saliency* to account for the patterns of phonological acquisition in Mandarin (Putonghua)(see Chapter 2). Phonological saliency is described as a syllable-based and language-specific concept, which takes into account the role of each syllable in carrying and distinguishing lexical information. The value of saliency is determined by three features: (i) How capable is the syllable of distinguishing lexical meaning? (ii) What is the status of the feature involved i.e. is it a compulsory feature of a syllable or not? And (iii) how many choices are permitted in a syllable? According to this theory, the reason tone was acquired the earliest is because of the small number of items (four) in the tonal system, plus its compulsory status in a syllable to distinguish lexical meaning, i.e. it meets all three criteria. The syllable-final consonant and vowels were acquired next. There are only two syllable-final consonants (criterion iii), but they are optional in a syllable, going against criterion (ii). The vowel is compulsory in a syllable (ii), but it has a large number of items (21), i.e. going against (iii). Syllable-initial consonants are acquired last: they are the least salient of all four owing to their large number (21) and their optional status in a syllable. Phonological saliency is supported by data from Cantonese (Dodd, 1995; So & Leung, 2006), another Chinese language which has a comparable structure. It is also supported by data from a multilingual child acquiring Spanish-Mandarin-Taiwanese (Yang & Zhu in press): see Chapter 2. The multilingual child demonstrated a slightly faster acquisition rate in Taiwanese than in Mandarin, and highest speech accuracy in Taiwanese among all three languages even though he had the least input in Taiwanese. These findings were attributed to the effects of phonological saliency: Taiwanese has the least number of consonants (16) compared to Mandarin (19) and Spanish (19), and so its consonant system is most salient, explaining why Taiwanese consonants are acquired earlier than those of Mandarin. The present findings in Mandarin are consistent with previous findings for Mandarin (Putonghua) (Zhu & Dodd, 2000). Tones and vowels were acquired earlier than consonants. The age-range employed in the present study i.e. with the youngest age being 2;06, makes it difficult to pinpoint exactly the order of acquisition of tones and vowels. Though there are fewer tonal errors than vowel errors in the youngest age group, some vowels might have already been acquired at the same time as tones before 2;06. As both the word initial and the word final consonants /n, ŋ/ were combined, word final consonants are disregarded here for comparison. This pattern of phonological acquisition can be attributed to the effects of phonological saliency. Further, the results for accuracy of singleton consonant production across the three languages revealed that the Malay score (90.42) was not lower than Mandarin (89.59) and English (87.06) (see Table 6.1 in Chapter 6) even though the multilingual children have the least speech input and output in Malay, and Malay is generally known to be the weakest language for ethnic Chinese Malaysians in terms of comparative proficiency across the three languages (see Chapter 5). The relatively high level of accuracy for Malay consonants may be attributable to the effects of phonological saliency: Malay has the least number of singleton consonants (19) compared to Mandarin (22) and English (24), and so by this criterion it is most salient. This finding is comparable to the finding of Yang & Zhu (in press) regarding Taiwanese. Amount of language input is not the sole factor governing the pathway of multilingual phonological acquisition: the nature and complexity of the languages involved seem to be contributing factors as well.

So (2006) attributed the faster rate of consonant acquisition in Cantonese than English (c.f. Prather et al., 1975)(see Chapter 2) to the relatively simpler phonological system of Cantonese, compared to English. In English, words are distinguished by a more complex system of vowels, syllable structure, stress and consonants than in Cantonese, hence the functional load of English consonants is relatively lower than those of Cantonese. Cantonese has a simpler syllable structure with mainly monosyllabic words, and there are only eight vowels in Cantonese, thus consonants and tones carry a heavier functional load, which may explain why consonants are acquired earlier. Compared to English, Cantonese has a smaller number of consonants (17)(c.f. 24 in English). In addition, consonants in Cantonese are repeated in many words of similar phonotactic structure, for instance, the word /ma/ can carry six tones with six different word meanings. The widespread use of the same phonotactic structure may therefore have accelerated the learning of the Cantonese consonants (Stokes & Surendran, 2005). So (2006) recommended that functional load should be extended beyond consonants to consonant clusters, vowels, tones and stress (see also So & Dodd, 1995; Zhu & Dodd, 2006c).

The discussion of phonological saliency and functional load in explaining phonological development in Chinese languages, i.e. Mandarin (Putonghua) and Cantonese, has pointed to the influence of phonological complexity. However, determining comparative phonological complexity in two or more languages is an ongoing task. For instance, a metric would be needed to compare the relative complexity of consonants and tones in Mandarin and Cantonese (Law & So, 2006). Table 9.6 summarizes the phonological components or complexity in each of the three languages being acquired by the multilingual children in the present study:

Table 9.6 Phonological complexity in English (Manglish), Mandarin (Maldarin) and Malay (ChinMalay)

	English (Manglish)	Mandarin (Maldarin)	Malay (ChinMalay)
Tones	nil.	4	nil.
Consonants	24	22	19
Consonant clusters	48	nil.	nil.
Vowels	15	20	9
Syllable Structure	$C_{0-3}VC_{0-4}$	$C_{0-1}VC_{0-1}$+Tone	*(C)V(C)

**(C)V(C): Basic syllable structure in Malay. There can be a long string of syllables due to its derivative or agglutinative nature, though reduced words rather than derived words are commonly used in spoken Malay (see Chapter 3).*

At first glance, Malay is relatively simple phonologically compared with English and Mandarin, namely: 19 consonants and 9 vowels compared with 72 consonants (singletons and clusters) and 15 vowels in English (Manglish), and 22 consonants and 20 vowels in Mandarin (Maldarin). Where relevant to the scope of the present investigation, the smallest contrasting segmental patterns in Malay seem to have accelerated the learning of them (c.f. Vihman, 1996; Zhu 2002). Further research using a more controlled test design is needed to validate this claim.

Psycholinguistic factors

Turning to the underlying *psycholinguistic processes* that contribute to the multilingual phonological development as reviewed in Chapter 2, the present findings show that the multilingual phonological acquisition is commensurate with the monolingual and bilingual phonological acquisition. All essential phonological milestones are reached at about the same ages as the monolingual and bilingual population (see section 9.2 & 9.3), albeit with some qualitative and quantitative differences in the developmental features used. The rate of multilingual phonological acquisition is found to be parallel or faster to that of monolingual phonological acquisition in each of the three languages. A few consonants of the three languages are shown to have acquired faster than the monolingual and bilingual children (see Chapter 7). On the basis of analysis of the children's simplification patterns (Chapter 7), it seems likely that similar underlying psycholinguistic processes are responsible for the error patterns or acquisition strategies used by the monolingual children and by multilingual children. These will now be described.

For years researchers have been interested in exploring the factors underlying phonological development. Since the 1990s, two main psycholinguistic models have been developed in an effort to pinpoint the underlying psycholinguistic processes that are responsible for the developmental features, with the main aim of improving the differential diagnosis of speech difficulties in children, with primary reference to children learning English in monolingual contexts (Duggirala & Dodd, 1991 and Dodd & McCormack, 1995- a revised version; Stackhouse & Wells, 1997)(see Appendix 2 & 3). According to such psycholinguistic approaches, the input skills (auditory discrimination), output skills (oro-motor ability), and the relationship between the speech input and output (cognitive-linguistic ability) are thought to underlie young children's phonological development (see Chapter 2). Once children have acquired about 50 words, their pronunciation errors are claimed to be more consistent, and can be described as phonological output rules (Smith, 1973), or phonological mapping rules or simplifying processes (Stackhouse & Wells, 1997). Children's production forms become more systematic, with less variability, in corresponding to the adult forms. Their word templates have gradually been expanded, with patterns affecting whole words (e.g. reduplication) being replaced by patterns affecting individual segments (e.g. fricative stopping), except for cluster reduction which is more persistent in limiting children's speech output (Stackhouse & Wells, 1997).

The psycholinguistic origins of the simplification patterns at the systematic simplification phase can be traced to various places in a psycholinguistic model, such as that of Stackhouse and Wells (1997)(see Appendix 3). Some error patterns which involve less oro-motor complexity are more likely to have their origin in peripheral auditory input processing, such as initial weak syllable deletion (Stackhouse & Wells (1997). This error was evident in the present study: for example, BANANA→[nanə], PYJAMAS→[dʒaməs]. In this case, children deleted the first non-salient unstressed syllable (though in Manglish, the primary stress in the second syllable is generally weakened). In order for this error pattern to be suppressed, the child's perceptual abilities must develop. The child must learn to abstract the phonological units from words and store them for phonological recognition purposes, which in turn allows for precise auditory discrimination of speech sounds (Stackhouse & Wells, 1997). This in turn is dependent on exposure to sufficient input in the language variety in question. Other error patterns that children made are more likely to have their origin in oro-motor speech output processing. These include for instance: partial reduplication (Stackhouse & Wells, 1997), which was also evident in the present study (SMALL→[smɔs]); /ɹ/ɹ̠/r/→[l] substitution, liquid gliding in the three languages, fricative stopping and cluster reduction). However, the replacement of /ɹ/ɹ̠/r/ by [l] or by the glides [j, w] is claimed to be associated with both the complex articulation and perception involved with the liquids (Locke, 1980, 1983; Kent, 1992)(see also discussion on "linguistic factors" earlier in this section).

Speech input is related to speech output (Stackhouse & Wells, 1997; Dodd & McCormack, 1995; Dodd, 2005). With age, in order to move closer to the adult phonological targets, both the perceptual skills and oro-motor skills must develop. For instance, in order to suppress velar fronting (/k/→[t]), the child must be able to discriminate between [k] and [t] by consistently updating his phonological representation and motor program in his mental lexicon for e.g. KEY vs. TEA. The child's oro-motor skills must also develop at the same time, in this case, producing a more back (velar) tongue contact in the prevocalic position (Stackhouse & Wells, 1997).

In their psycholinguistic model, Dodd & McCormack (1995) also highlight the importance of looking at the third component: the relationship between speech input and output (see Appendix 2). Dodd & McCormack (1995) discussed the relationship between speech input and output in terms of phonological realization rules (see Appendix 2), the mental processes thought to be responsible for children's phonological errors. Cognitive ability is linked to language skill (Dodd & Crosbie, 2002). Children unconsciously derive rules from their mental lexicons which govern the speech sounds, syllable structures and word structures that they use, reflecting their implicit understanding of the phonological constraints in their ambient languages (Dodd &McCormack, 1995; Dodd, 2005). If children's systematic speech errors arise from the application of phonological rules or processes as above-mentioned, these phonological errors should reflect the immature functioning of their mental processes working on the phonological information (Dodd & McCormack, 1995). The mental processes that are responsible for the assembly of a phonological plan for speech production are located at the "realization rules" box in the psycholinguistic model of Dodd & McCormack (1995)(see Appendix 2). When children produce speech, they select words from their mental lexicon to express their needs, the lexical phonological specification is fed through the existing realizational rules, leading to the assembly of a phonological plan for speech production (Dodd & McCormack, 1995)(see Appendix 2 & Chapter 2). Some evidence supporting the claim that these mental processes are accountable for the phonological errors made by children is to be found in the language-specific errors found in children of the same ages acquiring the same languages (Dodd, 2005). In the present study, [w] was commonly used to replace the liquid /r/ in English, consistent with the previous findings of the English-speaking children; but [j] was commonly used to replace the liquid /r/ in Mandarin, consistent with the previous findings of the Putonghua-speaking children; whereas a mixture of [w] and [j] were commonly used to replace the liquid /r/ in Malay, consistent with the previous findings of the native Malay-speaking children. This variability across languages suggests that the origins of the error patterns are not oro-motor or perceptual, but rather that these patterns of liquid substitution reflect the multilingual children's implicit understanding of their three ambient languages and their differing phonological constraints. Further evidence is that the age-appropriate typical error patterns can change to atypical error patterns not found in the typically developing monolingual peers following the child's exposure to a second phonology, as observed in successive bilingual Cantonese-English children (Dodd et al., 1996; Holm & Dodd, 1999b; 2006)(see Chapter 2). This suggests that established developmental features can be dislodged by exposure to a second language with differing phonological constraints (Dodd, 2005).

Conclusion

The discussion so far suggests that no single factor (or theory) is able to fully account for the patterns of multilingual phonological acquisition in the present research; rather there are several factors which seem to play a role. The present study did not set out to test a particular theory of phonological development, but nevertheless the results do indicate that multilingual phonological acquisition involves complex underlying processes and contributing factors which inter-relate with one another. Future research using more controlled research design is thus desirable in order to specific theories of multilingual phonological acquisition.

9.5 THEORETICAL IMPLICATIONS

The theoretical perspectives on bilingual and multilingual phonological acquisition reviewed in Chapter 2 will be scrutinized here. Comparison of the present findings for a multilingual population with previous findings for monolingual and bilingual populations acquiring the same languages revealed both qualitative and quantitative differences in the age of acquisition or order of acquisition, plus the type of error patterns and number of error patterns used (see Chapter 7), though the essential phonological milestones were reached at about the same ages. It is not surprising that there are differences, as the multilingual children, learning additional language(s), are subject to specific language combination effects.

The results show that the multilingual children have clearly developed three phonological systems that are somehow interacting. This is manifested in their use of atypical errors in each of the three languages, i.e. error patterns that are not found in their monolingual and bilingual peers described in the literature. There are at least three pieces of evidence supporting this claim that the children have three separate phonological systems, rather than one unified phonological system (c.f. Holm & Dodd, 1999b, 2006):

1. A feature shared by two or three of the languages was used in one language before the other. For example, even though /ɹ/, /ɻ/ and /r/ from the three languages were frequently realized as [ɹ] in each language, /ɹ/ in English was acquired earlier than the other two languages.

2. Language-specific features were not generally used in another language. For example, English consonant clusters were never used in Mandarin and Malay.

3. The same features were simplified differently in each language (e.g. /l/→[ø] in Mandarin, /l/→[j] in English, and /l/→[w] in Malay).

This language separation issue is implicated in psycholinguistic models such as De Bot's (1992, 2000) bilingual speaking model. De Bot (1992, 2000) adapted slightly Levelt's (1989) "steady-state speaking model" to account for the bilingual system at any moment and development stage. In De Bot's (1992, 2000) psycholinguistic model, which is capable of accommodating an indefinite number of languages, it is assumed that there are separate formulators and lexical subsets for each language in the single lexicon, thus suggesting that it is possible for bilingual or multilingual speakers to separate their two or more language systems (c.f. Wei, 2003).

Similar underlying acquisition strategies or factors that affect monolingual and bilingual phonological development seem to apply to multilingual phonological acquisition: chronological age, linguistic factors (common tendencies and language-specific patterns), psycholinguistic factors (auditory discrimination ability, oro-motor ability and cognitive-linguistic ability) and the input model. In addition, multilingual phonological acquisition is affected by specific bilingual or multilingual factors: unequal amount of input exposure and extent of use, language dominance and cross-linguistic influences. Multilingual phonological acquisition involves complex acquisition processes, all these factors seeming to play a role in the acquisition route.

The present findings illustrate the importance of taking into account the phonological details of the adult input model in studies of phonological development. The present analysis has shown how imprecise analysis of bilingual phonological development has occurred, as a result of misinterpretation of local socio-linguistic variants as developmental error patterns, owing to a failure of not taking into account the local adult accents. It is possible that this misinterpretation may have led to a mistaken conclusion that bilingual development is delayed. Full consideration of the quality of the spoken input in the phonological analysis of bilingual and multilingual children is recommended for other bilingual or multilingual populations for whom local adult accents are likely to be the model in the children's immediate linguistic environment.

The present findings have demonstrated that multilingual children are able to cope with three developing phonological systems during the primary language acquisition period, showing comparable phonological competence to their monolingual and bilingual peers in the same languages. This finding is in support of the claim that the human language faculty predisposes children to become multilingual learners (Meisel, 2001), in that it permits the acquisition and use of more than one language (Genesee, 2000a). This multilingual capability is also implicated in De Bot's (1992, 2000) model, which is said to be able to cope with an indefinite number of languages. As far as phonology is concerned, the present results suggest that the acquisition capability of multilingual children is equal to that of their monolingual and bilingual peers (see Genesee, 2003 for empirical evidence supporting a comparable syntactical competence in multilingual and monolingual peers).

There is at least one piece of evidence supporting an even quicker acquisition rate in the multilingual children's phonological acquisition compared to the monolingual and bilingual peers. A systematic retrospective qualitative comparison of the acquisition rate of the consonants, vowels, syllable structures, tones (for Mandarin) and consistency of word production in the three populations revealed a quicker acquisition rate for certain consonants by the multilingual children (see Chapter 7). In addition, the multilingual children were found to have made far fewer errors in certain consonants such as the Mandarin final nasals /n, ŋ/ (6%) compared to Putonghua-speaking children (58%)(Zhu & Dodd, 2000). It was argued that this is because of their sensitivity to closed-syllable structure words owing to their additional exposure to English and Malay, which both have more closed-syllable structure words (see Chapter 7). The literature provides abundant evidence of a better auditory discrimination ability, auditory awareness and phonological knowledge in bilingual and multilingual populations compared with monolingual populations (see Chapter 2). Having been exposed constantly to multiple languages in a stable multilingual language learning context, the multilingual children are constantly discriminating sounds of language that are familiar, as well as unfamiliar to them to ensure that the sounds they hear is worth attending to, which in turn results in better phonological awareness and phonological knowledge (see Chapter 2).

Phonological knowledge is enhanced further by having to learn three languages in the pre-school educational setting alongside the home setting. The present findings support the claim that input exposure or language dominance is a strong influence in bilingual and multilingual language acquisition. The multilingual children in the present study outperformed previously described bilingual children growing up in a minority immigrant community, presumably because of the input amount factor (see Chapter 7). In the context of the present study, there is also evidence showing the impact of input on sound acquisition, namely the late acquisition of the nasal /ɲ/ in Malay (see discussion on "linguistic factors" earlier in this section).

Finally, statement intonation, which has a falling pitch contour, is acquired before question intonation, which has a rising pitch contour (see Chapter 8). This finding is congruent with previous findings for English monolingual children, indicating a comparable competence in intonation development by the multilingual population and the monolingual population. Both general tendencies and language specific factors seem to affect multilingual intonation error patterns.

9.6 CONCLUSION

A comparison of the cross-linguistic similarities and differences that exist between the present multilingual population and monolingual and bilingual populations illustrates that the multilingual children show parallel phonological competence to the monolingual and bilingual peers, with all essential phonological milestones being reached at about the same ages. In fact they are shown to have a quicker acquisition rate for certain consonants, which is thought to be associated with their better phonological knowledge. Some qualitative and quantitative differences are observed however in the developmental patterns used and the number of these patterns used by the multilingual children with the monolingual and bilingual children. Many of the patterns that the multilingual children used are commensurate with patterns used in monolingual and bilingual children acquiring the same languages. The multilingual children's pattern of phonological development is observed to be a consequence of the interaction of general tendencies and individual language-specific effects. The present findings provide empirical evidence supporting the view that multiple factors seem to underlie multilingual phonological acquisition. These include the chronological age, unequal amount of input exposure and extent of use, language dominance, input model, cross-linguistic influences, linguistic factors (common patterns and language-specific patterns) and psycholinguistic factors (auditory discrimination, oro-motor and cognitive-linguistic abilities). This indicates that multilingual phonological acquisition involves complex acquisition processes or strategies. The present study demonstrates the importance of taking into account the adult input model in the phonological analysis of the bilingual Chinese children growing up in a bilingual or multilingual language learning context in Asia. This is recommended for future studies dealing with bilingual or multilingual children in which local adult variety of languages are likely to be the input model for the children.

CHAPTER 10

CONCLUSION

10.0 INTRODUCTION

The present study of English, Mandarin and Malay phonological development by the multilingual Malaysian Chinese children is possibly the first cross-sectional study of multilingual phonological acquisition in the literature of child language. As such, the present findings have contributed novel information to the field of child language and other relevant fields such as clinical linguistics, speech-language pathology and education. In this chapter, the key findings of the present study, in relation to the clinical and theoretical aims and research questions set out in Chapter 1, will be summarized. The clinical implications will be described. The limitations of the present study and recommendations for future studies will also be discussed.

10.1 SUMMARY

In general, there were significant developmental trends in the phonological acquisition of English, Mandarin and Malay by the multilingual children in the present study. These trends were evident in the children's production accuracy of consonants, vowels, syllable structures, and consistency of word production.

By and large, in the present study, the children's rate of consonant acquisition is similar to that of monolingual children and bilingual children in each language, or faster. All singleton consonants in the three languages were acquired by 4;00-4;05. With one exception, all vowels were acquired by 2;06-2;11. Of the three syllable structures tested, monosyllable structures were generally acquired before disyllable structures and trisyllable structures. Tones were acquired early, by 2;06-2;11. The children were fairly consistent with their word production. The younger children tended to be more consistent with inaccurate word productions than the older children, while the older children tended to be both consistent and accurate in their word production. These findings suggest that multilingual phonological development is largely commensurate with monolingual and bilingual phonological development, all essential phonological milestones being reached at about the same ages.

Both systemic and structural simplifications were evident in the consonants and vowels of the three languages, congruent with the previous findings for English. Mandarin and Malay described in the literature. Some consonant simplifications were shared by the three languages, others were shared by two languages (i.e. English and Mandarin plus English and Malay, but not Mandarin and Malay), and the rest were used in one language only. Most of these simplifications, for example, deletion, gliding, stopping, deaffrication, fronting and metathesis, are also commonly found in the other languages such as German, Cantonese and Turkish (Zhu & Dodd, 2006a) being acquired by both monolingual and bilingual populations.

On the other hand, some of the English and Mandarin simplifications observed in the present study were absent from the same languages being acquired by the monolingual peers described in the bilingual Chinese children literature (Dodd, So & Li, 1996; Holm & Dodd, 1999b, 2006; So & Leung, 2006): backing, affrication, frication in English, and final consonant deletion, deaffrication in Mandarin. These errors alongside several other errors are described as the "atypical error patterns" not found in the typically-developing monolingual peers acquiring English and Mandarin, but are claimed to be demonstrated by phonologically disordered monolingual peers in the bilingual Chinese children literature; however, as the number of these atypical errors used by the bilingual Chinese children is large, they are described as the "normal bilingual" English and Mandarin errors (Dodd, So & Li, 1996; Holm & Dodd, 1999b, 2006; So & Leung, 2006). The above five atypical English and Mandarin errors were shared by the present multilingual children and the bilingual Cantone-English and bilingual Cantonese-Putonghua children, implicating the effects of individual languages irrespective of the potential interacting effects of additional languages.

Conversely, a few atypical errors in English and Malay but not Mandarin observed in the present study were not found in the above bilingual Cantonese-English children as well as native-Malay speaking children described in the literature: within word consonant deletion, final glottal replacement in English, and final plosive release in Malay. These differences can be attributed to the effects of acquisition of two additional languages namely: Mandarin and Malay upon English, and English and Mandarin upon Malay respectively. Alternatively, these English and Malay atypical error patterns not found in bilingual peers alongside all other atypical errors found in the three languages can be attributed to the effects of specific language combination of English, Mandarin and Malay.

It is hard to compare the present multilingual atypical errors with the atypical errors of the above bilingual children acquiring the similar languages (English and Mandarin), as some of the atypical developmental errors identified in the bilingual studies are in fact sociolinguistic variants commonly observed in the Chinese speakers with Southern Chinese dialect background, for example: deaspiration of English consonants and nasalization of Mandarin consonants. These bilingual Chinese phonological acquisition studies suffer from a methodological limitation. in that the details of the adult input model are not systematically taken into account in the phonological analysis of the children's speech output.

Turning to vowel acquisition, there are some similarities and differences in the vowel simplifications observed in the present study and the past studies of English and Mandarin on monolingual population. There are no previous studies of vowel acquisition in Malay with which to compare the present findings. All vowel errors observed in the present study have been reported in past studies of English and Mandarin on monolingual population. However, some of the vowel errors reported in English and Mandarin (Putonghua) were absent in the present study e.g. substitution of the neutral unrounded vowels [ʌ, ə] for other vowels in English (Dodd, 1995a) and diphthong reduction in Mandarin (Zhu & Dodd, 2000). In the present study, substitution of English vowels involved mostly vowels close to the target vowel space but more lowered (e.g. /e/→[e̞]). One reason Mandarin diphthong reductions were absent in the present study could be that diphthongs are commonly simplified in local sociolinguistic variant forms (e.g. /uo/→[uᵒ]), which were scored as correct productions.

The present findings of vowel acquisition are inconsistent with the previous studies of bilingual Cantonese-English (Dodd et al., 1996; Holm & Dodd, 1999b, 2006) and bilingual Cantonese-Putonghua (So & Leung, 2006) children, in which pervasive vowel errors are found particularly in the second language. Detailed examples of vowel errors are not provided in these studies. Vowel errors in Putonghua are claimed to persist beyond 5;00 (So & Leung, 2006). As mentioned above, these studies suffer from a methodological limitation, the adult input models are not considered. This might have influenced the claim of delayed vowel development in bilingual Chinese children.

Syllable structure simplifications were closely associated with vowel and consonant simplifications in the present study. In English, syllable structures which were acquired late involve a cluster coupled with a diphthong, for example: CCVV and CCVV-CVC. In Mandarin, the most challenging syllable structure was GV-CGVC which consists of two GVs and one final C. In Malay, the challenging syllable structure was CVC-CVC which includes a syllable final-within word (word medial) C. There was a common tendency to replace a marked syllable structure (with a longer string of consonants) with a less marked one (with a shorter string of consonants). This supports the concept of markedness (Yavas, 1998). The most basic CV syllable structure was acquired before the less basic syllable structures such as CCVV, CGVC. With one exception, syllable structures shared by the three languages were acquired at the same age. Research into syllable structure acquisition in monolingual populations is sparse, while research into syllable structure acquisition in bilingual and multilingual populations is possibly non-existent. The present finding for English syllable structure acquisition is consistent with the previous findings for monolingual populations in that monosyllable structures CV, CVC and disyllable structures CV-CV, CV-CVC (Stoel-Gammon, 1987) are reported to be acquired by the age of two. The preliminary information on multilingual syllable structure acquisition reported in the present study provides a novel contribution to the literature.

In the present study, though some inconsistency of word production was associated with vowel variations, and syllable structure variations, the main source of inconsistency in all three languages was consonant variations. This is not surprising as consonant accuracy posed most challenges in the present study. Inconsistency of syllable structure was most prevalent in English, and vowel inconsistency was only evident in Mandarin, implying a language-specific tendency. Syllable structure is most complex in English because it has many close-syllable words as well as consonant clusters. Vowels are more complex in Mandarin (Maldarin) because it has more diphthongs and triphthongs compared to English (Manglish) and Malay. Overall the multilingual children were fairly consistent in their word production. The younger children tend to produce more consistently inaccurate realizations of target words than the older children, while older children tend to produce both consistent and accurate realisations of target words. These findings are consistent with the previous findings for a monolingual English-speaking population (Holm et al., 2007). Studies of consistency of word production in bilingual and multilingual populations are possibly non-existent. For this reason, the present findings on consistency of word production development in multilingual children provide a novel contribution to the literature.

Tone errors were rare in the present study, consistent with the previous findings of Putonghua (Zhu & Dodd, 2000; Zhu, 2002) and Cantonese (So & Dodd, 1995). In the present study, tone errors, though very rare, have involved all four basic tones and the only third tone sandhi tested. The rising tone (T2) was frequently used to replace all other tones including the third tone sandhi. In contrast, the young Putonghua-speaking children (aged between 1;00-2;00) in Zhu's (2002) study frequently used the high level tone (T1) to replace for all other tones. The differences of the tone error patterns in the two studies may be attributed to age differences in the children. The preliminary information on tone acquisition in multilingual children reported in the present study has thus contributed to the limited literature on Chinese child language.

Statement intonation errors were much rarer than question intonation errors in the present study. This finding is congruent with the previous findings for languages such as English (Crystal, 1986). Rising pitch contour is claimed to be more effortful in production than falling pitch contour, in physiological terms, by the breath group theory (Lieberman, 1967), and so it is acquired after falling pitch contour. The present finding seems to lend some support to this theory. Overall the most frequent types of question intonation errors evident in the three languages involved flattening of pitch contour, making question intonation sound like statement intonation. Some qualitative similarities and differences are noted in the error patterns used across the three languages in the present study: in all three languages, the final tone i.e. "final fall" and "final rise", is crucial in distinguishing statement intonation from question intonation. In Mandarin however, the overall pitch register is also important in distinguishing both types of intonation. This indicates that individual language effects are also playing a part in the acquisition of intonation in multilingual development. Since there is a lack of studies on bilingual and multilingual intonation development, the preliminary information on intonation development provided in the present research has made a useful contribution to the field of developmental intonation.

In summary, the discussion so far suggests that the multilingual phonological acquisition is largely commensurate with the monolingual and bilingual phonological acquisition of the same languages by different populations of children in the world. Despite some qualitative and quantitative differences that exist between the multilingual and the monolingual and bilingual phonological patterns, the multilingual phonological (consonantal) rate of acquisition is parallel or faster than the monolingual and bilingual phonological (consonantal) rate of acquisition. In this respect, the present findings challenge the previous claims of delayed phonological development, by bilingual Cantonese-English and bilingual Cantonese-Putonghua children, compared to the monolingual peers. There is a methodological concern over these studies, namely that they did not sufficiently consider the adult input model. This has sometimes resulted in misinterpretation of adult sociolinguistic variants as child developmental errors. Further, in the present study, cross-linguistic influences are mainly manifested in the use of atypical error patterns not found in the monolingual peers described in the literature. These atypical error patterns are governed by specific language (combination) effects. The multilingual children have clearly developed three separate phonological systems that are somehow interacting.

The present findings have illustrated that multilingual phonological acquisition involved highly complex acquisition processes or strategies. The following contributing factors, only some of which also occur in monolingual phonological development, all seem to underlie multilingual phonological development: chronological age, unequal amount of input exposure and extent of use, language dominance, input model, cross-linguistic influences, linguistic factors and psycholinguistic factors.

In the present study, there were statistically significant relationships among the three languages, when comparing production accuracy of consonants, vowels, syllable structures and consistency of correct word production. This provides evidence, albeit indirectly that the children have all received input in the three languages in a roughly similar proportion. This suggests that these children are growing up in a relatively stable multilingual community. This implied that the present approach of selecting a random sample rather than a conventional L1/L2 (most dominant language/second dominant language) sample, is reliable and valid, and it is recommended for future research involving a complex socio-linguistic background where determining L1/L2 language dominance in the children subjects is a challenging task.

Further, highly significant relationships were found when comparing scores on the sub-parts of the test in each language. This shows that overall the sub-parts of the test are tapping into a common factor i.e. speech ability. Hence, it can be concluded that in this respect the test validity is high.

10.2 CLINICAL IMPLICATIONS

In addition to its general contribution to the study of multilingual phonological development, the present study provides some preliminary normative information to local professionals such as speech-language pathologists, school teachers and paediatricians working with children in Malaysia.

The present phonological test battery is the first test which adopts well-defined scoring criteria drawing on local accents. The local socio-linguistic variants in the three local languages were scored as correct productions. This procedure has been neglected in phonological acquisition research of bilingual Chinese children, which has sometimes resulted in peculiar results. Examples are the delayed vowel development reported for bilingual Cantonese-English children (Dodd et al, 1996; Holm & Dodd, 1999b, 2006) and bilingual Cantonese-Putonghua children (So & Leung, 2006). It is essential to identify the phonological features of the adult's local variety of languages, before analysing the children's phonological patterns, since that is the variety that the children are exposed to. Otherwise mistaken clinical diagnoses about speech delay may be made.

The three phonological tests devised in the present study have been shown to be valid, based on statistical analysis. Hence, they can be used with some confidence as clinical tools by local professionals dealing with Malaysian Chinese children. Currently such language assessment tools are in high demand in Malaysia. These phonological tests will facilitate the assessment of phonological error patterns in the local Malaysian Chinese children, and the identification of targets for remediation.

Few studies have used statistical analysis to explore the developmental relationship among languages in terms of phonological production, in particular in the multilingual population. The partial correlation statistical analysis of the relationships among the three languages carried out in the present study served as a preliminary analytical approach. In the present study, the significant relationships that were found among the three languages when comparing production accuracy of consonants, vowels, syllable structures and consistency of correct word production have important implications, not only theoretically but also clinically, as they suggest that improvements in one language may transfer to other languages. This implies that phonological intervention administered in one language may have a beneficial knock-on effect on the multilingual child's phonological development in the other languages. This possibility merits further investigation (see further discussion in section 10.4).

The present findings provide empirical evidence that children are quite capable of coping with three languages, at least as far as phonology is concerned, and so parents can be assured that multilingual acquisition does not hinder phonological development in the individual languages. However phonological development is also subject to many other factors such as input exposure, so parents still need to be aware that multilingual phonological acquisition is a potentially complex process.

10.3 LIMITATIONS

Vihman (1998) discussed the shortcomings of a cross-sectional study approach to phonological development. According to her, a cross-sectional study approach to later phonological development is valuable, in that it helps to provide a useful overview of phonological development beyond the earliest first word stage i.e. from 2;00 and above. The large numbers of children employed in a cross-sectional study enable the establishment of developmental norms for production of phonological segments such as consonants and vowels. These developmental norms are particularly useful to professionals dealing with children such as speech-language pathologists, since they can be used as bases for comparison with disordered speech. However as she commented, in a cross-sectional study approach, different children across various age ranges are all assessed at a single point of time. Thus, a cross-sectional study approach to phonological development does not allow the researcher to trace the sequential phonological pattern in an individual child, so production variability at different age points, and across different time spans is neglected. Following which, information on individual differences across different children is also missing. This information is potentially important given the possible heterogeneity of bilingual and multilingual populations.

Because each child was assessed at a single time point, it was essential to control the test length in order to avoid exhaustion and distraction in the children, particularly those of the youngest age group 2;06-2;11. For instance, with this in mind, in the present research, the intra-word production consistency sub-test only included five test items being targeted over two trials, compared to the conventional three trials of more target word items such as 25 words (Dodd, 1995b; Holm et al., 2007).

Although one aim of the study was to find out how similar multilingual development is compared to monolingual and bilingual development, it was impossible to recruit Malaysian Chinese nursery children around the age of three and beyond who are monolingual, against whom to compare the multilingual children. Consequently, interpretation and discussion of this aspect of the study has relied heavily on a comparison with the previous findings of monolingual and bilingual acquisition described in the literature. Ideally one should compare the children of differing populations growing up in the same community, using similar methodology (Yavas & Goldstein, 2006). In this way, methodological bias which includes geographical and cultural differences will be avoided.

Ideally in a cross-sectional study, the sample should be as large and as homogeneous as possible. The sample size used in the present study was relatively small i.e. sixty four children, with 16 per age band. This was due to practical issues of time available for data collection. The sample also was necessarily heterogeneous because the language background of children in this population is highly complex (see Appendix 1 on participant's home language and/or dialect usage profiles, and Chapter 1). This meant that sometimes developmental error patterns by only two children in an age group was used when classifying that pattern as typical for the age group (see definition of "error patterns" on section 7.2 in Chapter 7). As a consequence, the findings need to be interpreted with caution. However, they provide a basis for further investigation with a larger cross-sectional study or a longitudinal study in the future. Similarly, the number of test stimuli used for some phonological targets such as the trisyllables in English and Mandarin was small. This has led to some caution with regards to findings of the children's speech performance on those tested targets.

In the present study, extensive effort has been put forward in identifying the prominent Malaysian adult phonological variants/targets, which served as the baseline for scoring on the children's speech production. Nevertheless, there may be other less obvious phonological variants used by some adult speakers which were not captured in the tests.

10.4 RECOMMENDATIONS

Future longitudinal studies on a similar population would help to trace sequential phonological patterns in individual children in greater detail, and to investigate individual differences across children. Using more carefully controlled longitudinal studies, contributing factors in multilingual phonological acquisition or monolingual phonological acquisition in general can be explored in a more systematic way. For instance more detailed information can be collected about the amount and quality of input in child directed speech from interlocutors such as parents, siblings and domestic helpers.

Future local longitudinal studies of young monolingual children aged below one year or so is desired. It is possible to recruit very young children who are monolingual at the speech onset stage and particularly before their entry into nursery in Malaysia, to explore various phonological theories such as early templatic multilingual phonology (c.f. Vihman, 2007), and the relationship between the phonological complexity of the multilingual child's early words and the ambient languages (c.f. Bunta, Davidovich & Ingram, 2006). This will require a carefully controlled research design to take account of the heterogeneous sociolinguistic backgrounds of the interlocutors interacting with the monolingual children. This kind of monolingual research against the multilingual backdrop will shed light on the natural route of children who are progressively becoming more heterogeneous in their socio-linguistic skills, following an enlarged social circle that comes along with age.

Future research on intonation development using different methods of data collection could provide a more comprehensive picture of intonation developmental profiles in this population. This approach would allow inclusion of various factors that have been proposed in relation to intonation development, e.g. linguistic factors such as grammatical complexities involved in questions as opposed to statements, linguistic development such as mean length of utterances, sentence position and emotional factors. It would contribute knowledge to the current literature of intonation, especially since there are so few studies of intonation development in multilingual children.

Future cross-sectional studies using a larger sample size an more controlled tested targets are desired in order to validate the present findings. For example, whether the Malay phonological productions of /r/ of the children who have a live-in Indonesian maid at home are systematically different from the children who do not have a live-in maid at home. It is interesting to note that some error patterns were shared by two or three languages while others were not. Future research using a more controlled research design to investigate this issue is needed.

An extension to the present study would be to carry out more robust statistical validation on the three phonological tests devised such as content validity and concurrent validity. Another extension to the present study would be to enhance the usability of the present phonological tests by norming on local children of other ethnic backgrounds, notably the other two major ethnic groups in Malaysia: Malay and Indian. Such future work will involve duplicate cross-sectional studies with Malay and Indian children. It will require some preliminary empirical research into adult local varieties of English (Manglish) and Malay as spoken by ethnic Malay and Indian adults (c.f. the sub-study of two nursery teachers done in the present study). These future studies will also require a robust statistical standardization and validation, which will be of important practical value to local professionals dealing with the child population, such as speech-language pathologists.

Further local research on phonological disorders in English, Mandarin and Malay is very much needed. The findings of these clinical disorder studies will help to shed light on whether or not the atypical errors found in the present study are indeed used by children with phonological difficulties growing up in the same community.

In relation to these clinical studies, there should be future investigation into the remediation effects of phonological therapy on multilingual children, specifically, whether remediation on one target phonological segment in one language will be generalised to the same target in the other two languages. This is relevant since significant relationships were found when comparing production accuracy of consonants, vowels, syllable structures and consistency of correct word production among the three languages presumably due to homogeneous input exposure to the three languages in this multilingual context. This kind of information would be valuable to local speech-language pathologists, as it helps to motivate a specific remediation strategy and this save time and money. At present, research on remediation effects across languages in multilingual children is sparse (e.g. Ray, 2002; Vuu, 2003), and past studies on remediation effects across languages in bilingual and multilingual children have provided conflicting results (see Holm & Dodd, 1999a; 2001; 2006; Ray, 2002; Vuu, 2003). Further research pursuing the idea of generalisation across languages in multilingual children is therefore necessary.

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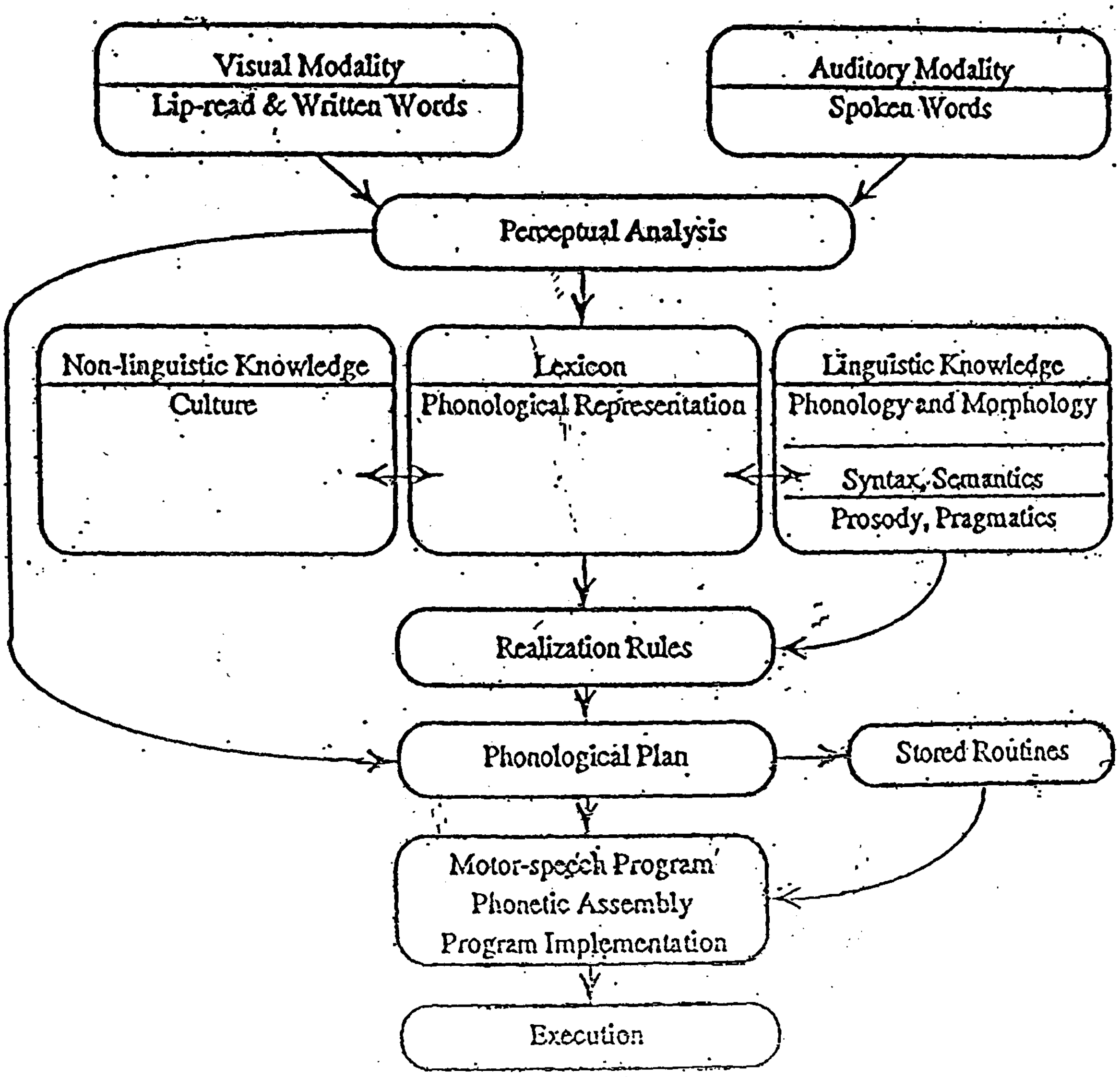
Participants' language background: use of home language and/or dialect

Subject	Age	Sex	Mandarin	English	Malay (with Indonesian maid only)	Chinese dialect: Cantonese[1], Hokkien[2], Hakka[3].
1	2;07	M	√	√		
2	2;07	M	√			
3	2;09	M	√		√	1
4	2;10	M	√	√		
5	2;10	M	√	√	√	
6	2;10	M	√			
7	2;11	M	√		√	
8	2;11	M		√	√	
9	2;08	F	√			
10	2;08	F		√	√	
11	2;08	F		√	√	
12	2;09	F	√			
13	2;09	F	√		√	
14	2;09	F	√			1
15	2;11	F	√			
16	2;11	F	√	√		
17	3;02	M		√	√	
18	3;03	M	√	√	√	2
19	3;03	M		√	√	
20	3;04	M		√		1
21	3;04	M	√	√		
22	3;04	M	√	√		2
23	3;04	M	√			
24	3;05	M		√		
25	3;00	F		√	√	
26	3;03	F	√		√	
27	3;04	F	√	√		2
28	3;04	F	√			2
29	3;05	F	√			1
30	3;05	F	√			1
31	3;05	F	√			1
32	3;05	F	√			
33	3;06	M	√	√		1
34	3;08	M	√	√		1

Participants' language background: use of home language and/or dialect

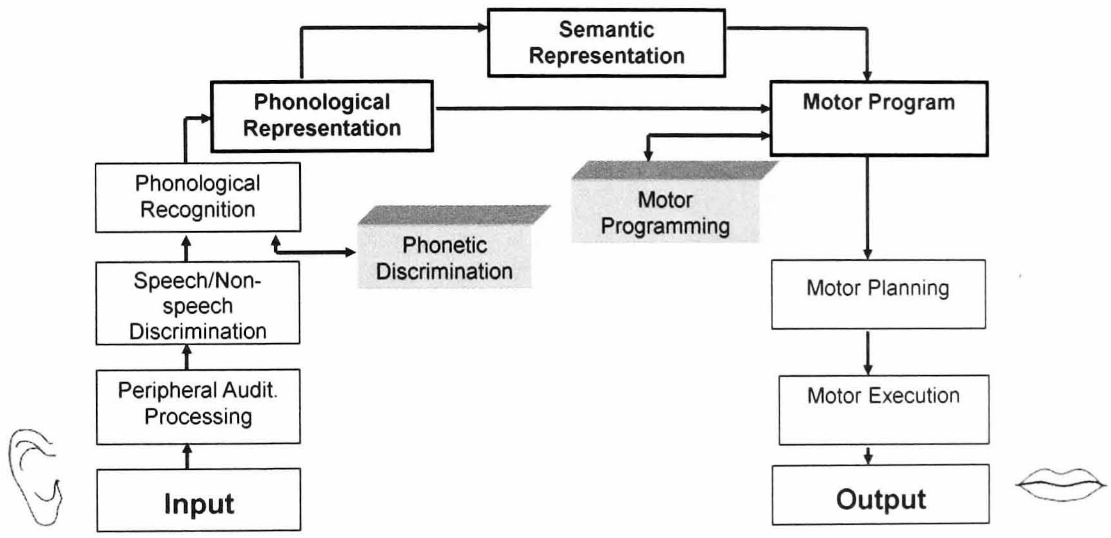
35	3;08	M		√		
36	3;08	M		√		2
37	3;09	M	√			
38	3;10	M	√		√	1
39	3;11	M	√		√	
40	3;11	M	√		√	1
41	3;06	F		√	√	1
42	3;09	F	√		√	1
43	3;09	F	√	√		
44	3;10	F	√		√	
45	3;11	F	√			
46	3;11	F	√	√		
47	3;11	F	√	√	√	
48	3;11	F	√	√		
49	4;00	M	√		√	
50	4;04	M	√	√		
51	4;04	M	√	√		2
52	4;04	M	√			1
53	4;04	M	√	√		
54	4;04	M	√	√		
55	4;05	M	√	√		3
56	4;05	M	√	√		1
57	4;00	F		√		
58	4;00	F		√		
59	4;03	F	√			1
60	4;03	F	√			
61	4;03	F	√			1
62	4;03	F	√			1
63	4;04	F	√			2
64	4;05	F	√	√		

Model of speech-processing chain



Source: Dodd & McCormack (1995:67)

Speech processing model



Source: Stackhouse & Wells (1997:350).

Malaysian English (Manglish) phonology test done by two teachers

Word	Teacher 1	Teacher 2
1. EAR	iə	iə
2. NOSE	nos	nos
3. MOUTH	mauf	mauf
4. TEETH	tif	tif
5. DOG	dɔʔ	dɔʔ
6. CHICKEN	tʃ˭ik˭ən	tʃikən
7. FISH	fiʃ	fiʃ
8. HORSE	hɔs	hɔs
9. FROG	fɹɔʔ	fɹɔʔ
10. SNAKE	snek	sneʔ
11. ZOO	zu	zu
12. TIGER	taigə	t˭aigə
13. WEB	web˺	web˺
14. SMALL	smɔ	smɔ
15. TABLE	tebə	te˭bə
16. SPOON	spun	spun
17. GLASS	glɑs	glɑs
18. BREAD	bɹed	bɹed˺
19. JAM	dʒɛm	dʒɛm
20. PLATE	plet	plet˺
21. ORANGE	ɔrentʃ	ɔɹentʃ
22. BANANA	bənanɑ	bənanə
23. CUP	kap˺	kap
24. BOY	bɔi	bɔi
25. GIRL	gə	gə
26. MOTHER	mɑdə	mɑθə
27. THIN	θin, tin	θin
28. SHOES	ʃus	ʃus
29. PYJAMAS	pədʒɑməs	pədʒɑməs
30.SLEEPING	slipiŋ	slipiŋ

Malaysian English (Manglish) phonology test done by two teachers

Word	Teacher 1	Teacher 2
31. EATING	itiŋ	itiŋ
32. SINGING	siŋiŋ	siŋiŋ
33. DRIVING	dɹaiviŋ	dɹaiʋiŋ
34. SWIMMING	swimiŋ	swimiŋ
35. LAUGHING	lɑfiŋ	lɑfiŋ
36. WASHING	wɑʃiŋ	wɑʃiŋ
37. DADDY	dɛdi	dɛdi
38. FIVE	faif	faif
39. THAT	ðɛt	dɛt, dɛt˺
40. PENCIL	pensə	pensə
41. CRAYON	kɹejɔn	kɹejɔn
42. BLUE	blu	blu
43. RED	ɹed˺	ɹed
44. YELLOW	jəlo	jəlo
45. GREEN	gɹin	grin
46. CLOCK	klɔk	klɔk
47. WATCH	wɑtʃ	wɑtʃ
48. SCISSORS	sizəs	sizəs
49. YOYO	jojo	jojo
50. HOUSE	haus	haus
51. FLOWER	flawə	flawə
52. LEAF	lif	lif
53. TREE	tri	tɹi
54. SKY	skai	skai
55. VAN	vɛn	ʋɛn
56. STAR	stɑ	stɑ
57. ZOO	zu	zu
58. BANANA	bənɑnə	bənɑnɑ
59. DRIVING	dɹaiʋiŋ	dɹaiviŋ
60. CLOCK	klɔk	klɔk
61. VAN	vɛn	vɛn

Highlighted words: target words for consistency of word production sub-test.

Malaysian Mandarin (Maldarin) phonology test done by two teachers

Word	Teacher 1	Teacher 2
1.ZUI3BA1	tsueɪ3pa̰l	tsuɪ3pa̰l
2. YA2CHI3	ia̰2tʂʰi̮3	ia̰2tsʰi̮3
3. TOU2	tʰoʊ2	tʰoᵘ2
4. KU1	kʰul	kʰu4
5. SHUI4JIAO4	suɪ4tsiɑo4	suɪ4tsiɑo4
6. ZUO4	tsuo4	tsᵘo4
7. ZHAN4	tsan4	tsan4
8. PAO3	pʰɑo3	pʰɑo3
9. XI2SHOU3	si2ʂoʊ3, si2soʊ3	si2soʊ3
10.HUA4HUA4	xua̰4xua̰4	xua̰4xua̰4
11. CHONG1LIANG2	tsʰoŋliɑŋ2	tsʰoŋliɑŋ2
12. PAI1SHOU3	pʰaelsoʊ3	pʰaelsɔᵘ3
13. CHI1FAN4	tsʰi̮lfan4	tsʰi̮4fan4
14. CAI4	tsʰae4	tsʰae4
15. JI1ROU4	tsilɹoᵘ4	tsilɹoᵘ4
16. TANG2GUO3	tʰɑŋ2kuo3	tʰɑŋ2kᵘo3
17. MA1MA1	ma̰lma̰0	ma̰lma̰l
18. DI4DI4	ti4ti0	ti4ti4
19. NÜ3HAI2ZI3	ny3xae2tʂi3, ni3xae2tʂi3	ni3xae2tʂi3. ny3xae2tʂi3
20.YA1	ia̰l	ia̰4
21. YANG2	iɑŋ2	iɑŋ2
22. GOU3	koʊ3	koᵘ3
23. KUAI4	kʰuae4	kʰuae4
24. SAN1	sanl	sanl
25. SI4	si̮4	si̮4
26. WU3	u3	u3
27. LIU4	liʊ4	lioʊ4
28. QI1	tsʰil	tsʰi4
29. PA1	pa̰l	pa̰4

Malaysian Mandarin (Maldarin) phonology test done by two teachers

Word	Teacher 1	Teacher 2
30. XIE2ZI3	siɛ2tsi̺3	siɛ2tsi̺3
31.QIAN2	tsʰiɛn2	tsʰiɛn2
32.DA4	ta̰4	ta̰4
33.LI3MIAN4	li3miɛn4	li3miɛn4
34. ZHUO1ZI3	tsuo1tsi̺3	tsᵘo1tsi̺3
35. RE4	ɻɤ 4	ɻɤ 4
36. CAO3	tsʰɑo3	tsʰɑo3
37. FEI1JI1	feⁱ1tsi1	feⁱ1tsi1
38. YUE4LIANG4	iɛ4liɑŋ4	yɛ4liɑŋ4
39. XI2SHOU3	si2soʊ3	si2soᵘ3
40. CHI1FAN4	tʂʰi̺1fan4	tsʰi̺4fan4
41. JI1ROU4	tsi1dzoᵘ4	tsi1ɹoᵘ4
42. NÜ3HAI2ZI3	ny3xae2tsi̺3	ny3xae2tʂi3
43. RE4	ɻɤ4	ɹɤ 4

Highlighted words: target words for consistency of word production sub-test.

Chinese Malay (ChinMalay) phonology test done by two teachers

Word	Teacher 1	Teacher 2
1. MULUT (MOUTH)	mulut	mulut
2. GIGI (TEETH)	gigi	gigi
3. HIDUNG (NOSE)	hidoŋ	hidoŋ
4. TANGAN (HAND)	taŋan	taŋan
5. IKAN (FISH)	ikan	ikan
6. AYAM (CHICKEN)	ajam	ajam
7. KUCING (CAT)	kutʃeŋ	kutʃiŋ
8. ROTI (BREAD)	rɔʔti	ɹoti
9. JEM (JAM)	dʒɛm	dʒɛm
10. SUSU (MILK)	susu	susu
11. EPAL (APPLE)	epə	epəl
12. MEJA (TABLE)	medʒa	medʒə
13. CAWAN (CUP)	tʃawan	tʃawan
14. YOYO (YOYO)	jojo	jojo
15. PENSEL (PENCIL)	p^hensə	pensə
16. BAS (BUS)	bas	bas
17. LORI (LORRY)	lɔɾi	loɹi
18. RUMAH (HOUSE)	ruma	ruma
19. TIGA (THREE)	tiga	tigə
20. DAUN (LEAF)	daun	daun
21. WANG (MONEY)	waŋ	waŋ
22. HUJAN (RAIN)	hudʒan	hudʒan
23. NENEK (GRANDMOTHER)	neneʔ	neneʔ
24. IBU (MOTHER)	ibu	ibu
25. DUDUK (TO SIT)	dudoʔ	dudoʔ
26. NYANYI (TO SING)	ɲaɲi	ɲaɲi
27. ROTI (BREAD)	rɔʔti	ɹoti
28. SUSU (MILK)	susu	susu
29. BAS (BUS)	bas	bas
30. LORI (LORRY)	lɔɾi	lori
31. NYANYI (TO SING)	ɲaɲi	ɲaɲi

Highlighted words: target words for consistency of word production sub-test.

Malaysian English (Manglish) phonology test

Name: Sex: Age:

Word	IPA	Syllable structure	Initial	Medial	Final	Vowel	Transcription
1. ear	iə	VV ( )	-	-	-	iə ( )	
2. nose	nos	CVC ( )	n ( )	-	s/(z) ( )	o ( )	
3. mouth	mauf	CVVC ( )	m ( )	-	f/(θ) ( )	au ( )	
4. teeth	tif	CVC ( )	t ( )	-	f/(θ) ( )	i ( )	
5. dog	dɔʔ	CVC ( )	d ( )	-	ʔ/(g) ( )	ɔ ( )	
6. chicken	tʃikən	CV-CVC ( )	tʃ ( )	k ( )	n ( )	i( ) ə ( )	
7. fish	fiʃ	CVC ( )	f ( )	-	ʃ ( )	i ( )	
8. horse	hɔs	CVC ( )	h ( )	-	s ( )	ɔ ( )	
9. frog	fɹɔʔ	CCVC ( )	fɹ ( )	-	ʔ/(g) ( )	ɔ ( )	
10. snake	snek	CCVC ( )	sn ( )	-	ʔ/k ( )	e ( )	
11. zoo	zu	CV ( )	z ( )	-	-	u ( )	
12. tiger	taigə	CVV-CV ( )	t ( )	g ( )	-	ai ( ) ə ( )	
13. web	web˺	CVC ( )	w ( )	-	b˺/(b) ( )	e ( )	
14. small	smɔ	CCV(C) ( )	sm ( )	-	Ø /(l) ( )	ɔ ( )	
15. table	tebə	CV-CV(C) ( )	t ( )	b ( )	Ø /(l) ( )	e ( ) ə ( )	
16. spoon	spun	CCVC ( )	sp ( )	-	n ( )	u ( )	
17. glass	glɑs	CCVC ( )	gl ( )	-	s ( )	ɑ ( )	
18. bread	bɹed	CCVC ( )	bɹ ( )	-	d˺/d ( )	e ( )	
19. jam	dʒɛm	CVC ( )	dʒ ( )	-	m ( )	ɛ ( )	
20. plate	plet	CCVC ( )	pl ( )	-	t˺/t ( )	e ( )	

Word	IPA	Syllable structure	Initial	Medial	Final	Vowel	Transcription
21. orange	ɔɹentʃ	V-CVCC ( )	-	r/ɹ ( ) n ( )	tʃ/(dʒ) ( )	ɔ ( ) e ( )	
22. banana	bənɑnə	CV-CV-CV ( )	b ( )	n ( ) n ( )	-	ə ( ) ɑ ( ) ɑ/ə ( )	
23. cup	kɑp	CVC ( )	k ( )	-	p˺/p ( )	ɑ ( )	
24. boy	bɔi	CVV ( )	b ( )	-	-	ɔi ( )	
25. girl	gə	CV(C) ( )	g ( )	-	Ø/(l) ( )	ə ( )	
26. mother	mɑθə	CV-CV ( )	m ( )	d/(ð) ( )	-	ɑ ( ) ə ( )	
27. thin	θin	CVC ( )	t/θ ( )	-	n ( )	i ( )	
28. shoes	ʃus	CVC ( )	ʃ ( )	-	s ( )	u ( )	
29. pyjamas	pədʒɑməs	CV-CV-CVC ( )	p ( )	dʒ ( ) m ( )	s/(z) ( )	ə ( ) ɑ ( ) ɑ/ə ( )	
30.sleeping	slipiŋ	CCV-CVC ( )	sl ( )	p ( )	ŋ ( )	i ( ) i ( )	
31. eating	itiŋ	V-CVC ( )	-	t ( )	ŋ ( )	i ( ) i ( )	
32. singing	siŋiŋ	CV-CVC ( )	s ( )	ŋ ( )	ŋ ( )	i ( ) i ( )	
33. driving	dɹaiviŋ	CCVV-CVC ( )	dɹ ( )	ʋ/v ( )	ŋ ( )	ai ( ) i ( )	
34. swimming	swimiŋ	CCV-CVC ( )	sw ( )	m ( )	ŋ ( )	i ( ) i ( )	
35. laughing	lɑfiŋ	CV-CVC ( )	l ( )	f ( )	ŋ ( )	ɑ ( ) i ( )	
36. washing	wɑʃiŋ	CV-CVC ( )	w ( )	ʃ ( )	ŋ ( )	ɑ ( ) i ( )	
37. daddy	dɛdi	CV-CV ( )	d ( )	d ( )	-	ɛ ( ) i ( )	
38. five	faif	CVVC ( )	f ( )	-	f/(v) ( )	ai ( )	
39. that	ðɛt	CVC ( )	d/ð ( )	-	t˺/t ( )	ɛ ( )	
40. pencil	pensə	CVC-CV(C) ( )	p ( )	n ( ) s ( )	Ø/(l) ( )	e ( ) ə ( )	
41. crayon	kɹejɔn	CCV(-C)VC ( )	kɹ ( )	(j)/Ø ( )	n ( )	e ( ) ɔ ( )	
42. blue	blu	CCV ( )	bl ( )	-	-	u ( )	
43. red	ɹed	CVC ( )	ɹ ( )	-	d˺/d ( )	e ( )	

3+3

Word	IPA	Syllable structure	Initial	Medial	Final	Vowel	Transcription
44. yellow	jəlo	CV-CV ( )	j ( )	l ( )	-	ə ( ) o ( )	
45. green	gɹin	CCVC ( )	gr/gɹ ( )	-	n ( )	i ( )	
46. clock	klɔk	CCVC ( )	kl ( )	-	k ( )	ɔ ( )	
47. watch	wɑtʃ	CVC ( )	w ( )	-	tʃ ( )	ɑ ( )	
48. scissors	sizəs	CV-CVC ( )	s ( )	z ( )	s/(z) ( )	i ( ) ə ( )	
49. yoyo	jojo	CV-CV ( )	j ( )	j ( )	-	o ( ) o ( )	
50. house	haus	CVVC ( )	h ( )	-	s ( )	au ( )	
51. flower	flɑwə	CCV(-C)V ( )	fl ( )	(w)/Ø ( )	-	ɑ ( ) ə ( )	
52. leaf	lif	CVC ( )	l ( )	-	f ( )	i ( )	
53. tree	tɹi	CCV ( )	tr/tɹ ( )	-	-	i ( )	
54. sky	skai	CCVV ( )	sk ( )	-	-	ai ( )	
55. van	vɛn	CVC ( )	ʋ/v ( )	-	n ( )	ɛ ( )	
56. star	stɑ	CCV ( )	st ( )	-	-	ɑ ( )	
57. zoo	zu	CV ( )	z ( )	-	-	u ( )	
58. banana	bənɑnɑ	CV-CV-CV ( )	b ( )	n ( ) n ( )	-	ə ( ) ɑ ( ) ɑ/ə ( )	
59. driving	dɹaiviŋ	CCVV-CVC ( )	dɹ ( )	ʋ/v ( )	ŋ ( )	ai ( ) i ( )	
60. clock	klɔk	CCVC ( )	kl ( )	-	k ( )	ɔ ( )	
61. van	vɛn	CVC ( )	ʋ/v ( )	-	n ( )	ɛ ( )	

No. 57-61: repeated words for intra-word consistency of production sub-test.

MALAYSIAN ENGLISH (MANGLISH) INTONATION TEST

Stimuli	Target pitch contour	Transcription
Statement intonation		
1.Baby is drinking milk.	Level-Falling 2-2-2-2-2-1	
Question intonation		
2. Did baby drink milk?	Rising 2-2-3-3-4	

<u>*IPA column:*</u>

-Manglish pronunciation based on present study nursery teachers' most standard realization, e.g. no (2) ear: iə.

<u>*Initial/Medial/Final/Vowel columns:*</u>

-Target segment on the left represents amongst the most common variant used by the teachers, e.g. no (10) snake: **ʔ**/k.

-Target segment on the right represents a standard RP realisation, which is also used by the teachers, e.g. no (10) snake: ʔ/**k**.

-Target segment on the right in bracket represents another acceptable standard RP realisational form, but not used by the teachers in responding on this test, e.g. no (2) nose: s/**(z)**.

Ø/( ): Target segment on the right in bracket represents a standard RP realization form, but omitted by the teachers in responding on this test, e.g. no (14) small: **Ø**/(l).

( )/Ø: Target segment on the left in bracket is not present in RP realization, but is present in the teachers' pronunciation as a variant, e.g. no (41) crayon: **(j)**/Ø.

Malaysian Mandarin (Maldarin) phonology test

Name: Sex Age:

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Word	IPA	Syllable structure	Initial	Medial	Final	Vowel	Tone	Trancription
1.zui3ba1	tsueɪ3pa̱1	CG(V)G-CV ( )	ts ( )	p ( )		uɪ/ueɪ ( ) a̱ ( )	3 ( ) 1 ( )	
2. ya2chi3	ia̱2tʰʂi̱3	GV-CV ( )	-	tsʰ/tʂʰ ( )		ia̱ ( ) i̱ ( )	2 ( ) 3 ( )	
3. tou2	tʰoʊ2	CVG ( )	tʰ ( )	-		oᵘ/oʊ ( )	2 ( )	
4. ku1	kʰu1	CV ( )	kʰ ( )	-		u ( )	4/1 ( )	
5. shui4jiao4	suɪ4tsiɑo4	CG(V)G-CGVG ( )	s/(ʂ) ( )	ts/(tɕ) ( )		uɪ/(ueɪ)( ) iɑo ( )	4 ( ) 4 ( )	
6. zuo4	tsuo4	CGV ( )	ts ( )	-		ᵘo/uo ( )	4 ( )	
7. zhan4	tsan4	CVC ( )	ts/(tʂ) ( )	-	n ( )	a ( )	4 ( )	
8. pao3	pʰɑo3	CVG ( )	pʰ ( )	-		ɑo ( )	3 ( )	
9. xi2shou3	si2ʂoʊ3	CV-CVG ( )	s/(ɕ) ( )	s/ʂ ( )		i ( ) oᵘ/oʊ ( )	*23 ( )	
10.hua4hua4	xua̱4xua̱4	CGV-CGV ( )	x ( )	x ( )		ua̱ ( ) ua̱ ( )	4 ( ) 4/(0) ( )	
11. chong1liang2	tsʰoŋ1liɑŋ2	CVC-CGVC ( )	tsʰ/(tʂʰ)( )	ŋ ( ) l ( )	ŋ ( )	o/(ʊ) ( ) iɑ ( )	1 ( ) 2 ( )	
12. pai1shou3	pʰae1soʊ3	CVG-CVG ( )	pʰ( )	s/(ʂ) ( )		ae ( ) ɔᵘ/oʊ ( )	1 ( ) 3 ( )	
13. chi1fan4	tsʰi̱1fan4	CV-CVC ( )	tsʰ/(tʂʰ)( )	f( )	n ( )	i̱ ( ) a ( )	4/1 ( ) 4 ( )	

Word	IPA	Syllable structure	Initial	Medial	Final	Vowel	Tone	Transcription
14. cai4	tsʰae4	CVG ( )	tsʰ( )	-	-	ae ( )	4 ( )	
15. ji1rou4	tsi1ɻoʊ4	CV-CVG ( )	ts/(tɕ) ( )	ɹ/ɻ ( )		i ( ) oᵘ/oʊ ( )	1 ( ) 4 ( )	
16. tang2guo3	tʰɑŋ2kuo3	CVC-CGV ( )	tʰ ( )	ŋ ( ) k ( )		ɑ ( ) uo ( )	2 ( ) 3 ( )	
17. ma1ma1	ma̰1ma̰0	CV-CV ( )	m ( )	m ( )		a̰ ( ) a̰ ( )	1 ( ) 1/0 ( )	
18. di4di4	ti4ti0	CV-CV ( )	t ( )	t ( )		i ( ) i ( )	4 ( ) 4/0 ( )	
19. nü3hai2zi3	ny3xae2tʂi̪3	CV-CVG-CV ( )	n ( )	x ( ) ts ( )		i/y ( ) ae ( ) i̪ ( )	3 ( ) 2 ( ) 3/(0) ( )	
20.ya1	ia̰1	GV ( )	-	-		ia̰ ( )	4/1 ( )	
21. yang2	iɑŋ2	GVC ( )	-	-	ŋ ( )	iɑ ( )	2 ( )	
22. gou3	koʊ3	CVG ( )	k ( )	-		oᵘ/oʊ ( )	3 ( )	
23. kuai4	kʰuae4	CGVG ( )	kʰ( )	-		uae ( )	4 ( )	
24. san1	san1	CVC ( )	s ( )	-	n ( )	a ( )	1 ( )	
25. si4	si̪4	CV ( )	s ( )	-		i̪ ( )	4 ( )	
26. wu3	u3	V ( )	-	-		u ( )	3 ( )	
27. liu4	lioʊ4	CG(V)G ( )	l ( )	-		iu/ioʊ( )	4 ( )	
28. qi1	tsʰi1	CV ( )	tsʰ/(tɕʰ)( )	-		i ( )	4 1/ ( )	
29. pa1	pa̰1	CV ( )	p ( )	-		a̰ ( )	4/1 ( )	
30. xie2zi3	siɛ2tsi̪3	CGV-CV ( )	s/(ɕ) ( )	ts ( )		iɛ ( ) i̪ ( )	2 ( ) 3/(0) ( )	

Word	IPA	Syllable structure	Initial	Medial	Final	Vowel	Tone	Transcription
31.qian2	tsʰiɛn2	CGVC ( )	tsʰ/(tɕʰ)( )	-	n ( )	iɛ ( )	2 ( )	
32.da4	ta̰4	CV ( )	t ( )	-	-	a̰ ( )	4 ( )	
33.li3mian4	li3miɛn4	CV-CGVC ( )	l ( )	m ( )	n ( )	i ( ) iɛ ( )	3 ( ) 4 ( )	
34. zhuo1zi3	tsuo1tsi̯3	CGV-CV ( )	ts/(tʂ) ( )	ts ( )	-	ᵘo/uo ( ) i̯ ( )	1 ( ) 3/(0) ( )	
35. re4	ɻɤ 4	CV ( )	ɹ/ɻ ( )	-	-	i̯/ɤ ( )	4 ( )	
36. cao3	tsʰɑo3	CVG ( )	tsʰ( )	-	-	ɑo ( )	3 ( )	
37. fei1ji1	feⁱ1tsi1	CVG-CV ( )	f ( )	ts/(tɕ) ( )	-	eⁱ/ei ( ) i ( )	1 ( ) 1 ( )	
38. yue4liang4	yɛ4liɑŋ4	GV-CGVC ( )	-	l ( )	ŋ ( )	i/yɛ( ) iɑ( )	4 ( ) 4 ( )	
39.xi2shou3	si2soʊ3	CV-CVG ( )	s/ɕ ( )	s/(ʂ) ( )	-	i ( ) oᵘ/oʊ ( )	*2 ( ) 3 ( )	
40. chi1fan4	tʂʰi̯1fan4	CV-CVC ( )	tsʰ/tʂʰ( )	f ( )	n ( )	i̯ ( ) a ( )	4/1 ( ) 4 ( )	
41.ji1rou4	tsi1ɹoʊ4	CV-CVG ( )	ts/(tɕ) ( )	ɹ/(ɻ) ( )	-	i ( ) oᵘ/oʊ ( )	1 ( ) 4 ( )	
42. nü3hai2zi3	ny3xae2tsi̯3	CV-CVG-CV ( )	n ( )	x ( ) ts ( )	-	y ( ) ae ( ) i̯ ( )	3 ( ) 2 ( ) 3/(0) ( )	
43.re4	ɻɤ4	CV ( )	ɹ/ɻ ( )	-	-	i̯/ɤ ( )	4 ( )	

No.39-43: repeated words for ***intra-word consistency of production sub-test.***

MALAYSIAN MANDARIN (MALDARIN) INTONATION TEST

Stimuli	Target pitch contour	Transcription
Statement intonation		
1.Meimei he neinei.	Level-Falling 3-3-3-1-1	
Question intonation		
2. Meimei he neinei ma?	Level-Falling-Rising 4-4-4-2-3	

IPA column:

-Maldarin pronunciation based on present study nursery teachers' most standard realisation, e.g. no (2) ya2chi3: **ia̰2tʂʰi̠3.**

Initial/Medial/Final/Vowel/Tone columns:

-Target segment/tone on the left represents amongst the most common variant used by the teachers, e.g. no (2) ya2chi3: tsʰ/tʂʰ.

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-Target segment/tone on the right represents a standard Putonghua realisation/tone, which it is also used by the teachers,
e.g. no (2) ya2chi3: tsʰ/**tʂʰ.**
*e.g. no (17) ma1**ma0**: second syllable 1/**0.***

-Target segment/tone on the right in bracket represents another acceptable standard Putonghua realisational form/tone, but not used by the teachers,
*e.g. no (11) chong1liang2: o/(**ʊ**).*

*-*Third tone sandhi namely: T3 becomes T2 when it precedes another T3 i.e. XI3 SHOU3*→si2ʂou3.

Chinese Malay (ChinMalay) phonology test

Name: Sex: Age:

Word	IPA	Syllable struc.	Initial	Medial	Final	Vowel	Transcription
1. mulut (mouth)	mulut	CV-CVC ( )	m ( )	l( )	t ( )	u ( ) u ( )	
2. gigi (teeth)	gigi	CV-CV ( )	g ( )	g ( )	-	i ( ) i ( )	
3. hidung (nose)	hidoŋ	CV-CVC ( )	h ( )	d ( )	ŋ ( )	i ( ) o ( )	
4. tangan (hand)	taŋan	CV-CVC ( )	t ( )	ŋ ( )	n ( )	a ( ) a ( )	
5. ikan (fish)	ikan	V-CVC ( )	-	k ( )	n ( )	i ( ) a ( )	
6. ayam (chicken)	ajam	V-CVC ( )	-	j ( )	m ( )	a ( ) a ( )	
7. kucing (cat)	kutʃeŋ	CV-CVC ( )	k ( )	tʃ( )	ŋ ( )	u ( ) i/e ( )	
8. roti (bread)	roti	CV-CV ( )	ɹ/r ( )	t ( )	-	ɔ/o ( ) i ( )	
9. jem (jam)	dʒɛm	CVC ( )	dʒ ( )	-	m ( )	ɛ ( )	
10. susu (milk)	susu	CV-CV ( )	s ( )	s ( )	-	u ( ) u ( )	
11. epal (apple)	epəl	V-CV(C) ( )	-	p ( )	Ø/l ( )	e ( ) ə ( )	
12. meja (table)	medʒə	CV-CV ( )	m ( )	dʒ ( )	-	e ( ) a/ə ( )	
13. cawan (cup)	tʃawan	CV-CVC ( )	tʃ ( )	w ( )	n ( )	a ( ) a ( )	
14. yoyo (yoyo)	jojo	CV-CV ( )	j ( )	j ( )	-	o ( ) o ( )	
15. pensel (pencil)	pensə	CVC-CV(C) ( )	p ( )	n ( ) s ( )	Ø/(l) ( )	e ( ) ə ( )	
16. bas (bus)	bas	CVC ( )	b ( )	-	s ( )	a ( )	
17. lori (lorry)	lori	CV-CV ( )	l ( )	ɹ/(r) ( )	-	ɔ/o ( ) i ( )	
18. rumah (house)	ruma	CV-CV(C) ( )	r ( )	m ( )	Ø/(h) ( )	u ( ) a ( )	
19. tiga (three)	tigə	CV-CV ( )	t ( )	g ( )	-	i ( ) a/ə ( )	
20. daun (leaf)	daun	CV-VC ( )	d ( )	-	n ( )	au ( )	
21. wang (money)	waŋ	CVC ( )	w ( )	-	ŋ ( )	a ( )	

Word	IPA	Syllable structure	Initial	Medial	Final	Vowel	Transcription
22. hujan (rain)	hudʒan	CV-CVC ( )	h ( )	dʒ ( )	n ( )	u( ) a( )	
23. nenek (grandmother)	neneʔ	CV-CVC ( )	n ( )	n ( )	ʔ ( )	e( ) e( )	
24. ibu (mother)	ibu	V-CV ( )	-	b ( )	-	i( ) u( )	
25. duduk (to sit)	dudoʔ	CV-CVC ( )	d ( )	d ( )	ʔ ( )	u( ) o( )	
26. nyanyi (to sing)	ɲaɲi	CV-CV ( )	ɲ ( )	ɲ ( )	-	a( ) i( )	
27. roti (bread)	roti	CV-CV ( )	ɹ/r ( )	t ( )	-	ɔ/o ( ) i ()	
28. susu (milk)	susu	CV-CV ( )	s ( )	s ( )	-	u( ) u( )	
29. bas (bus)	bas	CVC ( )	b ( )	-	s ( )	a( )	
30. lori (lorry)	lori	CV-CV ( )	l ( )	ɾ/r ( )	-	ɔ/o ( ) i( )	
31. nyanyi (to sing)	ɲaɲi	CV-CV ( )	ɲ ( )	ɲ ( )	-	a( ) i( )	

No. 27-31: repeated-words for intra-word consistency of production sub-test.

CHINESE MALAY (CHINMALAY) INTONATION TEST

Stimuli	Target pitch contour	Transcription
Statement intonation		
1.Adik m-num susu.	Rising-Falling-Level-Falling 2-3-2-2-2-1	
Question intonation		
2. Adik minum susu tak?	Level-Falling-Level-Rising 2-3-2-2-2-3	

IPA column:

ChinMalay pronunciation based on present study nursery teachers' most standard realisation, e.g. no (8) roti: **roti.**

Initial/Medial/Final/Vowel columns:

-Target segment on the left represents amongst the most common variant used by the teachers, e.g. no (8) roti: ɹ/r.

*-Target segment on the right represents a standard Malay realization, which is also used by the teachers, e.g. no (8) roti: ɹ/**r**.*

-Target segment on the right in bracket represents another acceptable standard Malay realisational form, but not used by the teachers, e.g. no (15) pensel: Ø/(l).

Summary of phonology test

Malaysian English (Manglish) phonology test

Target words in English

a. Ear	31. Eating
b. Nose	32. Singing
c. Mouth	**33. Driving**
4. Teeth	34. Swimming
5. Dog	35. Orange
6. Chicken	36. Laughing
7. Fish	37. Washing
8. Horse	38. Daddy
9. Frog	39. Five
10. Snake	40. That
11. Zoo	41. Crayon
12. Tiger	42. Blue
13. Web	43. Red
14. Small	44. Yellow
15. Table	45. Green
16. Spoon	**46. Clock**
17. Glass	47. Watch
18. Bread	48. Scissors
19. Jam	49. Yoyo
20. Plate	50. House
21. Orange	51. Flower
22. Banana	52. Leaf
23. Cup	53. Tree
24. Boy	54. Sky
25. Girl	**55. Van**
26. Mother	56. Star
27. Thin	
28. Shoes	
29. Pyjamas	
30. Sleeping	

Highlighted words: target words for intra-word consistency of production sub-test.

Appendix 6 (cont'd)

Target consonants in English

	Initial	Medial	Final	Total
Stop				
1.p	2	1	1	4
2.b	2	1	1	4
3.t	3	1	2	6
4.d	2	1	2	5
5.k	1	1	2	4
6.g	1	1	2	4
Total	**11**	**6**	**10**	**27**
Nasal				
7. m	2	2	1	5
8.n	1	3	6	10
9.ŋ	-	1	7	8
Total	**3**	**6**	**14**	**23**
Affricate				
10.tʃ	1	0	1	2
11. dʒ	1	1	0	2
Total	**2**	**1**	**1**	**4**
Fricative				
12.f	2	1	1	4
13.v	1	1	1	3
14.θ	1	0	2	3
15.ð	1	1	0	2
16.s	2	1	4	7
17.z	1	1	3	5
18.ʃ	1	1	1	3
19.h	2	0	-	2
Total	**11**	**6**	**12**	**29**
Approximant				
20.ɹ	1	1	-	2
21.w	3	0	-	3
22.j	2	1	-	3
Total	**6**	**2**	-	**8**
Lateral approx.				
23.l	2	1	4	7
Total	**2**	**1**	**4**	**7**
Overall total	**35**	**22**	**41**	**98**

Appendix 6 (cont'd)

Target consonants in English

Initial consonant cluster	Total
1. pl	1
2. bl	1
3. bɹ	1
4. tɹ	1
5. dɹ	1
6. kl	1
7. kɹ	1
8. gl	1
9. gɹ	1
10. fl	1
11. fɹ	1
12. sp	1
13. st	1
14. sk	1
15. sm	1
16. sn	1
17. sl	1
18. sw	1
Total	**18**
Overall total singleton and cluster	**116**

Target vowels in English

Monophthong		Diphthong		**Total**
1. i	20	1. ai	4	
2. e	9	2. au	2	
3. ɛ	4	3. ɔi	1	
4. ə	13	4. iə	1	
5. ɑ	10	5.uə	0	
6. u	4	**Total**	**8**	
7. o	4			
8. ɔ	7			
Total	**71**			
Overall total	**71**		**8**	**79**

Target syllable structures in English

Monosyllable		Disyllable		Trisyllable		Total
1. VV	1	1. V-CVC	1	1. CV-CV-CV	1	
2. CV	1	2. V-CVCC	1	2. CV-CV-CVC	1	
3. CVV	1	3. CV-CV	4	**Total**	**2**	
4. CVC	16	4. CV-CVC	6			
5. CCV	3	5. CVV-CV	1			
6. CCVV	1	6. CCV-CV	1			
7. CVVC	3	7. CVC-CVC	1			
8. CCVC	9	8. CCV-CVC	3			
Total	**35**	9. CCVV-CVC	1			
		Total	**19**			
Overall total	**35**		**19**		**2**	**56**

Target intonation patterns in English

Statement		Question		Total
Level-Falling	1	Rising	1	
Total	**1**		**1**	
Overall total	**1**		**1**	**2**

Malaysian Mandarin (Maldarin) phonology test

Target words in Mandarin

Mandarin word	Meaning
1. ZUI3BA1	Mouth
2. YA2CHI3	Teeth
3. TOU2	Head
4. KU1	To cry
5. SHUI4JIAO4	To sleep
6. ZUO4	To sit
7. ZHAN4	To stand
8. PAO3	To run
9. XI2SHOU3	**To wash hands**
10. HUA4HUA4	To draw
11. CHONG1LIANG2	To take shower
12. PAI1SHOU3	To clap hands
13. CHI1FAN4	**To eat rice**
14. CAI4	Vegetble
15. JI1ROU4	**Chicken meat**
16. TANG2GUO3	Sweeties
17. MA1MA1	Mother
18. DI4DI4	Younger brother
19. NÜ3HAI2ZI3	**Girl**
20. YA1	Duck
21. YANG2	Goat
22. GOU3	Dog
23. KUAI4	Fast
24. SAN1	Three
25. SI4	Four

Malaysian Mandarin (Maldarin) phonology test

Target words in Mandarin

26. WU3	Five
27. LIU4	Six
28. QI1	Seven
29. BA1	Eight
30. XIE2ZI3	Shoes
31. QIAN2	Money
32. DA4	Big
33. LI3MIAN4	In
34. ZHUO1ZI3	Table
35. RE4	**Hot**
36. CAO3	Grass
37. FEI1JI1	Aeroplane
38. YUE4LIANG4	Moon

Highlighted words: target words for intra-word consistency of production sub-test.

Target consonants in Mandarin

	Initial	Medial	Final	Total
Stop				
1. p	1	1	-	2
2. pʰ	2	0	-	2
3. t	2	1	-	3
4. tʰ	2	0	-	2
5. k	1	1	-	2
6. kʰ	2	0	-	2
Total	**10**	**3**	-	**13**
Nasal				
7. m	1	2	-	3
8. n	1	0	5	6
9. ŋ	-	2	3	5
Total	**2**	**4**	**8**	**14**
Affricate				
10. ts	2	3	-	5
11. tsʰ	2	0	-	2
12. tʂ	2	0	-	2
13. tʂʰ	2	1	-	3
14. tɕ	1	2	-	3
15. tɕʰ	2	0	-	2
Total	**11**	**6**	-	**17**
Fricative				
16. f	1	1	-	2
17. s	2	0	-	2
18. ʂ	1	2	-	3
19. ɕ	2	0	-	2
20. x	1	2	-	3
Total	**7**	**5**	-	**12**
Approximant				
21. ɻ	1	1	-	2
Total	**1**	**1**	-	**2**
Lateral approximant				
22. l	2	2	-	4
Total	**2**	**2**	-	**4**
Overall total	**33**	**21**	**8**	**62**

Target vowels in Mandarin

Monophthong		Diphthong		Triphthong		Total
1. i	13 (i= 7, i̻/ɿ=4, i̻/ʅ=2)	1. ae	3	1. iɑo	1	
2. y	1	2. ɑo	2	2. ioʊ	1	
3. a̰	9 (a̰=5, a=3, ɑ=1)	3. ei	1	3. uae	1	
4. ɤ	1	4. oʊ	5	4. ueɪ	2	
5. u	2	5. ia̰	5	**Total**	**5**	
6. o	1	6. iɛ	3			
Total	**27**	7. ua̰	2			
		8. uo	3			
		9. yɛ	1			
		Total	**25**			
Overall total	**27**		**25**		**5**	**57**

Target syllable structures in Mandarin

Monosyllable		Disyllable		Trisyllable		Total
1. CGVC	1	1. GV-CV	1	1. CV-CVG-CV	1	
2. CGVG	2	2. GV-CGVC	1	**Total**	**1**	
3. CVC	2	3. CV-CGVC	1			
4. CVG	5	4. CV-CV	2			
5. CGV	1	5. CV-CVC	1			
6. CV	6	6. CV-CVG	2			
7. GVC	1	7. CVC-CGV	1			
8. GV	1	8. CVC-CGVC	1			
9. V	1	9. CVG-CV	1			
Total	**20**	10. CVG-CVG	1			
		11. CGV-CV	2			
		12. CGV-CGV	1			
		13. CGVG-CV	1			
		14. CGVG-CGVG	1			
		Total	**17**			
Overall total	**20**		**17**		**1**	**38**

Target tones in Mandarin

Basic tone		Tone sandhi (TS)		Total
1.T1	15	1.* TS3	1	
2.T2	8	**Total**	**1**	
3.T3	13			
4.T4	19			
Total	**55**			
Overall total	**55**		**1**	**56**

**TS3-third tone sandhi: T3 becomes T2 when it precedes another T3 (see Chapter 3).*

Target intonation patterns in Mandarin

Statement		Question		Total
Level-Falling	1	Level-Falling-Rising	1	
Total	**1**		**1**	
Overall total	**1**		**1**	**2**

Chinese Malay (ChinMalay) phonology test

Target words in Malay

Malay word	Meaning
1. GIGI	Teeth
2. MULUT	Mouth
3. HIDUNG	Nose
4. TANGAN	Hand
5. IKAN	Fish
6. AYAM	Chicken
7. KUCING	Cat
8. ROTI	**Bread**
9. JEM	Jam
10. SUSU	**Milk**
11. EPAL	Apple
12. MEJA	Table
13. CAWAN	Cup
14. YOYO	Yoyo
15. PENSEL	Pencil
16. BAS	**Bus**
17. LORI	**Lorry**
18. RUMAH	House
19. TIGA	Three
20. DAUN	Leaf
21. WANG	Money
22. HUJAN	Rain
23. IBU	Mother
24. NENEK	Grandmother
25. DUDUK	To sit
26. NYANYI	**To sing**

Highlighted words: target words for intra-word consistency of production sub-test.

Target consonants in Malay

	Initial	Medial	Final	Total
Stop				
1. p	1	1	0	2
2. b	1	1	0	2
3. t	2	1	1	4
4. d	2	2	0	4
5. k	1	1	-	2
6. g	1	2	0	3
7. ʔ	0	0	2	2
Total	**8**	**8**	**3**	**19**
Nasal				
8. m	2	1	2	5
9. n	1	2	5	8
10. ɲ	1	1	-	2
11. ŋ	0	1	3	4
Total	**4**	**5**	**10**	**19**
Trill				
12. r	2	1	-	3
Total	**2**	**1**	**-**	**3**
Affricate				
15.tʃ	1	1	0	2
16. dʒ	1	2	0	3
Total	**2**	**3**	**0**	**5**
Fricative				
13. s	1	2	1	4
14.h	2	-	1	3
Total	**3**	**2**	**2**	**7**
Approximant				
17.w	1	1	-	2
18.j	1	2	-	3
Total	**2**	**3**	**-**	**5**
Lateral approximant				
19. l	1	1	2	4
Total	**1**	**1**	**2**	**4**
Overall total	**22**	**23**	**17**	**62**

Target vowels in Malay

Monophthong		Vowel sequence		Total
1. i	9	1. au	1	
2. e	6	**Total**	**1**	
3. a	12			
4. ə	4			
5. u	9			
6. o	6			
7. ɛ	1			
Total	**47**			
Overall total	**47**		**1**	**48**

Target syllable structures in Malay

Monosyllable		Disyllable		Total
1. CVC	3	1. V-CV	1	
Total	**3**	2. V-CVC	3	
		3. CV-VC	1	
		4. CV-CV	8	
		5. CV-CVC	9	
		6. CVC-CVC	1	
		Total	**23**	
Overall total	**3**		**23**	**26**

Target intonation patterns in Malay

Statement		Question		Total
Rising-Falling-Level-Falling	1	Rising-Falling-Level-Rising	1	
Total	**1**		**1**	
Overall total	**1**		**1**	**2**

Appendix 7

Consent forms

15 FEBRUARY 2006

TO WHOM IT MAY CONCERN

Dear Sir/Madam,

Child pronunciation project

I am a lecturer in the Department of Audiology and Speech Sciences, National University of Malaysia (Universiti Kebangsaan Malaysia)(UKM). Currently I am doing full-time PhD study at the Department Of Human Communication Sciences, University of Sheffield, England.

As a lecturer cum speech-therapist in the above-mentioned department in UKM, I have been dealing with many Malaysian children in the departmental speech-therapy clinic for the past six years. I have also conducted some local studies on child language over the said period.

Currently my PhD study is another local study on language development in Malaysian children (see attached "Information sheet"). I am writing in to have your kind permission for your child/pupil(s) to participate in the project.

All materials I gather will be confidential and your child's/pupil(s)' name will not be used in the project. If you agree that your child/pupil(s) can participate in this project, please kindly sign the "Consent form for project participation", keep a copy, and return the second copy to me.

Also, if you agree, the audio and video tapes of the test sessions will be kept in a secure place in my university (University of Sheffield then UKM) for future research and teaching purposes (ref "Consent form for audio-video tape recording" options). Please kindly sign the said form, keep a copy, and return the second copy to me.

I will send a summary of my findings to you. If you have any queries about the project, please do not hesitate to contact me at my local contact number (tel: 03-4149-8019) or my supervisor-Prof. Bill Wells at the Department of Human Communication Sciences (tel: 0114-2222418).

Thank you very much. Look forward to hearing from you

Yours,

Lim Hui Woan

Student (U-card no: 040181400)

Attachment: 1. "Information sheet"

2. "Consent form for project participation":
   a. Parents.
   b. Nursery head teacher.

3. "Consent form for audio-video tape recording".
   a. Parents.
   b. Nursery head teacher.

Information sheet

Child pronunciation project

The present research project is about pronunciation development in Malaysian Chinese pre-school children. It aims at providing some preliminary information on child pronunciation development in the local Chinese population (e.g. at what age children acquired the */b/* sound, */t/* sound etc.) This information is particularly useful for local professionals such as speech-language therapists working with children with pronunciation delay or disorder. It also serves as a good source of reference for other professionals such as school teachers, special education teachers, paediatricians etc. dealing with children.

Sixty four children (aged between 2;06-4;06) will be participating in this project. The children will be asked to name some picture cards (*e.g. glass, ball etc.*) which will be audio-recorded and video-recorded (for some sessions only) for scoring purposes. Three pronunciation tests will be administered, each representing the three main local languages i.e. Mandarin, English and Malay, across three test sessions. Each test will take approximately 20-30 minutes.

The test sessions are meant to be non-stressful and rewarding for the child. A brief "warm-up" free play pre-test session will be conducted where desired in order to establish rapport with the child. A small token (e.g. sticker etc.) will be given post-test-session as a reward for the child. Occasionally, a little break will be given within test session (especially for younger child) to avoid exhaustion in the child. The test will be abandoned for reasons such as illness, mood swing etc in which case the test session will be rescheduled upon prior arrangement with parents/head teacher.

Parental consent form for project participation

Child pronunciation project

1. I have read and understood the letter about the project.
2. I agree to the arrangements described concerning my child's participation in the project.
3. I understand that my child's full name and other details will not be revealed in the project.
4. I understood that I can withdraw my child from the project at any time without giving any reason.
5. I have retained a copy of this completed consent form, and the accompanying covering letter and information sheet.

Parent's/guardian's name:

Signature:

Date:

Parental consent form for audio-video tape recording

<u>Child pronunciation project</u>

Options for recording (please circle your choice):

1. I agree for audio-video recording of my child being made for this project. (Yes/No)
2. I agree that audio-video recording of my child may be retained for future analysis after the end of the project. (Yes/No)

   (Answer "NO" will mean that the recording will be erased at the end of the project).
3. I agree to the showing of extracts from these recordings in teaching and research presentation. (Yes/No)

Parent's/guardian's name:

Signature:

Date:

Head teacher consent form for project participation

Child pronunciation project

1. I have read and understood the letter about the project.
2. I agree to the arrangements described concerning my pupil(s)' participation in the project.
3. I understand that my pupil(s)' full name and other details will not be revealed in the project.
4. I understood that I can withdraw my pupil(s) from the project at any time without giving any reason.
5. I have retained a copy of this completed consent form, and the accompanying covering letter and information sheet.

Name:

Signature:

Date:

Head teacher consent form for audio-video tape recording

Child pronunciation project

Options for recording (please circle your choice):

1. I agree for audio-video recording of my pupil(s) being made for this project. (Yes/No)

2. I agree that audio-video recording of my pupil(s) may be retained for future analysis after the end of the project. (Yes/No)

   (Answer "NO" will mean that the recording will be erased at the end of the project).

3. I agree to the showing of extracts from these recordings in teaching and research presentation. (Yes/No)

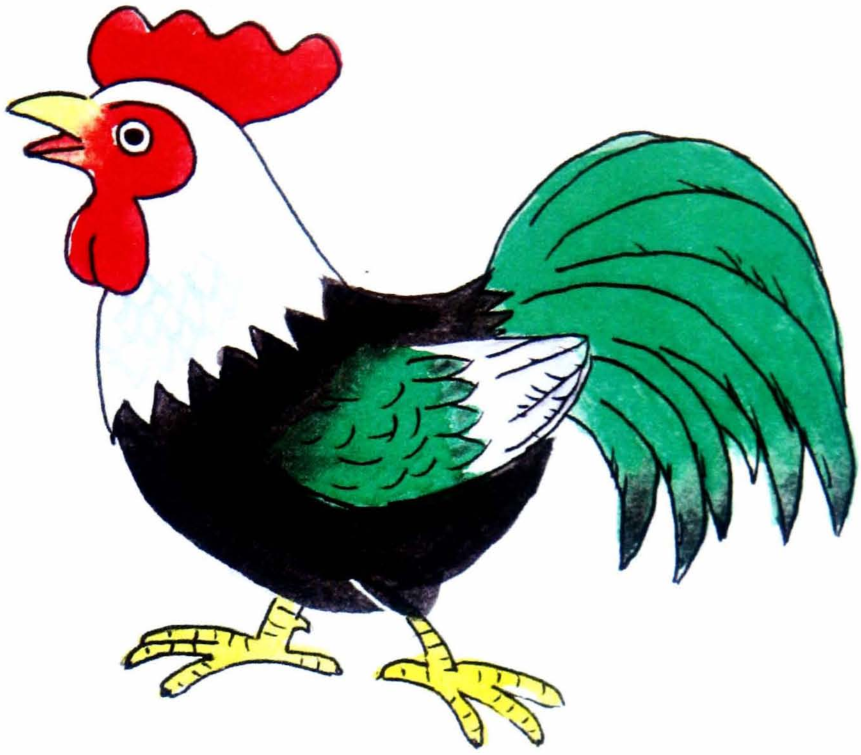
Name:

Signature:

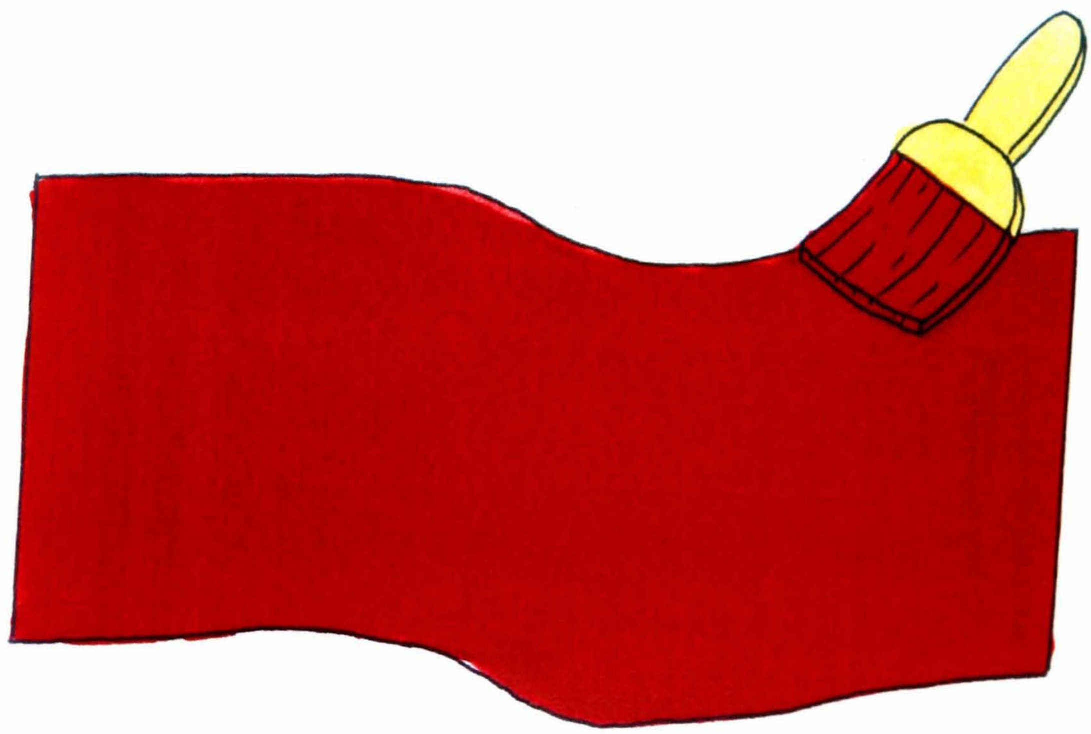
Date:

Phonology test picture samples

English



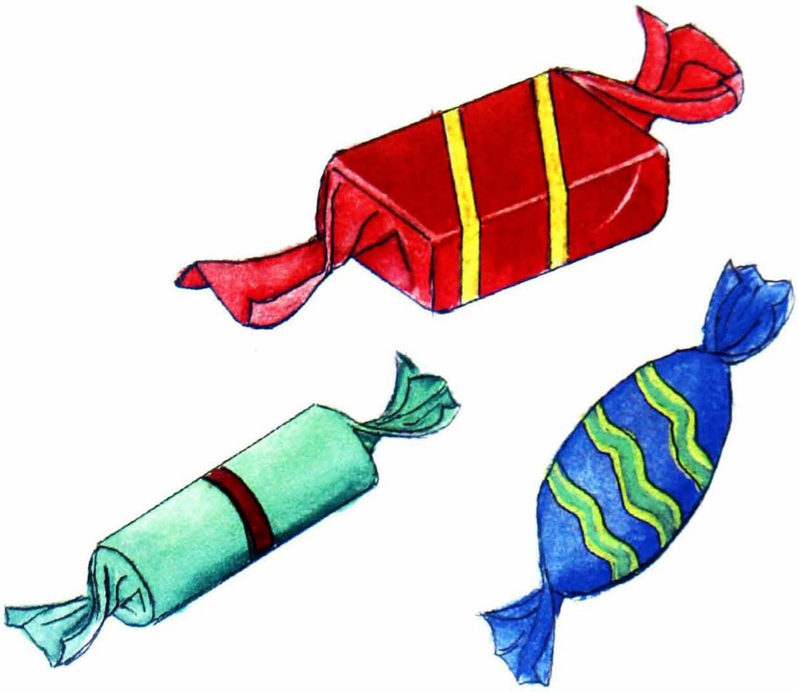
CHICKEN



RED

Phonology test picture samples

Mandarin



TANG2GUO3 (SWEETIES)

KU1 (TO CRY)

Phonology test picture samples

Malay

RUMAH (HOUSE)

HUJAN (TO RAIN)

Intonation test

Statement intonation

BABY IS DRINKING MILK.
MEIMEI HE NENE.
ADIK MINUM SUSU.

Question intonation

DID BABY DRINK MILK?
MEIMEI HE NENE MA?
ADIK MINUM SUSU TAK?