
SPEECH DEVELOPMENT AND DISORDER IN BILINGUAL CHILDREN

Alison Holm

Bachelor of Speech Pathology (Honours I)

Department of Speech
University of Newcastle upon Tyne

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DECLARATION OF ORIGINALITY

The material presented in this thesis is the original work of the candidate except as otherwise acknowledged. It has not been submitted previously in part or whole, for any award, at any university, at any other time.

Alison Holm

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ABSTRACT

Speech-language pathologists have no clear guidelines on how to assess, diagnose or treat bilingual children with speech disorders. This thesis addresses this issue. The phonological development of 91 Cantonese-English and Punjabi-English bilingual children is described. Two Cantonese-English bilingual children's phonological development over the year they were first exposed to English is also presented. The bilingual children's phonological systems were clearly differentiated. The bilingual children's speech also included many phonological processes that would be considered atypical for a monolingual child. The use of these processes is argued to be characteristic of normal bilingual development. The longitudinal data showed that the atypical error patterns were transient and directly related to the introduction of the second language. Some 'atypical' error patterns could be plausibly explained by referring to the nature of the two phonological systems. Other atypical processes could be explained by language-specific differences in normal developmental or adult variation patterns.

This thesis argues that the differences evident in the bilingual children's phonological patterns are due to 'hypothesis testing' resulting in underspecified realisation rules. There was no indication that bilingual children process phonological input and output differently to monolingual children. However, they differentiate the cognitive-linguistic information they abstract from the two languages, and they use separate phonological realisation rules for each language. This thesis argues that bilingual children use the same phonological processing mechanism for both languages, however they are able to filter each language through the appropriate language-specific phonological information.

Case studies of 21 children with disordered speech and treatment case studies of 2 children are also presented. The disordered speech data supports current psycholinguistic models of speech processing: the hypothesised levels of breakdown fit with the error profiles evident. The bilingual children with speech disorder validate Dodd's (1995) classification system: four different types of disorder were evident. The results of the two treatment case studies presented suggest that unless intervention targets the underlying deficit the effect of intervention will be language-specific.

The investigation into bilingual children with disordered speech indicates that speech-language pathologists need to assess both languages of a bilingual child to determine the language-specific patterns and the type of disorder and that it is important to compare bilingual children to their bilingual normally developing peers, not to monolingual developmental data.

PUBLICATIONS ARISING FROM THESIS

1. Holm, A., Ozanne, A., & Dodd, B. (1997). Efficacy of intervention for a bilingual child making articulation and phonological errors. *International Journal of Bilingualism*, 1, 55-69.
2. Dodd, B., Holm, A., & Li, W. (1997). Speech disorder in pre-school children exposed to Cantonese and English. *Clinical Linguistics and Phonetics*, 11, 229-243.
3. Holm, A., Dodd, B., Stow, S., & Pert, S. (1998). Speech disorder in bilingual children: four case studies. *Osmania Papers in Linguistics*, 22-23, 45-64.
4. Holm, A. & Dodd, B. (1999). Differential diagnosis of phonological disorder in two bilingual children acquiring Italian and English. *Clinical Linguistics and Phonetics*, 13, 113-129.
5. Holm, A. & Dodd, B. (In press). A longitudinal study of the phonological development of two Cantonese-English bilingual children. *Applied Psycholinguistics*.
6. Holm, A., Dodd, B., Stow, C. & Pert, S. (In press). Identification and differential diagnosis of phonological disorder in bilingual children. *Language Testing*.
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TERMINOLOGY

1. Ambiguous terms that could indicate language, ethnicity, or nationality, unless otherwise specified, will be used to refer to language only. Thus, for instance, “English” stands for “English-speaking”.
2. *Speech disorder* refers to a breakdown at any level in the speech processing chain, and can therefore encompass all children with speech difficulties regardless of the underlying deficit. *Phonological disorder* will specifically be used to refer to children with a deficit in either the cognitive-linguistic abstraction of rules or their phonological planning ability.
3. Some authors use the terms *phonological process* and *phonological rule* interchangeably (e.g., Fey, 1992). However, in this thesis the definitions described by Edwards (1992) and Dodd (1995) will be adopted: a phonological process is a general tendency that affects a group of sounds, while a rule is a statement of the specific contexts under which the process is implemented.
4. The terms *phonetic* and *phonological* are used contrastively in this thesis. The term phonetic refers to speech sound production (articulatory/motor skills). The term phonological refers to speech sound use (function/behaviour/organisation of the speech sound system).

SECTION I:
THE PHONOLOGICAL
DEVELOPMENT OF
BILINGUAL CHILDREN

CHAPTER 1:
INTRODUCTION AND
LITERATURE REVIEW

1.1 INTRODUCTION

Although almost half of the world's population has functional use of two languages (de Houwer, 1995; Genesee, 1993; Grosjean, 1982), bilingual language acquisition is often viewed as 'exceptional'. Research into child language development should therefore not focus on a subtype of development, monolingual acquisition, but also on the 'multilingual majority' (de Houwer, 1995). However, research on language acquisition in linguistics, psychology, and speech-language pathology has focused predominantly on monolingual children.

The phonological development of bilingual children is the "Cinderella of bilingual studies" (Watson, 1991, p.25). Most bilingual studies have investigated syntactic, lexical and pragmatic aspects of development. Watson suggests that phonology has been the least intensively researched area of language development because of its "peripherality to language processing... phonology is so far removed from the broader psychological issues of cognitive development and processing, that it fails to grab the attention" (p.25). However, this point of view does not explain the particular lack of bilingual research when there has been intense interest in the phonological development and processing of monolingual children. Stoel-Gammon (1992) identified the phonological development of bilingual children as an area of research that should become the focus of research in the 1990s: "Given the current theories regarding parameter setting, it would be of interest to investigate patterns of acquisition in a child learning two languages that differ on basic phonological parameters" (p.280).

There are important theoretical and clinical reasons that validate research into the bilingual development of phonology. Theoretical models of speech processing that identify specific underlying processes and skills need to be able to account for bilingual children as well as

monolingual children. This thesis argues that we can test psycholinguistic models by how well they account for the speech processing of bilingual children. It is also possible that investigating bilingual children will help identify the relative importance of language-specific and more universal factors that affect phonological development (de Houwer, 1995).

There are also implications for theories of bilingualism. Recurring questions in bilingual research (regarding unitary or differentiated systems, role of input, successive versus simultaneous acquisition, interactions between the two languages, effect of specific language combinations) can be addressed within the domain of phonological development. However, bilingual research has rarely investigated these larger 'bilingual issues' with reference to phonological data.

Bilingual language acquisition studies reveal the parameters of language learning in early childhood. However, most bilingual and second language acquisition studies have focused on the *potential* of early childhood language acquisition. These studies have not addressed the limitations or disorders of acquisition. Research into disordered development can provide valuable information regarding the process of normal development (Dodd, Campbell & Worrall, 1996; Holm & Dodd, in press).

Within the field of speech-language pathology, theories of phonological development and disorder have not adequately attempted to account for the multilingual acquisition environment. Developmental speech disorder affects up to ten percent of the population (Enderby & Phillip, 1986; Gierut, 1998; Kirkpatrick & Ward, 1984). Inadequate recognition of disorder in the bilingual population means that speech-language pathologists could be neglecting a significant number of children. The paucity of research also means that speech-language pathologists have a "lack of knowledge of the phenomena of

bilingualism". They also have an "inability to distinguish language difference from language disorder" (problems identified by speech-language pathologists working with bilingual children according to a survey of clinicians: Roseberry-McKibbin & Eicholtz, 1994, p.159). Without information regarding normal and disordered development valid decisions about diagnosis and intervention for bilingual children with disordered speech are difficult.

Section I of this thesis addresses the issue of the normal phonological development of bilingual children. Section II addresses the issues of disorder and intervention. The remainder of this chapter reviews the literature regarding the normal development of phonology and general issues within bilingualism. Chapter 5 reviews the literature specifically relating to phonological disorder and intervention for bilingual children.

1.2 BILINGUAL LANGUAGE DEVELOPMENT

1.2.1 SEQUENTIAL VERSUS SIMULTANEOUS ACQUISITION

The terminology used to differentiate bilingual children is often confusing. This confusion is due to different authors using the same or similar terminology (simultaneous, successive, sequential, consecutive, bilingual language acquisition, second language acquisition, incipient bilingual, foreign language learner) to mean different things. For example, de Houwer (1995) distinguishes between Bilingual First Language Acquisition (children exposed to both languages within a month of birth) and Bilingual Second Language Acquisition (children exposed to their second language within the first two years). In contrast, Genesee (1993) considers children to be 'bilingual language learners' when they are exposed to the second language within the first five years, and 'second language learners' after this period.

There is a degree of implicit value judgement regarding the 'true bilingual' or the 'balanced subject' - the child who has been exposed to equal amounts of each language since birth, preferably on a 'one-person - one-language' basis. These children are the linguist researcher's dream subjects, primarily because the effect of the variable 'time of first exposure' is removed (de Houwer, 1995). However, these children are "certainly the exception rather than the rule" (Watson, 1991, p.35) - many bilingual children are not exposed to their second language until after their first language has at least partially developed (Karniol, 1990; Watson, 1991). Most studies are single-subject longitudinal case studies that specifically target one aspect of language development. Most of these studies were conducted by the parent of the child (e.g., Burling, 1978; Fantini, 1985; Schnitzer & Krasinski, 1994, 1996) - and the children of linguists are probably not entirely representative of the bilingual population as a whole.

Most researchers agree that the order and relative ages at which the two languages are learned probably affects the language acquisition process. However, at this stage we do not know the nature and impact of these factors on language acquisition. There is one relatively clear pattern: children who acquire their second language within the primary language period develop higher levels of proficiency than children or adults who acquire the second language after this period (also referred to as the *critical period*) (Genessee, 1987; Ellis, 1994; Flege, 1992).

Of the bilingual research available, the focus has predominantly been on either simultaneous acquisition of two languages from birth, or the second language acquisition of adults or older children (often within classroom settings). However another group of children:

- ◆ learn two languages within the 'primary language development' period (during the first five years of life) (Genessee, 1993);

- ◆ in naturalistic environments (i.e., not in language classes); yet
- ◆ acquire at least minimal competence in one language before exposure to the second language (Karniol, 1990).

Researchers have ignored this significant demographic group of children, particularly in countries with large immigrant populations such as Australia and Britain (Karniol, 1990; Genesee, 1993). Yavas (1998) suggests that these children who “grow up in the home environment with their first dominant language and start acquiring the target community language when they begin (pre) schooling” (p. 217) are representative of many situations around the world. This thesis specifically investigates these *successive bilingual* children (i.e., children who have achieved minimal competence in one language before the introduction of the second within the primary language learning period).

1.2.2 ONE SYSTEM OR TWO?

Many of the issues in bilingual language acquisition are similar to those addressed in studies of monolingual acquisition: the rate, pattern and processes of language development, and the linguistic, cognitive and social factors that affect this development (Genesee, 1993). However, there are also issues specific to bilingual language acquisition. One of the primary theoretical questions that bilingual researchers have attempted to answer is: Do bilingual children have a unitary or differentiated language systems?

Volterra and Taeschner (1978) proposed a three stage model of early simultaneous bilingual language development: (i) initial single system containing lexical and syntactic information from both languages; (ii) differentiation of the lexicon of each language but shared syntax; (iii) differentiation of lexicon and syntax of each language. This model has been widely supported (e.g., Redlinger & Park, 1980; Vihman, 1985) and criticised (e.g., Meisel, 1989; Quay, 1993). De Houwer (1995) reviewed the research and concluded “it is

not clear whether infant bilinguals in their earliest language production process two linguistic systems or one” (p.235).

Phonological evidence regarding the use of a single or separate systems has been minimal. Early studies all reported initial periods of single phonological systems (Garo-English: Burling, 1959; German-English: Leopold, 1947; German-French: Ronjat, 1913 cited in Schinke-Llano, 1989). Vogel (Romanian-English: 1975) also concluded that a child studied at age two years used a single phonological system for both languages.

In contrast to these studies reporting an initial unitary system, Ingram (Italian-English: 1981) described a two year old whose phonological systems consisted of very different characteristics. Ingram was able to explain the differences in the child’s phonological systems in relation to the phonological systems of the two target languages (e.g., realisation of /r/ ⇔ [w] in English but /r/ ⇔ [r] in Italian, due to restricted use of /w/ in Italian). Deuchar (Spanish-English: 1989 cited in de Houwer, 1995) was also unable to find evidence that would support an initial unitary phonological system. It is possible however, that these children had already passed through a unitary system prior to investigation.

Schnitzer and Krasinski (Spanish-English: 1994, 1996) have specifically addressed the question of one phonological system or two in their reports of two contrasting case studies. The first case they reported revealed five stages in consonantal development: introduction of phone; unitary system; separate systems; adult-like system; interference between systems. The second child they reported revealed a consistent separation of the phonological systems throughout his development. Schnitzer and Krasinski (1996) argued that the differences in the children were due to differences in their individual strategies in responding to new phonological segments (i.e., one child was willing to attempt new

segments early, while the other did not attempt to produce the phones until he could differentiate his two languages accurately).

Unfortunately, Schintzer and Krasinski (1994, 1996) do not really address the phonological aspects of the two children's systems, and their analyses focus on the acquisition and differential use of phonetic segments. In fact, they reject the notion of a phonological *system*, because they viewed the emergence of speech to be "at the mercy of articulatory maturation" (1994, p.619). However, monolingual developmental models of speech processing have conclusively established the notion of phonological systems that *interact* with articulatory maturation but are not *governed* by it (Macken, 1992). Bilingual acquisition research may provide important evidence regarding the relationship between articulatory and phonological development.

There may also be significant differences in the path of acquisition between simultaneous and successive bilinguals. Watson (1991) posits two possible processes of phonological acquisition in bilingual children:

1. superimposing the unknown system on the known: using one system as a base, and differentiating the second system by altering or adding to the first system; or
2. starting with an averaged system that simultaneously differentiates into two phonologies.

Watson suggests that successive bilinguals are more likely to use the first process and simultaneous bilinguals the second. Simultaneous bilinguals might also use the first process if one of the phonological systems is less complex or more easily learned than the other - they may use their knowledge of one phonology to facilitate the development of the other.

The research concerning *successive* bilingual children's acquisition of phonology is minimal. However, Fantini (Spanish-English: 1985) described some aspects of the phonological

development of his son Mario, a successive bilingual. The evidence presented supports Watson's first acquisition process: Mario appeared to initially use a phonological system based on Spanish when he began to speak in English.

Wode (1980) also discussed the relationship between two developing phonological systems. He suggested that the phonology of the second language is acquired "through the grid of the learners L1 [first language] system" (p.129). In this process similar elements of the two languages are shared and the different elements undergo autonomous development. This process is similar to Watson's proposed "superimposed" system.

Pearson, Navarro and Gathercole (1994) and Schnitzer and Krasinski (1994) both presented three alternative possibilities regarding the bilingual phonological acquisition process:

- ◆ a single unitary system that serves both languages (identical patterns; language-specific phonemes not acquired);
- ◆ completely separate systems that have no influence on each other;
- ◆ separate systems that interact.

The lack of research available makes it difficult to determine *how* successive bilingual children acquire phonology, and what the relationship between the two phonological systems is. However, there is limited evidence that bilingual children develop two separate phonological systems (although they may or may not have initially been merged). The lack of systematic analyses of more than one child limits the inferences that can be made about the process of bilingual phonological development. This thesis will address this need.

1.2.3 BILINGUAL COMPARED WITH MONOLINGUAL ACQUISITION

Another major issue within bilingual research has been whether the developmental path of bilingual children is identical to that of monolingual children. Research into simultaneous bilingual children has provided the majority of evidence on this issue (as these children are the most directly comparable to monolingual children). De Houwer (1995) reviewed the evidence (primarily morphosyntactic studies) regarding monolingual and simultaneous bilingual equivalence. She concluded: "For each of their languages respectively, bilingual children make the same types of errors as their monolingual peers and use similar structures at similar stages of development" (p.244).

One study of simultaneous bilingual phonological production reported by Navarro, Pearson, Cobo-Lewis and Oller (Spanish-English: 1995), directly compared bilingual and monolingual acquisition. They reported that the bilingual children acquired their phonological systems at the same rate as monolingual children. The acquisition of language-specific elements in each language was not delayed. They also reported that the same phonological error patterns were evident in the speech of the bilingual children as were evident in the speech of monolingual children in each language. However, they did note qualitative differences in the acquisition patterns of the two groups and concluded that "even though bilinguals and monolinguals achieve comparable degrees of phonological correctness, they might be following different paths to reach the same goal" (p.4). There have been no comparisons between successive bilingual children's phonology and monolingual children's phonology.

Although the relationship between the phonological systems of a bilingual child have not been specifically explored in terms of theoretical models, anecdotal references to phonological features noticed in longitudinal case studies of individual children are

available. The concept of phonological interference, phonological mixing, or what is sometimes referred to as a form of accent, is reported consistently in the bilingual literature. This suggests that bilingual children are making phonological errors that are not typical of monolingual children (cf. Burling, 1959; Fantini, 1985; Leopold, 1949). These differences suggest that there is an interaction between the two phonological systems.

1.2.4 INTERACTION AND INTERFERENCE

Within second language learner research there is a differentiation between:

- ◆ transfer/interference effects - specific to differences/similarities between the two languages involved (e.g., use of elements from one language while speaking another); and
- ◆ intralingual effects - the result of general processes of language development (reflecting general characteristics of rule learning, for example, faulty generalisation, incomplete application of rules, underspecified rules) (Ellis, 1994).

Most research has focused on evidence of transfer or interference. The *Contrastive Analysis Hypothesis* (initially proposed by Lado, 1957) attempted to trace difficulties in second language learning to differences in the languages involved. One of the main aims of many of the contrastive analysis studies conducted in the 1960s was to predict the errors made in a second language. Unfortunately, the data did not support the possibility that all error patterns could be predicted in this way (Ellis, 1994) and the hypothesis was rejected. However, contrastive analysis is still an important tool within studies comparing learners of different languages to explain, at least partially, differences between language combinations.

There are various hypotheses about specific sound types that will effect the accuracy of the second language learner's production (contrastive analysis studies of the 1950s and 60s). Flege (1992) suggested that there is a "U" shaped effect of differences between sounds in

two systems: second language sounds that are both very similar to and very different from the first language will be produced more authentically than sounds that are slightly different to the first language. However, the bases for these differences is hypothesised to be either perceptual differences (unable to hear the differences between similar sounds) or motor production difficulties (unable to develop a new articulatory pattern).

The effect of interference or transfer from one phonological system to the other has not been investigated systematically in bilingual children. However, there has been some research into the perceptual skills of bilingual children. Watson (French-English: 1991) reported a relative delay in the perceptual development of bilingual children in comparison to monolingual children (he concluded that they had more difficulty identifying voice-onset time contrasts because of cross-language differences).

Some instrumental studies have investigated specific aspects (usually voice-onset time) of phonetic production. Watson (1991) reviewed the research into Spanish-English bilingual children's production and concluded that although "bilinguals are similar to monolinguals, there is nonetheless evidence that their realizations of voicing contrasts do have some significant differences" (p.39). When compared to monolingual speakers, bilingual subjects make different aspiration contrasts (French-English: Watson, 1991). These differences have been attributed to specific differences in the contrasts within the two phonological systems.

In contrast to the considerable research into *phonetic segments*, few studies have specifically described the *phonological systems* of bilingual children. However, there are several descriptions of phonological characteristics within studies of other areas of bilingual language development. A summary of the evidence from individual studies follows:

- ◆ Schnitzer and Krasinski's (Spanish-English: 1994) first case study identified evidence of interference between the two languages. The interference was bi-directional and involved language-specific elements being used in the wrong language, and shared phonemes being used in the wrong phonotactic position (although appropriate for the other language). Schnitzer and Krasinski argue that these errors were no different to "slips of the tongue of monolinguals" (p.621).
- ◆ Vogel (English-Romanian: 1975) reported data from a two year old. The child is reported to have aspirated and unaspirated stops in both languages although they are only appropriate for English; and used dental and alveolar stops in both languages instead of only dental in Romanian and only alveolar in English. Vogel does not report whether these errors were frequent or consistent. Nor does Vogel present developmental data regarding the use of these error patterns by monolingual children of either language. The report reveals that the child used the same phonological processes and phonotactics in both languages.
- ◆ Fantini (Spanish-English: 1985) described some of the phonological aspects of his son Mario's successive bilingual development. (Fantini refers to Mario as a simultaneous bilingual, however, English words were produced a year after Spanish.) Fantini lists several characteristics he considers to be evidence of interference:
 - a) /ʃ, tʃ/ ⇒ [s] in English due to lack of these sounds in final position in Spanish;
 - b) /v/ ⇒ [b] in English due to irrelevance of v/b distinction in Spanish;
 - c) /h/ ⇒ [x] because /h/ is not a Spanish phoneme;
 - d) addition of /ε/ before initial /s/ words in English to prevent clusters that break Spanish phonotactic constraints;
 - e) /θ, ð/ ⇒ [t, d] in English due to lack of equivalent phonemes in Spanish.

Fantini suggests that all except (e) of these error patterns is due to interference between the two languages. However, it could be argued that only the processes of /h/ ⇒ /x/, and addition of /ε/ are due to interactions between the phonological systems. All the other error patterns are normal English monolingual errors (Dodd, 1995). Mario also had difficulty differentiating aspiration contrasts in both languages (initially not producing any aspiration in English, and later aspirating sounds in Spanish).

- ◆ Burling (English-Garo: 1959/78) described some of the phonological aspects of his son Stephen's successive bilingual acquisition. He described the initial emergence and then suppression of English phonemes. Burling interpreted this as a marking of Stephen's "real transition to Garo" (p.57) as they were language-specific to English. Other evidence of an interaction between the two phonological systems (although Burling considered Stephen to only have one system with language-specific elements) includes:
 - a) Stephen's use of a far back postvelar position (appropriate for Garo) when producing the phonemes /k, g/ in both languages, giving a "distinctly foreign quality" (p.58) to his English;
 - b) Stephen's pattern of using unreleased word-final stops (appropriate for Garo) in both languages;
 - c) his inconsistent aspiration contrasts in both languages;
 - d) use of glottal stop in English clusters (appropriate in Garo);
 - e) voicing difficulties involving /z, s, ʒ, ʃ/ in English (only /s/ used in Garo);
 - f) /r/ ⇒ [w] in English - /r/ ⇒ [l] in Garo;
 - g) use of a bilabial fricative in English.
- ◆ Itoh and Hatch (Japanese-English: 1978) described phonological aspects of a successive bilingual child's acquisition. Their subject used error patterns thought to be uncommon

for monolingual English children (e.g., /f/ ⇔ [h]; and /s/ ⇔ [tʃ, f]) that could be traced to Japanese (e.g., /f/ and /h/ are sometimes allophonic). Another example of possible interference between the languages was the child's simplification of clusters in English by inserting an epenthetic vowel when such clusters would not occur in Japanese.

- ◆ Leopold (English-German: 1949) described a simultaneous bilingual child's acquisition of language. He noted some aspects of bi-directional interference in the speech of Hildegard. She is reported to have spoken English with a marked German accent following a four week stay in Germany, and after returning to the USA she began to have low-level problems in pronouncing German.

In summary, the literature indicates that although bilingual children usually appear to develop two phonological systems that are separate and differentiated, each phonological system may not develop in the same way as in monolingual children. Watson concluded that "one system, or at least aspects of it, will dominate the other, so that the child fails to make some oppositions in one language, or at least produces some sounds in a *foreign* way, due to interference" (p.37).

Yavas (1998) reviewed the literature on bilingual phonological error patterns. He concluded that interference between the two phonologies is evident in bilingual children. However, interference patterns alone do not account for the errors of bilinguals. Universal markedness constraints also affect bilingual speech errors. For example, regardless of first language, bilinguals have more difficulty with obstruent than sonorant coda consonants, different error patterns are evident for obstruent + sonorant clusters and /s/ + stop clusters, and final consonant devoicing is prevalent. However, the studies that have examined these universal patterns have investigated second language learner errors rather

than the normal phonological *developmental* error patterns of bilingual children. This thesis will investigate the nature of normal bilingual phonological development to determine the separateness of the children's phonological systems, as well as the interference and universal patterns evident.

1.2.5 SPECIFIC INTERACTION OF LANGUAGE COMBINATIONS

Genesee (1993) highlighted the possibility of "specific interaction effects between particular language combinations" (p.63). Ingram (1981) also suggests (in relation to the question of identification of separate systems within the bilingual child) that it is important to investigate children "who are learning highly different languages" (p.105). There are very few specific references to these cross-linguistic effects in the bilingual literature. This is probably due to the lack of research that has specifically compared children learning differing language combinations. The issue is important because we cannot attribute any differences observed between bilingual and monolingual acquisition to differences in underlying processes of acquisition. Differences may be due to superficial interactions between specific aspects of the two languages involved.

Cross-linguistic differences between language combinations have been investigated by researchers into second language learners (e.g., comparing Japanese speakers ability to contrast /r/ and /l/ in English; Chinese speakers ability to mark voicing rather than aspiration contrasts in English) (Flege, 1992). This research has supported the hypothesis that the phonetic and phonological characteristics of the two languages will result in different effects. However, Flege's (1992) hypotheses regarding the expected error types in second language learners, are related to learners exposed to the second language (L2) after the age of 5 years. This age is hypothesised to be when children start to stabilise their perceptual parameters of individual sounds within languages. Therefore, later learners of a

second language are more likely to equate a sound in the L2 with a sound from their first language instead of establishing a new phonetic category for the new sound.

In one of the few specific studies of phonological development of a bilingual child, Ingram (1981) identified differences in the child's two phonological systems. He was able to relate these differences to the phonological systems of the input languages. Yavas (1998) compared the phonological structure of English, Portuguese, Spanish, Italian, Turkish, Swedish and Cantonese. From this comparison, he predicted several probable interference patterns between specific language combinations based on differences in the ambient phonologies. For example, "More final consonant deletion is expected from the speakers whose primary system is Italian, Spanish or Portuguese. These three languages are striving for an open syllable pattern that is diametrically opposed to a syllable-final consonant" (p.222). However, Yavas does not provide any data to prove whether or not these "probable" patterns are actually evident in the developmental speech production of bilingual children.

Although expected and logical, differences in development stem from the characteristics of the ambient phonology of the language not just from interactions between the two systems. This fact indicates that different language combinations need investigation.

Research is required to identify:

- ◆ what are specific interaction effects between the two languages;
- ◆ what are general intralingual processes common to all bilingual children;
- ◆ what are the characteristics that reflect the nature of the specific phonological system.

In contrast to the few studies into bilingual children's phonological development, many studies have investigated the phonological acquisition of monolingual children.

1.3 MONOLINGUAL PHONOLOGICAL ACQUISITION

It is important to examine the monolingual cross-linguistic literature because of the need to differentiate general universal phonological acquisition patterns from patterns that result from interaction between two phonologies in a bilingual child. One of the dominating issues in monolingual phonological acquisition has been the search for “universal” patterns of development. The order of acquisition and error patterns evident in bilingual children could provide insights into the role of the ambient phonology as opposed to innate universal patterns (Yavas, 1998). Stoel-Gammon (1992) also highlighted the possibility that research into bilingual children with phonological systems differing on specific parameters could influence theories of phonological development.

Studies of child speech development have tended to focus on either phonetic or phonological aspects of acquisition. Macken (1992) argued against what she saw as a preoccupation with the phonetics of acquisition, and emphasised the importance of an autonomous phonological component. Undoubtedly there is a significant interface between phonetic and phonological acquisition. Common to both areas of research has been a search for cross-linguistic universals, language-specific characteristics, and the development of models that can account for individual variation and disorder.

1.3.1 CROSS-LINGUISTIC COMPARISONS OF ACQUISITION

The similarities and differences in the developmental patterns of children from various language backgrounds have been examined. The order and rate of acquisition of phonemes have been compared. Far fewer studies have described the developmental phonological error processes used in different languages. A summary of the commonly cited cross-linguistic studies will be presented.

- ◆ Pye, Ingram and List (1987) studied five children learning Quiche, a Mayan language. They found that the children's early phonetic inventories included sounds (e.g., / tʃ, l/) which were not acquired until later by English children.
- ◆ Mowrer and Burger (1991) compared Xhosa and English children aged 2 to 6 years. They found that Xhosa children mastered the 20 phonemes common to Xhosa and English earlier than English children. The Xhosa children mastered 31 of their 41 consonants by the age of three, including some affricates (e.g., / ts, tʃ/) and clicks. They also made fewer errors on stops and fricatives than the English group. However, the two groups used similar substitution patterns for fricatives, affricates and liquids. The sounds most frequently in error and acquired last by Xhosa children (e.g., / s, ʃ, r/) were the same phonemes English, German and Swedish children find difficult.
- ◆ So and Dodd (1995) found that the order of acquisition of Cantonese consonants was similar, although more rapid, when compared to the order and rate of acquisition of English consonants. Most of the developmental error patterns used by Cantonese children were common to other languages. However, specific phonological processes used by Cantonese children were also identified (e.g., use of affrication: / pa si/ ⇒ [pa tsi] - not a typical pattern in English; cluster reduction patterns: Cantonese children mark level of aspiration /kw/ ⇒ [f]; /k^hw/ ⇒ [p] - but English children do not mark level of voicing). Tse (1991) has reported similar findings to So and Dodd.
- ◆ Magnusson (1983) reported that the phonological processes used by Swedish children were similar to those reported for English, Czech, French and Spanish children.
- ◆ Bortolini and Leonard (1991) reported that Italian children use similar phonological processes to those used by English children. However, they also identified language-

specific patterns that reflected the ambient phonology of the language (e.g., Italian children substitute /r/ ⇔ [l] whereas English children usually use /r/ ⇔ [w]. Bortolini and Leonard argued that this different pattern was due to the restricted use of /w/ in Italian.)

Theories of phonological acquisition need to account for evidence from cross-linguistic studies. Various theories attempt to explain cross-linguistic similarities (universal tendencies in children's phoneme acquisition: Why do children acquiring what appear to be quite linguistically diverse languages acquire phonemes in a similar order?). They also attempt to explain differences (language-specific features: Why are there differences in order of acquisition and error patterns?).

Jakobson (1941/68) suggested that the distribution of the sound amongst the world's languages could explain whether the sound would be acquired early. According to his 'laws of irreversible solidarity', nasals, front consonants and stops (found in virtually all languages) should be acquired earlier than orals, back consonants and fricatives respectively. He proposed that there are certain sounds which are more basic and central to all human languages and these sounds would therefore be acquired earlier than other sounds (cf. Macken, 1980). Jakobson's view of phonological acquisition in the terms of oppositions or contrasts set the agenda for subsequent studies of child phonology.

The cross-linguistic data does appear to support Jakobson's hypothesis to a certain extent. There are clear similarities in the order of acquisition across a range of the world's languages (Dodd, 1995). However, there are also some significant differences in the cross-linguistic data. There have been many differing theories on how best to explain these differences. Ingram (1989, 1992) has suggested a "neo-Jakobsonian theory of acquisition" based on the concept of *functional load*. In this theory the rate and order of acquisition is

affected by biological and linguistic factors (e.g., the contrastive use and prevalence of phonemes within the language).

The notions of *naturalness* and *markedness* have also been used to interpret the similarities and differences in the order of sound acquisition. It was hypothesised that unmarked features would be acquired first because unmarked features are considered more phonetically natural. Evidence used to determine the 'naturalness' of sounds includes not only prevalence across phonetic inventories of different languages, but also patterns of acquisition and disorder, slips of the tongue and historical changes (Yavas, 1998). Markedness theory has attempted to explain both the order of phoneme acquisition and the use of phonological error processes.

According to markedness theory, children tend to replace marked features with unmarked features. For example, the syllable structure CV is cross-linguistically the most preferred syllable type and is the syllable structure children use first. Therefore the natural or unmarked syllable structure and all other syllable types are considered marked. The common phonological error processes of final consonant deletion (e.g., /kat/ ⇒ [ka]) and cluster reduction (e.g., /blu/ ⇒ [bu]) are therefore evidence of children preferring the natural (unmarked) CV syllable structure. The element deleted from the cluster is also subject to markedness. The common cross-linguistic pattern of different patterns of cluster reduction depends on the specific cluster elements (e.g., /br-/ ⇒ [b-], /st-/ ⇒ [t-]): the element that is more marked is deleted.

Dinnsen (1992) proposed that there might be a universal hierarchical structure with a strictly limited set of features applicable to all phonetic inventories (*feature geometry* theory). Each feature in the hierarchy has a number of default specifications (i.e., unmarked values). Phonetic development requires replacing a default value with a language-specific value.

The order of phoneme acquisition would therefore depend on the dominance relationships and default values of the language. Therefore, features ranked highly in the hierarchy would be acquired early and default features would be acquired before non-default features.

Dinnsen's (1992) model offers an alternative account for cross-linguistic similarities and differences in the order of phoneme acquisition. The explanatory power of his model has so far rarely been tested with the phonological acquisition of children other than English and Spanish children. However, the model has been applied to children with phonological disorders (Chin & Dinnsen, 1991) and intervention studies (basis of 'maximal opposition' treatment e.g., Gierut & Neumann, 1992).

The role of articulatory and perceptual constraints on children's acquisition of phonology has also been emphasised (Locke, 1980, 1983; Kent, 1992). Locke (1983) proposed three universal mechanisms of development: maintenance; learning; and loss. When children pass the babbling stage and start to acquire a target phonological system, they maintain certain sounds from the babbling repertoire. Sounds not present in the babbling repertoire are then developed through interactions in the linguistic environment (a learning process). The child must also relinquish and lose the 'extrasystemic sounds', sounds existing in the babbling repertoire but not in the target phonological system. The interaction of these three mechanisms results in the acquisition of the target phonology. However, Locke's proposed mechanisms have been criticised by Pye, Ingram and List (1987) who argued that the mechanisms did not adequately explain cross-linguistic differences.

Locke's proposal of maintenance and relinquishment of sounds from the babbling repertoire depends on the premise that children start with a full specification of all the features and feature values present in the underlying form. Input from the ambient

language allows the child to discover the contrastive features and *eliminate* redundant contrasts. However, other theories claim that the child initially only has the universally specified minimal distinctive features, and exposure to the ambient language allows the child to *add* the relevant contrasts as they discover them (reviewed in Yavas, 1998).

These two conflicting views represent the main division within generative linguistic theories: do children construct hypotheses in order to account for adult input data? (hypothesis construction); Or do children have an innate set of principles that they modify on the basis of the input data? (hypothesis selection) (Mohanan, 1992). Developmental studies continue to debate this issue (Dinnsen, 1995; Gierut, 1996; Ingram, 1992).

Dinnsen (1992) summarised the search for universal order in phoneme acquisition studies: “The variation that exists across phonetic inventories and in the order of acquisition of sounds has rendered untenable absolute universals... we are left with weaker statements that can only be expressed as trends or general tendencies” (p.193). There has been less attention paid to the possibility of cross-linguistic trends or tendencies in developmental phonological error patterns.

The use of phonological processes has been described as “‘natural’, an innate endowment for language learning” (Dodd, 1995, p.43). Cross-linguistic studies that have not solely focused on phoneme acquisition, but also described error patterns in the acquisition process, have shown that similar processes are used across different languages (Dodd, 1995; Locke, 1983). However, there are also language-specific patterns that have been identified (see examples presented earlier from Italian and Cantonese).

Phonological processes are a useful descriptive tool: they enable us to describe sound patterns. Phonological processes have been explained as a pathway for simplifying the

adult system (Smith, 1973). Macken (1992) hypothesised a “central acquisition mechanism [that] is a hypothesis formation mechanism where patterns are discovered and generalisations, or rules, are created” (p.249). Therefore, children construct and test hypotheses about the phonological system of the language/s they are learning. In this way, the ambient phonology directly influences the hypotheses the children form.

Smith (1973) proposed that there may be some general categories in which children simplify their target phonology: consonant harmony; cluster reduction; systemic simplification. So and Dodd (1995) suggested that cross-linguistic similarities may be evident in these general categories (i.e., all children will simplify their target phonology using processes within Smith’s categories). However, “the way in which those strategies are implemented in terms of realisation rules might vary according to the phonetic and phonological structure of the specific language being learned” (So & Dodd, 1995, p.476).

The concept that children use a highly organised system of phonological rules that governs their speech output is based on a model called generative phonology. One of the foundations of generative phonology is that “there is a systematic relationship between the target system the child is trying to acquire and his or her erroneous production. It assumes that the child’s underlying representation of these words is correct (i.e., adultlike)” (Yavas, 1998, p.116). Theoretical debate about the issue of the need to assume correct underlying forms is ongoing. One- and two-lexicon models have been posited that attempt to clarify the issue (Dinnsen & Chin, 1994; Menn & Matthei, 1992; McGregor & Schwartz, 1992).

Psycholinguistic theories of *connectionism* (e.g., Stemberger, 1992) acknowledge the usefulness of phonological processes and rules for describing speech patterns. However, connectionists warn against giving phonological processes any psychological status or “reality” (as proposed by Macken, 1992). Connectionist models explain speech processing

in terms of a process of mapping connections between phonological units (phonetic and phonemic) and other language units (e.g., semantic information). The mapping of connections is learned through practise. Phonological units are activated, and depending on the level of activation (based on frequency of previous activation), that activation passes on to activate other units. Interference between the activated units and insufficient activation of the target unit causes errors. Connectionist models have been criticised for not satisfactorily accounting for processing differences between normally developing and disordered children (Leonard, 1992).

Children's phonological acquisition is highly complex and influenced by a variety of sources. Perhaps none of the theories discussed account for both the universal tendencies and the language-specific patterns. We need further cross-linguistic research on children's phonological acquisition. This research should focus on both the identification of universal tendencies and the influence of the ambient language. The patterns evident in the speech of bilingual children, with specific-language combinations, should provide interesting insights into how children acquire phonology.

1.4 AIMS OF THE CURRENT INVESTIGATION

The general aims of the current investigation are to:

1. Describe in detail the normal phonological development of successive bilingual pre-school children. Specifically the following questions are posed:
 - * Do bilingual children have a single phonological system that serves both languages or do they have differentiated systems?
 - * Do bilingual children develop their phonological system/s in the same way (in terms of developmental sequences, patterns and errors) as monolingual children?

2. Compare children with different language combinations to investigate the role of the ambient phonology of each language.
3. Investigate the effect of speech disorder on the phonological output of bilingual children in each language.
4. Explore the effect of different therapy methods for children with different types of speech disorder based on consideration of the hypothesised deficits underlying the speech impairment.

1.5 HYPOTHESES

It was hypothesised that:

1. The normal phonological development of successive bilingual pre-school children would be qualitatively different to the development of monolingual children. These differences would be due to normal interaction between the two separate phonological systems.
2. The structure and nature of the two phonological systems would affect the differences between monolingual and bilingual children.
3. Speech disorder would affect both of a bilingual child's phonological systems and the same types of disorder evident in monolingual children would be evident in bilingual children.
4. Different therapy methods would be suitable for children with different types of speech disorder based on consideration of the hypothesised deficits underlying the speech impairment.

CHAPTER 2:
OBSERVATIONAL STUDY -
A DESCRIPTION OF THE
PHONOLOGICAL DEVELOPMENT OF
CANTONESE-ENGLISH BILINGUAL
CHILDREN

2.1 INTRODUCTION

The current study seeks to describe the successive phonological development of Cantonese-English bilingual children. A previous group study of Cantonese-English bilingual children showed that error processes atypical for monolingual children in either language may be more prevalent in the speech of bilingual children (Dodd, So & Li, 1996). The current study investigates these differences further with a larger group of children. It also investigates factors that might have affected the children's phonological acquisition.

2.2 METHOD

2.2.1 SUBJECTS

The phonological development of 40 children will be presented. The children were recruited from childcare centres located in areas of Brisbane, Australia, with strong Chinese immigrant communities.

Thirty-six parents completed a questionnaire (see Appendix I) that provided information about each child's general developmental and medical history. The questionnaire was written in both Chinese and English. Parents also provided specific information about the type and amount of exposure and use of each language. All the children were acquiring Cantonese at home and were attending childcare centres where English was the only language spoken. The children had no significant exposure to any other languages. Children with intellectual or hearing impairment or a history of speech or language disorder were not included in the study. Equal numbers of boys and girls were included. Table 2.1 provides group subject information.

Table 2.1 Subject information in age bands

	26-39 months	40-54 months	55-67 months	Whole group
Number of children	13	15	12	40
Gender				
<i>Female</i>	7	6	7	20
<i>Male</i>	6	9	5	20
Exposure to English				
<i>Mean (months)</i>	10.23	19.75	25.7	18.14
<i>SD</i>	3.8	9.3	10.5	10.3
TACL Difference*				
<i>Mean (months)</i>	0.8	-7.1	-8.7	-5.5
<i>SD</i>	2.2	5.8	7.3	6.8

* Test of Auditory Comprehension of Language (TACL) Difference = TACL age equivalent score - child's chronological age

2.2.2 PROCEDURE

2.2.2.1 DATA COLLECTION

Each assessment session lasted approximately two hours. All assessments involved an adult interacting with the child. The assessment sessions involved two speech-language pathologists experienced in eliciting speech samples: one was a native Cantonese-speaker, the other a native English-speaker. The data included spontaneous speech samples collected while playing with toys and looking at picture books. Standardised speech assessments were used to elicit single word naming. The Cantonese Segmental Phonology Test (So, 1992) was used to elicit all the phonemes of Cantonese. The Goldman Fristoe Test of Articulation (Goldman & Fristoe, 1987) was used to assess the English phonemes. Three additional English words were elicited consistently: *quack*, *queen*, and *quiet*. These words were included because /k^(h)w/ is the only legal cluster in Cantonese. Some of the words on the Goldman Fristoe were elicited only in imitation because some children were

shy when speaking English or had limited vocabularies. Table 2.2 provides a comparison of the phonological structures of Cantonese and English.

To create two separate language environments, the assessment sessions were split into two distinct sections with a break in the middle. Often the English and Cantonese data were collected on different days because of fatigue, time restrictions or lack of co-operation. The data collections were always within three days of each other in these instances.

The transcription used for the analysis was based on the audio-recording taken during each session. The recorder used was a Marantz CP130 recorder and Sony lapel microphone. To ensure accuracy the data was transcribed as soon as possible. Experienced speech-language pathologists who were native speakers of the language transcribed the samples. The reliability of the transcribers was examined. Two independent judges, both native speakers of the language, were asked to transcribe the standardised tests. Ten English samples were transcribed with 89 percent agreement. Five Cantonese samples were transcribed with 92 percent agreement. The most consistent disagreement between the transcribers stemmed from vowel productions and voicing/aspiration contrasts. The English transcribers also occasionally disagreed about syllable-final consonant deletion vs. unreleased final consonants. For this reason aspiration/voicing, and final consonant deletion/unreleased final consonant were combined for phonological analysis.

The Test of Auditory Comprehension of Language - Revised (TACL-R: Carrow-Woolfolk, 1985) was administered to each child to monitor comprehension development in English (for results see Table 2.1). A TACL Difference score was calculated (TACL age equivalent score - child's chronological age) to provide a gross measure of English language competence. For example, a child aged 39 months with a TACL age equivalent of 32

months would have an TACL Difference score of -7 indicating delayed language competence.

Table 2.2 Comparison of the phonological structure of English and Cantonese*

	English	Cantonese
Vowels and diphthongs	21 + 5 triphthongs	8
Consonants	24 + 49 clusters	17 + 2 clusters
Syllable/word structure	[C ₀₋₃]-V-[C ₀₋₄] Polysyllabic	[C]-[G]-V-[C/G] Mostly monosyllabic
Tones	None	6 + 3 allotones
Stress	Complex	Simple

* adapted from So & Dodd (1995)

2.2.2.2 DATA ANALYSIS

The Cantonese and English data were analysed separately and then compared. The speech samples were analysed to provide data on the children's phonetic inventories and phonological processes for each language. A phone was considered to be part of the phonetic inventory if: (a) there were two productions of the sound in non-imitated speech; and (b) at least one production of the phone correctly (even if it occurred in imitation). Many phonological processes were evident in some children's spontaneous speech. For this reason the phone was not required to be used consistently and *correctly* to be included as part of their *phonetic* inventory. However, to allow comparison to published normative data, correct production in at least imitated speech was also required.

Phonological processes were classified as either:

- ◆ appropriate - occurring in the speech of normally developing monolingual children of the same age;
- ◆ delayed - occurring in the speech of normally developing monolingual children of a younger age; or
- ◆ atypical - used by less than 10 percent of the normally developing monolingual population.

Phonological processes were identified if there were at least five examples of the process in spontaneous speech. Counter examples of processes were also noted. Phonetic transcriptions of the raw data from a study reported by Dodd, So and Li (1996) (16 Cantonese-English bilingual pre-school children) were reanalysed and included with the data from the 40 children in the current study for the detection of phonological process use. Therefore, the phonological processes reported are from a sample of 56 children.

The percent phonemes correct (PPC: number of correct phonemes ÷ total number of phonemes in sample) was calculated. The PPC samples were the responses to the standardised assessments and provided quantitative information about the children's accuracy on a controlled word list. PPC data was further analysed into percent consonants correct (PCC).

The bilingual children's PPC were compared to matched (by age and sex) groups of monolingual children. The bilingual children's accuracy was compared to raw data from children assessed by So and Dodd (1995) in their study of monolingual Cantonese phonological acquisition. The bilingual children were also matched to data for monolingual English children collected by Dodd and Ozanne (in progress). An Analysis of

Variance confirmed that the groups did not differ with respect to age ($F_{2,117}=0.004$, $p>0.05$) or sex ($F_{2,117}=0.03$, $p>0.05$).

2.3 RESULTS

2.3.1 PHONETIC ACQUISITION

The phoneme repertoires of 33 of the 40 bilingual children were age-appropriate compared to monolingual norms (cf. English: Prather, Hendrick & Kern, 1975; Cantonese: So & Dodd, 1995). However, a single pattern of English plosive acquisition accounts for four of the group not meeting English monolingual norms. Four of the five children under 2;06 years used the voiced but not the unvoiced plosive of plosive pairs (i.e., /b/ but not /p^h/). Monolingual English children acquire /p^h/ by 2;06 years. Three other children were missing one or two of the later developing English phonemes (CL: 4;0 - tʃ; GC: 4;02 - r, ʃ; JC: 5;11 - θ, ð). The phonemic repertoires of three representative children are outlined in Table 2.3. Thirty-one of the children made vowel errors and five children made tone errors. However, all the children used the complete range of Cantonese and English vowels and Cantonese tones contrastively.

The phonemes shared by the two languages were generally evident in both languages simultaneously. Cantonese and English share 12 phonemes. Four of the forty children used a shared phoneme (expected to be present for their age in one of the languages) in only one language. All other children used all the shared phonemes that they had acquired in both languages.

Table 2.3 Typical phonological profiles of Cantonese-English children

	Subject 1: 2;06 years		Subject 2: 3;08 years		Subject 3: 4;10 years	
	English	Cantonese	English	Cantonese	English	Cantonese
Consonants						
<i>Present</i>	b, m, n, ŋ, h, j, l, w, f unaspirated t, k used	p, t, k, m, n, ŋ, h, j, l, w, f	p ^h , b, t ^h , d, k ^h , g, m, n, ŋ, h, j, l, r, w, f, s, ʃ, tʃ, ʧ, θ	All	All	All
<i>Absent</i>	p ^h , t ^h , d, k ^h , g, s, r, ʃ, tʃ, ʧ, ʒ, θ, ð, v, z	p ^h , t ^h , k ^h , s, ts, ts ^h	ʒ, ð, v, z	All	All	All
Vowels	All	All	All	All	All	All
Tones						
PPC	61	74	71	93	91	95
PCC	45	54	64	86	88	90
Processes						
<i>Expected</i>	Weak syllable deletion Final consonant deletion Stopping Fronting Gliding Cluster reduction	Deaspiration Fronting Cluster reduction	Cluster reduction Stopping Gliding	Stopping	Stopping Gliding	None
<i>Delayed</i>	Cluster reduction None	Initial /h/ deletion	Fronting Final consonant deletion	Deaspiration	Cluster reduction	Deaffrication Stopping Addition
<i>Atypical</i>	Backing Voicing/Aspiration Initial consonant deletion Frication Nasalisation	Backing Gliding Tone errors	Backing Addition Affrication	Voicing/Aspiration Initial consonant deletion	Backing Deaspiration	Voicing/Aspiration

Subject Information:

Subject 1: Aged 2;06 years. First exposed to English at age 1;07 years. TACL Age Equivalent Score 2;08 years.

Subject 2: Aged 3;08 years. First exposed to English at age 3;00 years. TACL Age Equivalent Score 2;10 years.

Subject 3: Aged 4;10 years. First exposed to English at age 2;09 years. TACL Age Equivalent Score 4;06 years.

2.3.2 SPEECH ACCURACY

2.3.2.1 WHOLE GROUP

The speech accuracy (percent phonemes correct: PPC) of the bilingual children was compared to the data available for matched monolingual children. Figure 2.1 shows the differences between the monolingual and bilingual children over the entire group. Independent samples *t*-tests with Bonferoni corrections indicated that:

- ◆ there was no difference in the Cantonese accuracy between the monolingual and bilingual speakers ($t=-1.67$, $df=77$, $p>0.05$);
- ◆ the bilingual children's English accuracy was significantly lower than the monolingual children's ($t=-5.03$, $df=78$, $p<0.001$).

Comparison of the bilingual children's Cantonese and English speech accuracy using a *t*-test for paired samples indicated that the children's Cantonese accuracy was significantly better than their English accuracy ($t=8.55$, $df=38$, $p>0.001$).

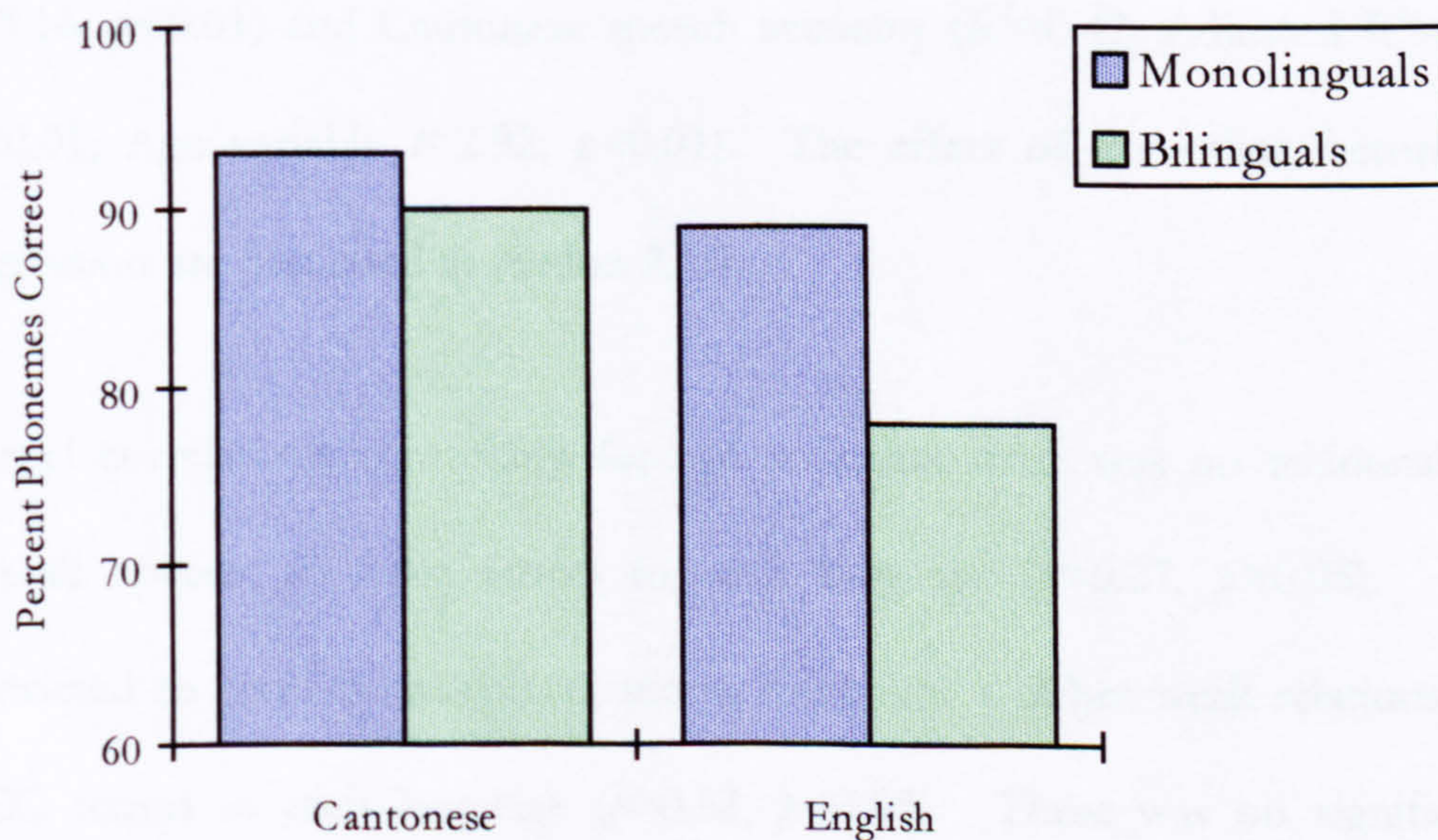


Figure 2.1 Speech accuracy - whole group

2.3.2.2 ACCURACY DEVELOPMENT OVER THE AGE GROUPS

An analysis of variance (group: bilingual vs. monolingual children \times condition: three age bands) of the children's Cantonese speech accuracy (PPC) revealed a significant group effect ($F_{1,73}=5.36$, $p<0.05$). There was also a significant effect of age ($F_{2,73}=28.96$, $p<0.001$). However, the interaction term (group \times condition) was not significant. Post-hoc analysis using independent t -tests with Bonferroni corrections showed that although there was an overall group effect there was no significant difference between the bilingual and monolingual children's Cantonese speech accuracy at any specific age band (see Figure 2.2).

In contrast, at each age level there was a significant difference between the monolingual and bilingual children's English PPC scores ($p<0.001$). The analysis of variance revealed a significant effect of group ($F_{1,73}=55.62$, $p<0.001$) and condition ($F_{2,73}=51.32$, $p<0.001$). However, the interaction effect was not significant (see Figure 2.3).

Step-wise multiple regression revealed that age was the only significant factor to affect English speech accuracy ($R^2=0.73$; Adjusted $R^2=0.68$; $F_{5,27}=14.36$; $p<0.0001$; Age variable $t=3.16$; $p<0.01$) and Cantonese speech accuracy ($R^2=0.42$; Adjusted $R^2=0.31$; $F_{5,26}=3.74$; $p<0.01$; Age variable $t=2.92$; $p<0.01$). The effect of the other factors entered in the regression are discussed in section 2.3.4.

Partial correlations controlling for age indicated there was no relationship between the overall speech accuracy scores in each language ($r=0.27$, $p>0.05$). However, when restricted to consonants correct scores there was a rather weak relationship between the PCC scores in each language ($r=0.32$, $p<0.05$). There was no significant relationship between vowel accuracy across languages. However, there was a relationship between the

accuracy of vowel and consonant accuracy within language: English ($r=0.34, p<0.05$); Cantonese ($r=0.59, p<0.001$).

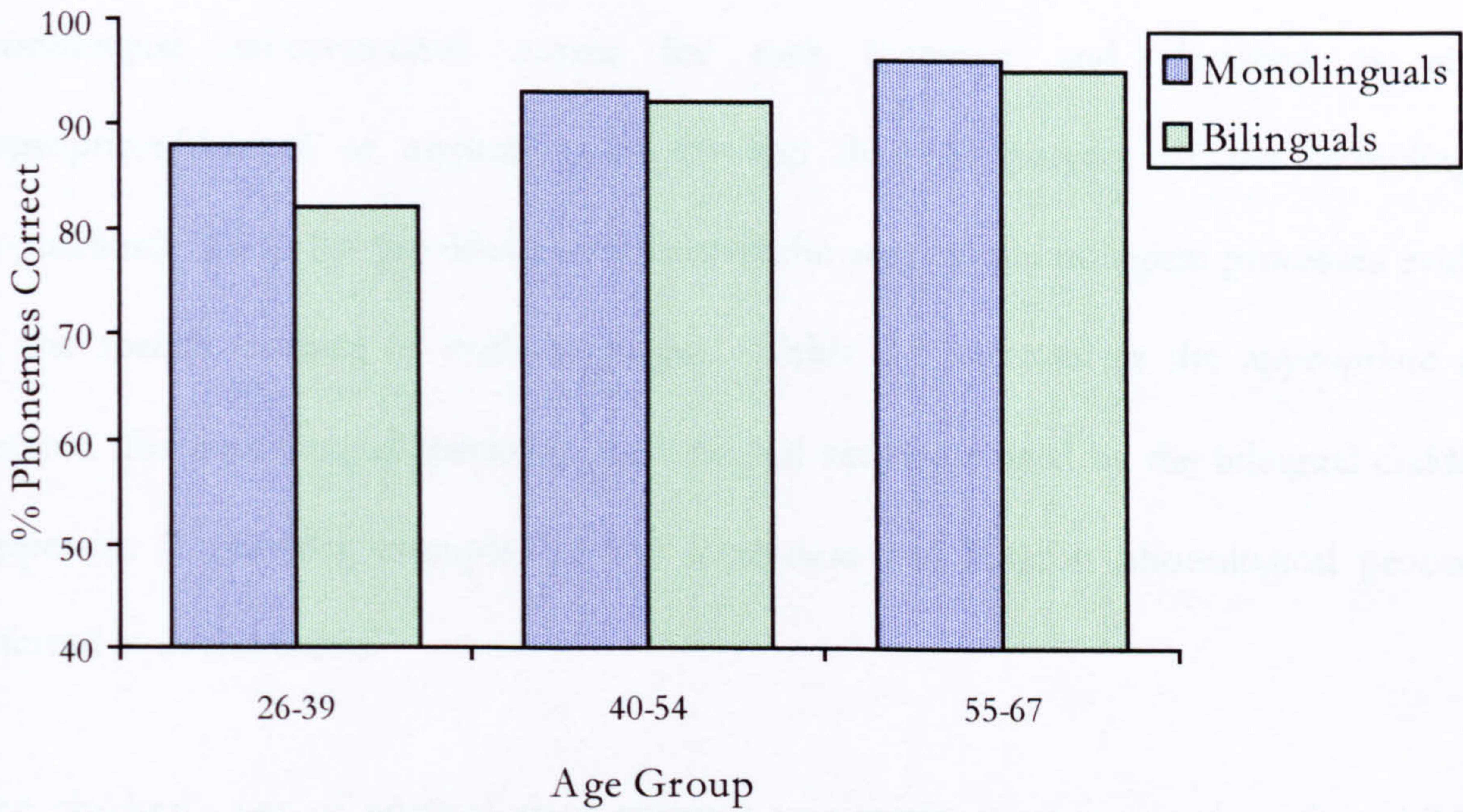


Figure 2.2 Cantonese speech accuracy - by age group

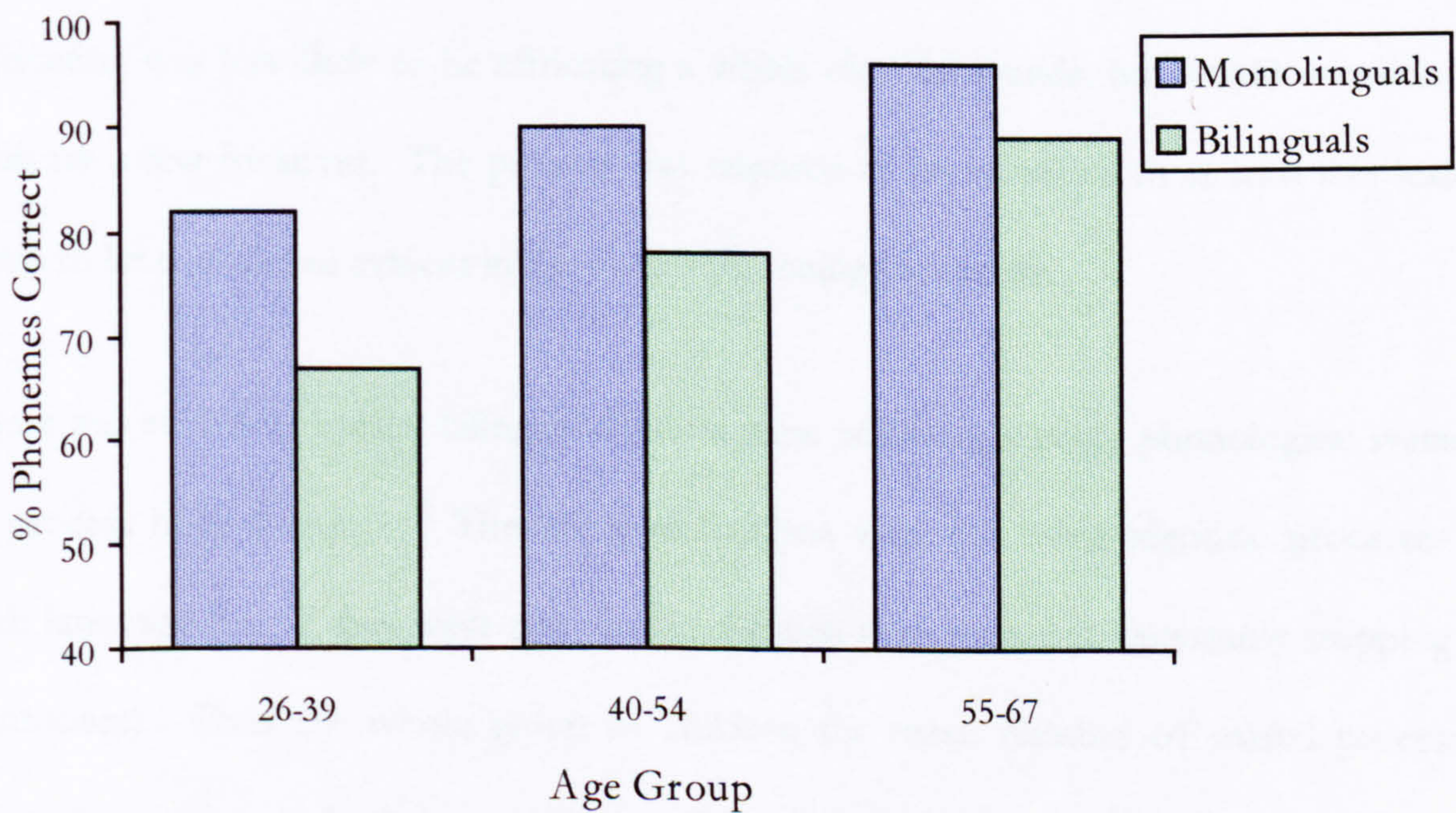


Figure 2.3 English speech accuracy - by age group

2.3.3 PHONOLOGICAL PROCESSES

Phonological process analysis of the Cantonese-English bilingual children's spontaneous speech was conducted. The phonological processes identified were compared to monolingual developmental norms for each language and classified as either appropriate/delayed or atypical (used by less than 10 percent of the monolingual population). Table 2.4 provides a summary of the atypical phonological processes evident in the speech samples of both languages. Table 2.5 summarises the appropriate and delayed (for monolingual speakers) phonological processes used by the bilingual children. Appendix II provides examples of the Cantonese and English phonological processes referred to in this thesis.

The children's use of atypical error patterns was rarely consistent: only a few children applied an atypical process in most of the phonetic contexts in which it could be evident. However, words that were elicited more than once were usually produced in the same way each time. The use of normal and delayed phonological processes was more routinely applied. For example, a child who was fronting sounds was more likely to front a range of back sounds in a variety of words and phonetic contexts. However, a child who was affricating was less likely to be affricating a whole class of sounds, but would occasionally affricate a few fricatives. The process was required to be identified in at least five lexical items to be considered evident in the child's phonological system.

There was evidence that the bilingual children were not using a single phonological systems to process both languages. The bilingual children were not using identical processes in each language (i.e., if they were stopping in English they were not necessarily stopping in Cantonese). Over the whole group of children the mean number of shared processes (processes evident in both languages) was 2.1 ($SD=1.2$). The mean number of processes

evident in the bilingual children's speech was 3.9 ($SD=1.7$) in Cantonese and 4.4 ($SD=2.4$) in English. Contradictory processes were also common (e.g., fronting /k/ \Rightarrow /t/ in English but backing /t/ \Rightarrow /k/ in Cantonese).

Partial correlation coefficients, controlling for age (which multiple regression showed to have an independent effect on speech accuracy), were calculated to determine whether there was a relationship between the use of different process types and speech accuracy. There was a correlation between Cantonese speech accuracy and the number of atypical processes ($r=-0.65, p<0.001$) and appropriate processes ($r=-0.49, p<0.01$). There was also a correlation between English speech accuracy and the number of atypical processes ($r=-0.48, p<0.01$) and appropriate processes ($r=-0.36, p<0.05$). There was not a significant correlation between the number of delayed processes and speech accuracy in either language.

Table 2.4 Use of atypical error patterns (N=56)

Cantonese		English	
Backing	27*	Backing	19*
Voicing	15*	Voicing	12*
Initial Consonant Deletion	12*	Initial Consonant Deletion	14*
Addition	4	Addition	12*
Aspiration	10*	Affrication	10*
Gliding	7*	Frication	6*
Tone Errors	5	Nasalisation	7*
		Transposition	4

*more than 10 percent of bilingual population

Table 2.5 Use of appropriate and delayed error patterns (N=56)

Cantonese		English	
<i>Appropriate</i>		<i>Appropriate</i>	
Cluster Reduction	21	Cluster Reduction	14
Final Consonant Deletion	5	Final Consonant Deletion	4
Stopping	8	Stopping	21
Fronting	9	Fronting	6
Deaffrication	6	Deaffrication	6
Affrication	9	Gliding	30
Deaspiration	10	Weak Syllable Deletion	6
		Voicing	9
		Consonant Harmony	4
<i>Delayed</i>		<i>Delayed</i>	
Cluster Reduction	5	Cluster Reduction	24
Final Consonant Deletion	7	Final Consonant Deletion	16
Stopping	3	Stopping	19
Fronting	5	Fronting	17
Consonant Harmony	6	Consonant Harmony	8
Deaffrication	14	Voicing	22
Affrication	10	Weak Syllable Deletion	5
Continuant Variation	9		
Deaspiration	9		
Reduplication	10		

2.3.4 INFLUENTIAL FACTORS

Partial correlation coefficients (controlling for age) were calculated to investigate the influence of the variables targeted in the parental questionnaire on the bilingual children's speech development. The multiple regression results, described earlier, showed that the only overall significant factor to affect speech development was the children's age. Controlling for age, therefore, allowed the effects of the other variables to be determined.

The effect of six other variables were investigated:

1. Age first exposed to English - there was no significant correlation between the age of first exposure to English and the children's English accuracy (PPC) ($r=0.27$, $p>0.05$),

- Cantonese accuracy ($r=0.05$, $p>0.05$), or language development (TACL differences scores) ($r=-0.35$, $p>0.05$).
2. Time in childcare - an estimate of the total number of hours the child had spent in childcare was determined from the parent questionnaires. There was no significant correlation between the time spent in childcare and the children's English accuracy ($r=0.13$, $p>0.05$), or Cantonese accuracy ($r=-0.18$, $p>0.05$). However, there was a correlation to the children's language comprehension development ($r=0.36$, $p<0.05$).
 3. Gender - there was no significant correlation between gender and the children's English accuracy ($r=-0.26$, $p>0.05$), Cantonese accuracy ($r=-0.06$, $p>0.05$), or language comprehension development ($r=-0.24$, $p>0.05$).
 4. Siblings - there was no significant correlation between number of older siblings and the children's English accuracy ($r=-0.08$, $p>0.05$), Cantonese accuracy ($r=-0.12$, $p>0.05$), or language comprehension development ($r=0.19$, $p>0.05$).
 5. Comprehension - the children's English comprehension scores were correlated to their English speech accuracy ($r=0.37$, $p<0.05$), but not to their Cantonese accuracy ($r=0.17$, $p>0.05$).
 6. Television exposure - the children's daily exposure to English language television was not correlated to the children's English accuracy ($r=0.10$, $p>0.05$), or language comprehension development ($r=-0.11$, $p>0.05$). However, there was a correlation to the children's Cantonese accuracy ($r=-0.45$, $p<0.05$). Although there was no overall correlation to the children's English accuracy, the children who watched more television used fewer atypical phonological processes in their English speech ($r=-0.48$, $p<0.01$).

2.4 DISCUSSION

The speech development of 40 Cantonese-English bilingual children was described and compared to monolingual development in each language. The results indicated that there were quantitative and qualitative differences between monolingual and bilingual development in both languages.

The differences resulted from the use of a larger number of delayed and atypical phonological processes when compared to monolingual normative data. In general, the phonetic (articulatory) development of the bilingual children did not differ from monolingual children. The acquisition of speech sounds appeared to be independent of phonological development:

- ◆ phonemes were acquired in similar sequences and at similar times in both languages
- ◆ shared phonemes were stimuable in both languages.

Although the bilingual children appeared to use a single articulatory system in both languages, there was clear evidence that the bilingual children used separate phonological systems. This evidence included both error types and phoneme use:

- phonemes acquired in one language but not used in the other language (although they were stimuable in imitation)
- language-specific phonemes not used in the 'wrong' language
- the same phoneme simplified differently in each language (e.g., stopping /s/ ⇔ /d/ in English but affricating /s/ ⇔ /ts/ in Cantonese)
- addition only of legal sounds (e.g., /tsi/ ⇔ [tsip] not [tsif] because final /f/ illegal in Cantonese)
- use of contradictory processes (e.g., backing in one language and fronting in the other)
- use of processes specific to only one language (e.g., stopping fricatives in one language but not in the other).

The bilingual children's speech accuracy was better in Cantonese than English (see Figure 2.1). The bilingual children's Cantonese speech accuracy was not different to the monolingual children's at any of the age bands. All the bilingual children in the study were monolingual Cantonese speakers for at least their first year and often until they were three years of age. Therefore, it is not surprising that the children's Cantonese speech development was more advanced than their English.

The differences between the monolingual and bilingual speech accuracy development (shown in Figures 2.2 and 2.3) decreased with age. This pattern showed that the bilingual children were 'catching up' to the accuracy levels of their matched monolingual peers. Therefore, it appears that within a couple of years of exposure to their second language the bilingual children's speech accuracy is comparable to monolingual development in each language.

In addition to the quantitative differences in the children's speech accuracy, there were also differences in the error patterns used by the bilingual children in comparison to normal monolingual development. Table 2.4 shows that there were seven processes evident in English, and five processes evident in Cantonese, that were used by more than 10 percent of the bilingual group. These processes were all considered to be atypical for monolingual children of each language (i.e., used by less than 10 percent of the monolingual population). The fact that many bilingual children used these processes indicates that they are "normal bilingual" processes. However, there were also many age-appropriate and delayed phonological processes in use.

Bilingual children's use of phonological patterns considered to be atypical for monolingual speakers has been previously reported by Gildersleeve, Davis and Stubb (Spanish-English: 1996; cited by Yavas & Goldstein, 1998). This study concluded that "compared with their

monolingual peers, normally developing bilingual children showed an overall lower intelligibility rating, made more errors overall (on both consonants and vowels), distorted more sounds, and *produced more uncommon errors patterns*' (p.53 - italics added for emphasis). The quantitative and qualitative data reported in this chapter supports most of these findings. However, the Cantonese-English bilingual children did not distort more sounds (presumably the authors mean articulatory distortion) in their speech in either language.

One of the confusing factors in the bilingual children's data was the great variation in the children's ages and their language backgrounds. For example, the children varied greatly in age, the amount of time they spent in childcare, the age they were first exposed to English, and their English comprehension development. Investigation into the relationships between these variables showed that age was the most significant factor in determining speech accuracy. Even when age was controlled for the other factors did not appear to play important roles in the children's development. When controlling for the effect of age the only significant relationships between variables were:

- ◆ the more time spent in childcare, the better the child's development of English comprehension;
- ◆ the better the child's English comprehension skills, the higher their English speech accuracy scores;
- ◆ the better the child's Cantonese speech accuracy, the better their English speech accuracy;
- ◆ within each language, fewer consonant errors are related to fewer vowel errors;
- ◆ both Cantonese and English speech accuracy were higher when there were fewer atypical and normal processes used;
- ◆ there were fewer atypical processes evident in the speech of the children who watched more English language television;

- ◆ the age at which the child was first exposed to English, gender, the amount of time spent in childcare, the amount of time spent watching television, and the number of older siblings were relatively unimportant factors in speech accuracy development.

The normative Cantonese-English bilingual group data show that there are clear differences between the acquisition of phonology in bilingual and monolingual children. However, the large number of variables within the data make it difficult to determine clear patterns that may indicate what the individual pattern of development of the phonological systems may be. For example, it is not clear from the group data whether the use of atypical processes is transient or persistent. It is also impossible to determine at what point atypical processes are first evident. To clarify these issues, two longitudinal studies were conducted that monitored the development of the two phonological systems in the first year of exposure to the second language. The results of these studies are reported in Chapter 3.

CHAPTER 3:
LONGITUDINAL STUDY -
THE PHONOLOGICAL ACQUISITION
OF TWO CANTONESE-ENGLISH
BILINGUAL CHILDREN

3.1 INTRODUCTION

Chapter 2 presented the results of a group study of the phonological skills of Cantonese-English successive bilingual children. This group study showed that the speech of the successive bilingual children contained more error processes that are atypical for monolingual children in either language. It was difficult to interpret the cross-sectional data accurately due to the number of variables affecting the sample. There were two primary confounding variables: the length of each child's exposure to each language; and the age at which the second language was introduced. However, the older children's speech was more accurate than the younger children's, the children's use of the atypical error patterns was often inconsistent, and there appeared to be a developmental pattern to the children's process use.

In Chapter 3 the primary objective is to describe in detail the successive phonological development of two Cantonese-English bilingual children during their first year of exposure to English. A longitudinal study was conducted to establish (a) when the atypical error patterns evident in the group study occurred and (b) how the atypical patterns evident in the group study manifested themselves. A longitudinal study also allows changes in the phonological systems to be described over time. Previous research on monolingual development provided data allowed comparison of the bilingual children's speech to that of monolinguals. It was also possible to make comparisons across each child's two languages. In this chapter error patterns are classified as atypical in comparison to monolingual development.

3.2 METHOD

3.2.1 SUBJECTS

3.2.1.1 CATHERINE

Catherine was aged 2;3 years when she was first assessed. She lived in Australia and was the daughter of immigrants from Hong Kong who moved to Australia when Catherine was six months old. Catherine's parents were both native speakers of Cantonese and were fluent speakers of English as a second language. Her father was a university lecturer and her mother was a homemaker. Catherine had two older brothers, aged 16 and 8 years. Both brothers were fluent, proficient bilingual Cantonese-English speakers. Catherine had grown up in an almost exclusively Cantonese environment until she was two years old. Although the primary language spoken outside the home was English, her parents decided to establish Cantonese as her first language.

At age two years Catherine began attending a childcare centre for approximately 18 hours per week. The language spoken in the childcare centre was exclusively English. Before attending the childcare centre, Catherine's exposure to English was minimal and she used no English words apart from her name and residential address. Her parents considered her Cantonese development up until this age to be normal. When Catherine started attending childcare, the family began to include some English in their home language environment. In particular Catherine's brothers began to use some English with her. Her parents claimed that the language spoken at home remained mostly Cantonese. Catherine watched approximately two hours of English language television and videos (e.g., Play School, Lion King) each day.

Catherine's birth and medical history were without incident. Her hearing was within normal limits. Her developmental milestones were appropriate.

3.2.1.2 MAX

Max was aged 2;9 years when he was first assessed for this study. He also lived in Australia and was the son of immigrants from Hong Kong who moved to Australia when Max was 18 months old. Max's parents were both native speakers of Cantonese and were fluent speakers of English as a second language. Before migrating to Australia, Max's father was an engineer and his mother worked in a bank, although neither parent was employed during the period of the study. Max had an older sister, aged 4 years who was a bilingual Cantonese-English speaker. Max was raised in an almost exclusively Cantonese environment until he was 2;6 years old. His parents decided to establish Cantonese as his first language.

At 2;6 years of age Max started to attend a childcare centre for approximately 35 hours per week. The language spoken in the childcare centre was exclusively English. Before attending the childcare centre Max's exposure to English had been minimal and his mother reported that he was not using any English words. His parents considered his Cantonese development to this time to be normal. Max's home environment language remained strictly Cantonese even after he started attending childcare. Max watched approximately one hour of English language television each day.

Max's birth and medical history were without incident. His hearing was within normal limits. His developmental milestones were age appropriate.

3.3 PROCEDURE

3.3.1 DATA COLLECTION

Both children were assessed at approximately one-month intervals, although there was one month when no data were collected. Catherine was assessed on 10 occasions over an 11-month period between the age of 2;3 years and 3;1 years. She was not assessed in the month that she was 2;7 years. Max was assessed 8 times over a 9 month period between the age of 2;9 years and 3;5 years. He was not assessed in the month that he was 2;11 years. Data collection began three months after they started attending the childcare centres where they were first exposed to English.

Each assessment session lasted for approximately two hours. All the assessments involved an adult interacting with the child. The first two assessment sessions involved two speech-language pathologists experienced in eliciting speech samples: one was a native Cantonese-speaker, the other a native English-speaker. The children's parents were present during the assessment sessions. The Cantonese-speaking speech-language pathologist demonstrated the assessment procedures to the parents. In the remaining assessment sessions the parents elicited the Cantonese speech samples. Data were collected when the child was interacting with a parent, and with the speech-language pathologists.

The data included spontaneous speech samples collected while playing with toys and looking at picture books. Single word naming was elicited using standardised speech assessments. The Cantonese Segmental Phonology Test (So, 1992) was used to elicit all the phonemes of Cantonese. The Goldman Fristoe Test of Articulation (Goldman & Fristoe, 1987) was used to assess English phonemes. Three additional English words were assessed consistently: *quack*, *queen*, and *quiet*. These words were included because /k^(h)w/ is the only legal cluster in Cantonese. The children were initially shy when speaking English and their

English vocabularies were limited. Therefore, in the first few assessment sessions, some of the words on the Goldman Fristoe were often elicited only in imitation of the assessor.

To create two separate language environments the assessment sessions were split into two distinct sections with a break in the middle. On a couple of occasions the English and Cantonese data were collected on different days because of time restrictions or lack of co-operation. In these instances the data collections were always within two days of each other.

The transcription used for the analysis was based on the audio-recording taken during each session. The recorder was a Marantz CP130 recorder and Sony lapel microphone. The data were transcribed as soon as possible to ensure accuracy. Experienced speech-language pathologists who were native speakers of the language transcribed the samples. The reliability of the transcribers was validated as part of the group study presented in Chapter 2.

3.3.2 DATA ANALYSIS

The Cantonese and English data were analysed separately and then compared. The speech samples were analysed to provide data on the children's phonetic inventories and phonological processes. A phone was considered part of the phonetic inventory if there were two productions of the sound in non-imitated speech. Phonological processes were classified as either:

- ◆ *appropriate* - occurring in the speech of normally developing monolingual children of the same age;
- ◆ *delayed* - occurring in the speech of normally developing monolingual children of a younger age; or

◆ *atypical* - used by less than 10 percent of the normally developing monolingual population.

At least five examples of the process in spontaneous speech were required before a phonological process was identified. The children's speech was monitored for vowel and tone accuracy. However, these errors will not be discussed in this thesis. The percent consonants correct (PCC: number of correct consonants ÷ total number of consonants in sample) was calculated. The PCC samples were the responses to the standardised assessments. They provided quantitative information about the children's accuracy on a controlled word list.

To monitor vocabulary and comprehension development in English the Peabody Picture Vocabulary Test-Revised (PPVT: Dunn & Dunn, 1981) and the Reynell Developmental Language Scales-Revised (RDLS: Reynell & Huntley 1985) were also administered on two occasions to each child.

3.4 RESULTS - CATHERINE

3.4.1 LANGUAGE STAGES

Catherine's language use and the error data suggest that there were three stages within the period her speech was monitored.

3.4.1.1 STAGE I - 2;3 TO 2;6 YEARS

Catherine's initial response to her new language environment in the childcare centre was silence. For the first eight months she did not talk to anybody in the centre. She was cooperative and participated in activities willingly. She appeared to understand instructions and took turns in games. However, Catherine spoke to neither children nor teachers at the

childcare centre during this period. This initial response to exposure to a second language has been observed in other successive bilingual children and is discussed in depth by Saville-Troike (1988). However, she began to respond to the limited amount of English stimulation she was receiving at home and she began trying out English words. During the assessment sessions Catherine willingly participated in the Cantonese sections but required more persuasion to attempt speaking in English. Most words elicited in the English assessment during this stage were imitations of the examiner.

3.4.1.2 STAGE II - 2;8 TO 2;11 YEARS

When she was 2;8 years she produced her first spontaneous English within the childcare environment. In a game of “Who stole the cookie from the cookie jar?” she responded, “Who me? Couldn’t be!” appropriately and clearly when she was accused of the wicked deed. From that time Catherine slowly became more willing to use English with the other children and adults at the centre. Much of the English speech data remained limited to imitated words, although Catherine’s spontaneous utterances increased at each assessment session.

Catherine’s initial unwillingness to offer any spontaneous speech made the teachers and her parents concerned about her language development. The receptive language assessments were first administered at age 2;8 years when she had been attending the centre for eight months. Her age equivalent on the RDLS was 2;5 years and standard score on the PPVT was 91. These assessments indicated that Catherine’s receptive vocabulary and comprehension were developing well. The language assessments were re-administered when Catherine was 2;11 years. Her RDLS age equivalent had improved to 2;10 years and her PPVT standard score was 98. Her performance on these assessments indicated that

her English language skills were age appropriate (in comparison to monolingual English children).

3.4.1.3 STAGE III - 3 - 3;1 YEARS

The final two assessment sessions saw an increased willingness to interact in English, with occasional English words being offered within the Cantonese assessment session. The majority of the English speech data was spontaneous. Catherine's Cantonese errors were minimal during this stage.

3.4.2 PHONETIC INVENTORY

3.4.2.1 CANTONESE

Catherine had already acquired 9 of 17 Cantonese phones at 27 months. She was also able to produce five other phones in imitated speech. She was not able to produce the phones /k^h, s, l/ at her first assessment. By 30 months Catherine had acquired five more phones and was able to use another two in imitated speech. The remaining phone that she not able to produce was /s/. Catherine consistently substituted a lateral alveolar fricative for /s/. Table 3.1 outlines the order of Catherine's Cantonese phone acquisition. All phones were evident in spontaneous speech at age 37 months. Catherine acquired the unaspirated stops before the aspirated stops.

Table 3.1 Phonetic Acquisition of Cantonese - Catherine aged 27-37 months*

Phoneme	27	28	29	30	32	33	34	35	36	37
p	■	■	■	■	■	■	■	■	■	■
p ^h	■	■	■	■	■	■	■	■	■	■
t	■	■	■	■	■	■	■	■	■	■
t ^h	■	■	■	■	■	■	■	■	■	■
k	■	■	■	■	■	■	■	■	■	■
k ^h	■	■	■	■	■	■	■	■	■	■
m	■	■	■	■	■	■	■	■	■	■
n	■	■	■	■	■	■	■	■	■	■
ŋ	■	■	■	■	■	■	■	■	■	■
f	■	■	■	■	■	■	■	■	■	■
s	■	■	■	■	■	■	■	■	■	■
h	■	■	■	■	■	■	■	■	■	■
w	■	■	■	■	■	■	■	■	■	■
j	■	■	■	■	■	■	■	■	■	■
l	■	■	■	■	■	■	■	■	■	■
ts	■	■	■	■	■	■	■	■	■	■
t ^h s	■	■	■	■	■	■	■	■	■	■
kw	■	■	■	■	■	■	■	■	■	■
k ^h w	■	■	■	■	■	■	■	■	■	■

Notes:

- * No measures were taken in the month Catherine was 31 months of age.
- Phone evident in spontaneous speech sample
- Phone evident only in imitated speech sample
- Phone not evident in sample.

3.4.2.2 ENGLISH

The speech data collected in the first three assessment sessions were mainly imitated. In imitated speech, Catherine used nine phonemes at age 27 months. The assessment session at age 30 months resulted in more spontaneous speech, although the majority of the sample collected remained imitated. However, in the spontaneous speech produced Catherine used nine phonemes. A further seven phonemes were also evident in her imitated speech. Table 3.2 outlines the order of Catherine's English phone acquisition. At age 37 months, Catherine used 20 phones in spontaneous speech. She did not use the phones /θ, ð, ʒ, r/ in any context over the period of the study.

3.4.2.3 COMPARISON OF CANTONESE AND ENGLISH PHONETIC ACQUISITION

Cantonese and English share 12 phonemes (plosives: /p^h, t^h, k^h/; nasals: /m, n, ŋ/; fricatives: /f, s, h/; glides: /w, j, l/). Due to the differences in speech samples available for analysis, it is only valid to compare speech sounds used in spontaneous speech from age 30 months onward. Of the 12 shared sounds, 10 were used in Cantonese and 6 were used in English. Four phones had been acquired in Cantonese but not in English, one phoneme was absent in both, one phoneme was evident in imitated speech in both. Shared phonemes were usually acquired in Cantonese before English, however, /k^h/ was evident first in English.

Catherine acquired the phone /ʃ/ in English at 30 months and substituted it for /s/ in both Cantonese and English until 34 months when she acquired /s/. Stops and nasals were the first sounds to be acquired in both languages. Catherine had acquired the phone /f/ in Cantonese at age 28 months, however, she did not start to use it in her English spontaneous speech until 33 months.

Table 3.2 Phonetic Acquisition of English - Catherine aged 27-37 months*

Phoneme	27	28	29	30	32	33	34	35	36	37
p	■	■	■	■	■	■	■	■	■	■
b	■	■	■	■	■	■	■	■	■	■
t	■	■	■	■	■	■	■	■	■	■
d	■	■	■	■	■	■	■	■	■	■
k	■	■	■	■	■	■	■	■	■	■
g	■	■	■	■	■	■	■	■	■	■
m	■	■	■	■	■	■	■	■	■	■
n	■	■	■	■	■	■	■	■	■	■
ŋ	■	■	■	■	■	■	■	■	■	■
θ	■	■	■	■	■	■	■	■	■	■
ð	■	■	■	■	■	■	■	■	■	■
f	■	■	■	■	■	■	■	■	■	■
v	■	■	■	■	■	■	■	■	■	■
s	■	■	■	■	■	■	■	■	■	■
z	■	■	■	■	■	■	■	■	■	■
ʃ	■	■	■	■	■	■	■	■	■	■
ʒ	■	■	■	■	■	■	■	■	■	■
h	■	■	■	■	■	■	■	■	■	■
w	■	■	■	■	■	■	■	■	■	■
j	■	■	■	■	■	■	■	■	■	■
l	■	■	■	■	■	■	■	■	■	■
r	■	■	■	■	■	■	■	■	■	■
tʃ	■	■	■	■	■	■	■	■	■	■
dʒ	■	■	■	■	■	■	■	■	■	■

Notes:

* No measures were taken in the month Catherine was 31 months of age.

- Phone evident in spontaneous speech sample;
- Phone not evident in sample.
- Phone evident only in imitated speech sample.

Catherine's acquisition of plosives was interesting. With plosive pairs in English she acquired the voiced before the voiceless. In Cantonese she acquired the unaspirated before the aspirated. Catherine's cluster development was systematic: /k^hw/ ⇔ [p]; /kw/ ⇔ [p] until 32 months, and then /kw/ ⇔ [f]. Catherine never realised singleton /k/ to [p] or [f], it was usually fronted to [t]. Catherine simplified most clusters in English in similar ways to monolingual children including the /kw/ words elicited in each session. Catherine reduced /k^hw/ and /k/ ⇔ [t] in English.

3.4.3 PHONOLOGICAL PROCESSES

3.4.3.1 CANTONESE

Table 3.3 outlines the phonological processes Catherine used between ages 27 and 37 months. No atypical processes were consistently applied. Catherine often used several processes simultaneously. Cluster Reduction, Stopping, and Fronting were the most frequent and consistently used processes.

The use of atypical processes in Catherine's Cantonese coincides with her use of spontaneous English speech. Catherine began having difficulty with aspiration/deaspiration/voicing contrasts when she started using spontaneous English at 32 months. The process of Addition was mainly restricted to final consonants, although there were also examples of initial consonant addition. When a consonant was added it was always phonotactically acceptable (e.g., /tsi/ to [tsip] not [tsif] because /p/ is a legal final consonant but /f/ is not). Initial Consonant Deletion was evident over 4 months from 32 to 35 months. In Cantonese it is acceptable sometimes to omit initial /ŋ/ and initial /h/ deletion is a normal developmental process. Catherine, however, was deleting a

range of initial consonants. The presence of atypical processes was transient: only errors involving Voicing were still evident at age 37 months.

Catherine used several phonological processes common to monolingual Cantonese children. Many of these processes were suppressed over the period of the study. Affrication and Deaffrication processes became evident following the gradual suppression of Stopping. There was also evidence of Continuant Variation involving /j, w, l, n/. Cantonese variation between /l/ and /n/ is sometimes appropriate. However, Catherine had extended the variation to these other sounds (e.g., /j/ to [n], or /w/ to [l]). The majority of errors for these phonemes however, involved variation between /j/ - /w/ and /l/ - /n/. Catherine's use of Final Consonant Deletion was inconsistent. In the first assessment she occasionally omitted final sounds. She did not show any evidence of this process again until she was 30 months, and then only for a few months before the process was again suppressed.

3.4.3.2 ENGLISH

Table 3.4 outlines the phonological processes Catherine used in English between ages 27 and 37 months.

Catherine used several processes simultaneously. However, as with her Cantonese, Cluster Reduction, Stopping, Fronting, and Continuant Variation (/j, w, l, n/) were the most frequent and consistently used processes. Again, no atypical processes were frequent or consistent but there was evidence of their use.

Table 3.3 Cantonese Phonological Processes - Catherine aged 27-37 months*

	27	28	29	30	32 [#]	33	34	35	36	37
<i>Developmental</i>										
Cluster Reduction ^a	■	■	■	■	■	■	■	■	■	■
Stopping ^a	■	■	■	■	■	■	■	■		
Fronting ^a	■	■	■	■	■	■	■			
Assimilation ^a	■	■	■	■	■	■				
Deaffrication ^a					■	■				
Deaspiration ^b	■	■	■	■	■	■	■	■	■	■
Backing Final Consonants ^b	■	■	■	■	■	■	■	■		
Final Consonant Deletion ^b	■			■	■	■	■			
Affrication ^b				■	■	■	■			
Reduplication ^c	■	■	■	■	■	■	■			
<i>Atypical</i>										
Initial Consonant Deletion ^a					■	■	■	■		
Addition ^a					■	■	■	■		
Voicing ^a							■	■	■	■
Backing Initial Consonants ^b				■	■	■	■	■		
Aspiration ^c						■	■	■		

Notes:

- Process evident in spontaneous speech sample
- * No measures were taken in the month Catherine was 31 months of age.
- # Catherine first started spontaneously speaking English at age 32 months.
- a process used in both languages with the same classification (normal or atypical) in both
- b process used in both languages but atypical for one language
- c process only used in one language

Table 3.4 English Phonological Processes - Catherine aged 27-37 months*

	27	28	29	30	32 [#]	33	34	35	36	37
<i>Developmental</i>										
Cluster Reduction ^a	■	■	■	■	■	■	■	■	■	■
Stopping ^a	■	■	■	■	■	■	■	■	■	■
Fronting ^a	■	■	■	■	■	■	■	■	■	■
Assimilation ^a	■	■	■	■	■	■	■	■	■	■
Deaffrication ^a					■	■	■	■	■	■
Final Consonant Deletion ^b	■	■	■	■	■	■	■	■	■	■
Continuant Variation ^b			■	■	■	■	■	■	■	■
Weak Syllable Deletion ^c	■	■	■	■	■	■	■	■	■	■
<i>Atypical</i>										
Initial Consonant Deletion ^a			■	■	■	■	■	■	■	■
Voicing ^a			■	■	■	■	■	■	■	■
Addition ^a				■	■	■	■	■	■	■
Backing ^b				■	■	■	■	■	■	■
Affrication ^b							■	■	■	■
Deaspiration ^b		■	■	■	■	■	■	■	■	■

Notes:

- Process evident in spontaneous speech sample
- * No measures were taken in the month Catherine was 31 months of age.
- # Catherine first started spontaneously speaking English at age 32 months.
- a process used in both languages with the same classification (normal or atypical) in both
- b process used in both languages but atypical for one language
- c process only used in one language

The most obvious atypical processes in Catherine's English were Backing and Initial Consonant Deletion. Although Catherine had acquired the appropriate front phones she commonly substituted a back phone. Initial Consonant Deletion was evident although the initial phone was often within Catherine's repertoire. Voicing errors were also evident in unusual contexts. Final consonant devoicing, and intervocalic voicing are normal processes used by monolingual children. However, in addition to these, Catherine sometimes voiced final consonants and devoiced prevocalic sounds. Affrication errors only became evident after Catherine had acquired the affricate phones. Addition of sounds was also evident in Catherine's English. Often Catherine added a sound to make an initial cluster instead of an initial single phoneme. She also occasionally added initial and final sounds, however the sounds were always phonotactically appropriate. At 37 months the only atypical processes evident were Backing and Voicing.

Catherine used a number of phonological processes common to monolingual English children. Most of these processes were still evident at the end of the period of the study. Affrication and Deaffrication processes only became evident following the gradual suppression of Stopping.

3.4.3.3 COMPARISON OF CANTONESE AND ENGLISH PHONOLOGICAL PROCESSES

Catherine had thirteen processes evident in both her languages. However, not all these shared processes were evident in both languages simultaneously. Five developmental processes were shared across both languages. Three atypical processes were evident in both languages. In addition, five other processes were used in both languages but were considered atypical for one of the languages. Three processes were only evident in one language. As Catherine's speech became more accurate the developmental processes used in Cantonese decreased over the period of the study.

The presence of atypical processes in Catherine's Cantonese was evident only following the increase in spontaneous use of English at 32 months. Atypical processes in Catherine's English were evident as soon as she started using non-imitated speech. The presence of atypical processes in Catherine's English also persisted longer than in her Cantonese (e.g., Backing Initial Consonants suppressed at 35 months in Cantonese but still evident at 37 months in English).

3.4.4 COMPARISON OF CANTONESE AND ENGLISH SPEECH ACCURACY

Figure 3.1 shows the changes in Catherine's Cantonese and English speech accuracy, as measured by percent consonants correct, over the period of the study. As Catherine acquired more phonemes and suppressed the use of phonological processes, her intelligibility improved. Catherine's Cantonese was more accurate than her English. In Catherine's Cantonese although the rate of speech accuracy declined slightly, concurrent with the use of atypical processes, the changes were minimal. Possibly the quantitative PCC scores were not sensitive to qualitative differences in Catherine's speech. The sample used to calculate PCC consisted entirely of single named or imitated words. The evidence for phonological process use and phoneme acquisition was based on the entire sample of speech collected at each assessment session. This sample included single words and connected speech.

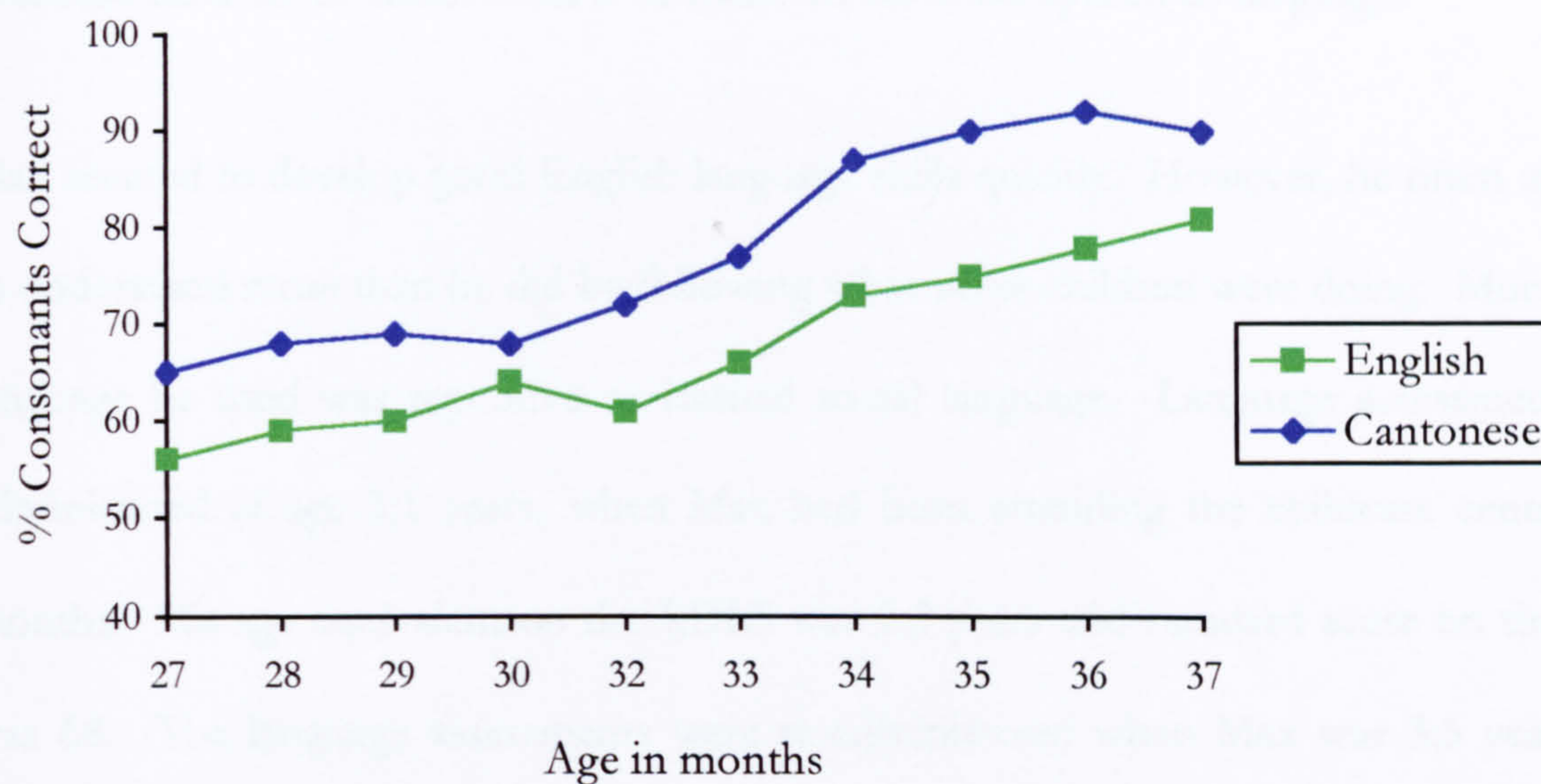


Figure 3.1 Percent Consonants Correct - Catherine aged 27 to 37 months.

3.5 RESULTS - MAX

3.5.1 LANGUAGE STAGES

Max's speech development did not fall into clear-cut stages like Catherine's. When he first started attending childcare Max copied the speech of other children and he interacted easily with them. During the assessment sessions he offered much spontaneous speech. If he did not know a specific vocabulary item, he would often say, "In Chinese it's...". He would imitate new words willingly.

Saville-Troike (1988) identified two successive bilingual language-learning strategies. Max's approach was assertive with a "predominant focus on the message". In contrast, Catherine's strategy had a "predominant focus on the language code" (Saville-Troike, 1988, p. 568). At the first assessment session Max was 2;9 years. He frequently used

3-5 word utterances after only 3 months in an English environment. Max did not like the childcare teachers to correct him if he made errors in his speech or language.

Max seemed to develop good English language skills quickly. However, he often appeared to understand more than he did by following what other children were doing. Much of the language he used was repetitive or learned social language. Language assessments were administered at age 3;1 years, when Max had been attending the childcare centre for 7 months. His age equivalent on the RDLS was 2;2 years and standard score on the PPVT was 68. The language assessments were re-administered when Max was 3;5 years. His RDLS age equivalent had improved to 2;8 years and PPVT standard score to 74. Therefore, although Max's language skills were not equivalent to a monolingual child's at the end of the study period, his English language skills were developing well.

3.5.2 PHONETIC INVENTORY

3.5.2.1 CANTONESE

Max used 10 of the 17 phones at age 33 months. By 37 months Max had acquired a further four phonemes and was able to use another in imitated speech. By the end of the study Max had acquired 15 phonemes and the remaining 2 were evident in imitated speech. Table 3.5 provides the phoneme acquisition data for Max's Cantonese development. Max acquired plosives and nasals before fricatives and affricates. He acquired unaspirated plosives before aspirated.

Table 3.5 Phonetic Acquisition of Cantonese - Max aged 33-41 months*

Phoneme	33	34	36	37	38	39	40	41
p	■	■	■	■	■	■	■	■
p ^h	■	■	■	■	■	■	■	■
t	■	■	■	■	■	■	■	■
t ^h	■	■	■	■	■	■	■	■
k	■	■	■	■	■	■	■	■
k ^h	■	■	■	■	■	■	■	■
m	■	■	■	■	■	■	■	■
n	■	■	■	■	■	■	■	■
ŋ	■	■	■	■	■	■	■	■
f	■	■	■	■	■	■	■	■
s	■	■	■	■	■	■	■	■
h	■	■	■	■	■	■	■	■
w	■	■	■	■	■	■	■	■
j	■	■	■	■	■	■	■	■
l	■	■	■	■	■	■	■	■
ts	■	■	■	■	■	■	■	■
t ^h s	■	■	■	■	■	■	■	■
kw	■	■	■	■	■	■	■	■
k ^h w	■	■	■	■	■	■	■	■

Notes:

* No measures were taken in the month Max was 35 months of age.

- Phone evident in spontaneous speech sample
- Phone evident only in imitated speech sample
- Phone not evident in sample.

3.5.2.2 ENGLISH

The spontaneous speech elicited when Max was aged 33 months included 8 of the 24 English phonemes, /b, d, g, m, n, ŋ, h, w/, and /l/ was evident in imitated speech. By 38 months Max had acquired 12 phonemes and he used another 5 in imitated speech. During the final assessment at 41 months Max used 19 phonemes in spontaneous speech, another 4 were evident in imitated speech and /ʒ/ was not elicited in any context. Table 3.6 shows the order of Max's English phoneme acquisition.

3.5.2.3 COMPARISON OF CANTONESE AND ENGLISH PHONETIC ACQUISITION

Of the 12 phonemes shared by English and Cantonese, Max had acquired 5 by 33 months. He had also acquired /j/ in Cantonese but was only able to use this phone in imitated English words. Max acquired the remaining shared phonemes over the period of the study. When a phoneme was evident in imitated speech it was consistently evident in both languages simultaneously. All the shared phonemes were evident in spontaneous Cantonese speech before English. However, each phoneme became evident in English within two months of its acquisition in Cantonese.

Max simplified clusters differently in each language. In Cantonese: /k^hw/ ⇨ [p]; /kw/ ⇨ [t]; in English: /k^hw/ ⇨ [w]. In Cantonese Max acquired unaspirated before aspirated plosives. In English he acquired voiced before voiceless plosives.

Table 3.6 Phonetic Acquisition of English - Max aged 33-41 months*

Phoneme	33	34	36	37	38	39	40	41
p	■	■	■	■	■	■	■	■
b	■	■	■	■	■	■	■	■
t	■	■	■	■	■	■	■	■
d	■	■	■	■	■	■	■	■
k	■	■	■	■	■	■	■	■
g	■	■	■	■	■	■	■	■
m	■	■	■	■	■	■	■	■
n	■	■	■	■	■	■	■	■
ŋ	■	■	■	■	■	■	■	■
θ	■	■	■	■	■	■	■	■
ð	■	■	■	■	■	■	■	■
f	■	■	■	■	■	■	■	■
v	■	■	■	■	■	■	■	■
s	■	■	■	■	■	■	■	■
z	■	■	■	■	■	■	■	■
ʃ	■	■	■	■	■	■	■	■
ʒ	■	■	■	■	■	■	■	■
h	■	■	■	■	■	■	■	■
w	■	■	■	■	■	■	■	■
j	■	■	■	■	■	■	■	■
l	■	■	■	■	■	■	■	■
r	■	■	■	■	■	■	■	■
tʃ	■	■	■	■	■	■	■	■
dʒ	■	■	■	■	■	■	■	■

Notes:

- * No measures were taken in the month Max was 35 months of age.
- Phone evident in spontaneous speech sample
- Phone not evident in sample
- Phone evident only in imitated speech sample

3.5.3 PHONOLOGICAL PROCESSES

3.5.3.1 CANTONESE

Table 3.7 presents the phonological processes Max used between ages 33 and 41 months. Max used several processes simultaneously and their use was consistent. Over the nine months of the study the use of many developmental processes was suppressed.

Evidence of atypical phonological processes in Max's Cantonese appeared in the second assessment session when he was 34 months. Max used five processes considered atypical for monolingual Cantonese children over the period of the study. Unlike the developmental processes that were applied systematically and quite consistently, the errors that indicated the use of an atypical process (e.g., deletion of initial consonants) were not systematic. However, use of these processes was evident and affected Max's intelligibility. Unlike the developmental processes, many of the atypical processes remained evident in Max's Cantonese through to the final assessment at 41 months.

Voicing and Aspiration errors were inconsistent. For example, Max used [p, p^h, b] as allophonic variants. Final and Initial Consonant Deletion was also inconsistent, although their use had a great effect on intelligibility. A range of consonants (although rarely plosives) was deleted. The addition of consonants was primarily of final consonants (changing CV to CVC structures). Most of the consonants added were plosives and they were always within Cantonese phonotactic constraints.

Table 3.7 Cantonese Phonological Processes - Max aged 33-41 months*

	33	34	36	37	38	39	40	41
<i>Developmental</i>								
Cluster Reduction ^a	■	■	■	■	■	■	■	■
Stopping ^a	■	■	■	■	■	■	■	■
Continuant Variation ^a	■	■	■	■				
Backing Final Consonants ^b	■	■	■	■	■	■		
Affrication ^b	■	■	■	■	■			
Deaspiration ^c	■	■	■	■	■	■	■	
Fronting ^c	■	■	■	■	■			
<i>Atypical</i>								
Initial Consonant Deletion ^a				■	■	■	■	■
Voicing ^a		■	■	■	■	■	■	■
Final Consonant Deletion ^c			■		■	■		
Addition ^c				■		■	■	■
Aspiration ^c			■	■	■	■	■	■

Notes:

■ Process evident in spontaneous speech sample

* No measures were taken in the month Max was 35 months of age.

a process used in both languages with the same classification (normal or atypical) in both

b process used in both languages but atypical for one language

c process only used in one language

3.5.3.2 ENGLISH

Table 3.8 shows Max's use of phonological processes in English. Max used six developmental phonological processes. During the initial assessments Max used the processes quite consistently and systematically. However, their application became less consistent over the period of the study. Only three developmental processes remained evident at 41 months.

Two atypical phonological processes, voicing and not releasing final consonants, were evident during the initial assessment of Max's English speech. At 33 months Max did not use voiceless plosives. Syllable-final plosives in Cantonese are unreleased. Max also produced word-final English plosives without audible release. In Australian English release of word-final plosives in unconnected speech is typical. Max used four other unusual error patterns through the period of the study. Affrication became evident only when Max had acquired affricate phonemes. Transposition of phonemes was seen in multisyllabic words. Nasalisation of /l/ to [ŋ] was common (e.g., [nait] for /lait/). Initial Consonant Deletion was evident although never consistent. Max would often self-correct words when misunderstood by producing the initial consonant. Backing of phonemes (in particular /n/ to [ŋ] and /t/ to [k]) affected intelligibility, although it was not systematic.

Table 3.8 English Phonological Processes - Max aged 33-41 months*

	33	34	36	37	38	39	40	41
<i>Developmental</i>								
Cluster Reduction ^a	■	■	■	■	■	■	■	■
Stopping ^a	■	■	■	■	■	■	■	■
Gliding ^a	■	■	■	■	■	■	■	■
Assimilation ^c	■	■	■	■	■			
Weak Syllable Deletion ^c	■	■	■	■	■	■	■	
Deaffrication ^c	■	■	■	■	■	■		
<i>Atypical</i>								
Initial Consonant Deletion ^a			■	■	■		■	
Voicing ^a	■	■	■	■	■	■	■	■
Backing ^b			■	■	■	■	■	■
Affrication ^b					■	■	■	■
Transposition ^c				■	■	■	■	■
Nasalisation ^c			■	■	■	■	■	
Unreleasing ^c	■	■	■	■	■	■		

Notes:

■ Process evident in spontaneous speech sample

* No measures were taken in the month Max was 35 months of age.

a process used in both languages with the same classification (normal or atypical) in both

b process used in both languages but atypical for one language

c process only used in one language

3.5.3.3 COMPARISON OF CANTONESE AND ENGLISH PHONOLOGICAL PROCESSES

Max used seven phonological processes in both languages. Two processes were atypical for only one language and two were atypical for both languages. Max used 11 other processes in only one language: 6 were specific to English; 5 were specific to Cantonese.

Of all the processes in both languages the three shared developmental processes (Cluster Reduction, Stopping, and Continuant Variation of /j, w/) were used the most consistently and persistently (over time). Some developmental processes in both languages were suppressed over the period of the study. Some of the atypical processes Max used in English were also suppressed, however most remained evident in Cantonese. Max's use of atypical processes in English was minimal at the initial assessment and none were evident in his Cantonese. However, by the age 36 months 8 of the 11 atypical processes were evident.

3.5.4 COMPARISON OF CANTONESE AND ENGLISH SPEECH ACCURACY

Figure 3.2 presents Max's speech accuracy scores. Max's speech accuracy scores increased over the period of the study. His Cantonese accuracy was consistently higher than his English accuracy. Max's Cantonese did not improve over the first few months of the study. This coincided with the period when Max was beginning to use English more and when atypical errors became evident in his Cantonese speech. After the initial slight plateau in accuracy, his Cantonese continued to increase steadily. Max's English accuracy gradually improved over the period of assessments.

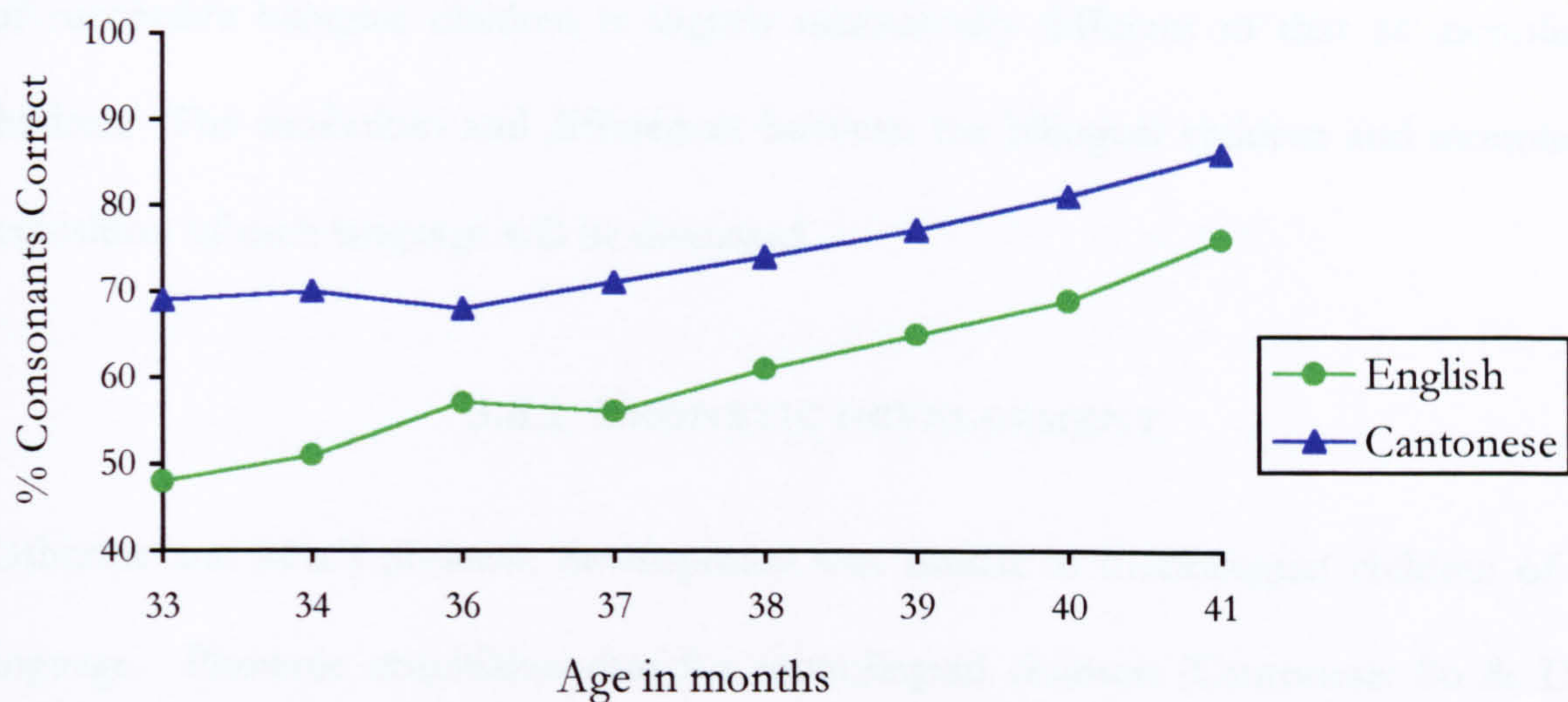


Figure 3.2 Percent Consonants Correct - Max aged 33 to 41 months.

3.6 DISCUSSION

Following the introduction of their second language two Cantonese-English successive bilingual two year-old children were assessed monthly. The phonological process use, phoneme repertoires, and phonetic accuracy of the two children were presented. The data presented in Chapters 2 and 3 provide novel evidence for an important theoretical issue: the children had separate phonological systems for each language. Their speech development indicated that:

- ◆ they often used shared phonemes in one language before the other;
- ◆ they used different phonological error patterns for each language;
- ◆ they did not use language-specific phonemes in the *wrong* language;
- ◆ they simplified the same phonemes differently in each language; and
- ◆ their errors always obeyed the phonotactic constraints of the appropriate language.

The two children used similar phonological patterns to the larger group study data (presented in Chapter 2). These patterns indicated that the phonological development

of successive bilingual children is slightly qualitatively different to that of monolingual children. The similarities and differences between the bilingual children and monolingual acquisition of each language will be discussed.

3.6.1 PHONETIC DEVELOPMENT

Catherine and Max's phonetic development was similar to monolingual children of each language. Phonetic acquisition data for monolingual children (Cantonese: So & Dodd, 1995; English: Prather, Hendrick & Kern, 1975) indicates that the order of acquisition for each language was generally the same for the successive bilingual children. Shared phonemes were usually acquired in Cantonese first, but could usually be elicited in imitated speech in both languages at the same time.

Catherine's phonetic development data are not clear because of her reluctance to offer any spontaneous English speech for the first few months of the study. It is also difficult to ascertain when phonemes have been acquired when consistent phonological processes that simplify the sounds are in use. For example, Catherine used /f/ in imitated Cantonese two months before she used it in imitated English. However, Catherine stopped most fricatives in English. Catherine's articulatory distortion of /s/ was identical in both languages. The phoneme was acquired simultaneously in each language and the distortion was the same in each language. When Catherine's production became more accurate at 33 months, the change was evident in both languages.

Max's phonetic development was quite clear across both languages. All his shared phonemes were acquired in spontaneous Cantonese first. However, they were all evident in his imitated English speech when they were evident in his spontaneous Cantonese. All shared phonemes were acquired in spontaneous English within two assessment sessions of their acquisition in Cantonese.

Catherine and Max both acquired English plosives in a different pattern to monolingual English children. Both successive bilingual children acquired voiced plosives before their voiceless counterparts. This pattern was consistent across all plosives for each child. Monolingual English children usually acquire voiceless plosives before voiced (Prather *et al.*, 1975). In Cantonese both children acquired the unaspirated plosives before aspirated in the same way as monolingual children (So & Dodd, 1995). The only shared phoneme that Catherine acquired in English before Cantonese was /k^h/. Both children acquired all other shared aspirated plosives in Cantonese before English.

Because the acquisition of phonemes is due to articulatory maturation, the phonetic development of the successive bilingual children suggests that the emergence of the sounds is approximately simultaneous in both languages. The articulatory development of both children and the suppression of phonological processes can be seen in their speech accuracy data of both languages. The quantitative data does not give a very good indication of the qualitative changes that were evident in the phonological processes and atypical errors evident in each language.

3.6.2 PHONOLOGICAL PROCESSES

The two children presented with different phonological process profiles. For Catherine both languages shared most processes. Max had more language-specific processes. Both children's speech included the use of atypical phonological processes for monolingual speakers of each language. However, all atypical processes were also evident in the speech of the group of successive bilingual Cantonese-English children. This indicates that for this group the use of these error patterns is normal (cf. Chapter 2).

Catherine's phonological process use followed a clear pattern. When she started using English spontaneously, atypical processes became evident in her Cantonese. However, the

atypical processes were inconsistent. They had a small impact on overall intelligibility, and were transient. Unlike the results of the group cross-sectional study of Cantonese-English successive bilingual children, Catherine's atypical processes were nearly all evident in both her languages. Atypical Aspiration and Continuant Variation of /j, w, l, n/ were evident in her Cantonese but not in her English. Most successive bilingual children in the group study shared some atypical processes but the processes were usually language-specific.

Although Catherine often used the same processes in both languages there was also clear evidence that she had discrete phonological systems. She did not necessarily simplify shared phonemes in identical ways. For example, Cluster Reduction (evident in both languages throughout the study): Cantonese - /k^hw/ ⇔ [p^h]; English /k^hw/ ⇔ [t^h]. When Catherine added a phoneme it was always phonotactically appropriate (e.g., English: /blu/ ⇔ [bluf]; Cantonese: /jɿ/ ⇔ [jɿk]).

Max's phonological processes were more language-specific than Catherine's. His speech was also less accurate than hers. While Catherine's speech was simplified by a wide range of processes all evident simultaneously but not consistently, Max's speech was dominated by consistent developmental processes. However, the use of atypical processes was not consistent and their presence was less transient than Catherine's. Initially, there was minimal evidence of atypical errors in Max's speech. However, in each assessment session for the duration of the study there were examples of atypical errors.

There was also clear evidence for two distinct phonological systems in Max's speech data. Unlike Catherine, who had many shared phonological processes across both languages, Max had many processes that were specific to one language only. For example, although from 33 to 38 months Max fronted some velars and nasals in Cantonese there was no evidence of this process in English. The difference in his realisation of /kw/ clusters (the

only shared cluster) was also distinct although different to the pattern Catherine used. Max's errors were always within the phonotactic constraints of each language. For example, there was no evidence of Cantonese-specific phonemes (e.g., /ts/) being used in English.

3.7 USE OF ATYPICAL PROCESSES

Some of the processes that the bilingual children used were atypical for one language only:

- ◆ **Backing:** Final consonant backing is not considered atypical in Cantonese but it is in English. Max consistently backed final consonants in both Cantonese and English. However, Catherine also occasionally backed initial consonants in both languages.
- ◆ **Final Consonant Deletion:** Atypical in Cantonese, yet a normal developmental process in English. Catherine and Max both deleted final consonants in Cantonese although they have a very high functional load.
- ◆ **Affrication:** Cantonese monolingual children often affricate fricatives (e.g., /s/ ⇔ [ts]). Catherine and Max both affricated some sounds in English as well as Cantonese.

Other atypical processes that were evident could be the result of over-generalisation of certain language-specific rules:

- ◆ **Initial Consonant Deletion:** Cantonese initial /ŋ/ and /h/ can sometimes be deleted, however the successive bilingual children deleted a range of initial consonants in both languages.
- ◆ **Continuant Variation of /j, w, l, n/:** Variation of [l] for /n/ in Cantonese is acceptable, but [n] for /l/ is uncommon. However, Catherine freely used /j, w, l, n/ as variants in Cantonese. Max used /l/ and /n/ as allophonic variants in English and Cantonese.

- ◆ **Addition:** The addition of an initial consonant is acceptable sometimes in Cantonese, although it is restricted to either a glottal stop or the same phoneme as the final consonant of the preceding word. The successive bilingual children added a range of both initial and final consonants, and occasionally made clusters out of singletons. The added sounds were always phonotactically appropriate.
- ◆ **Voicing, Deaspiration, and Aspiration:** Cantonese has an aspiration contrast for plosives. English has a voicing contrast. Both children made errors of voicing voiceless sounds in Cantonese and English, aspirating unaspirated sounds in Cantonese and deaspirating aspirated sounds in English. These errors suggest that the children did not appropriately contrast this class of sounds.
- ◆ **Unreleasing:** Final plosives in Cantonese are unreleased, while in Australian English they are usually released. Often Max did not release final consonants in English.

Max also made two types of errors that cannot be seen as just over-generalisation of specific rules. Transposition of sounds was evident in Max's English speech. These errors were primarily on multisyllabic words (e.g., helicopter \Leftrightarrow [tɛlipokə]; caterpillar \Leftrightarrow [pætɛlɪlə]). He did not make transposition errors in Cantonese which is primarily a monosyllabic language. The other unusual error that Max made in his English speech was nasalisation. Although Cantonese has a variant where [l] can be used for /l/ or /n/, a substitution of [n] for /l/ is unusual. Max did not substitute [n] for /l/ in Cantonese but he used [n] for /l/ in English. Catherine used /j, w, l, n/ in free variation rather than a specific rule of nasalisation of /l/.

3.8 MODEL OF BILINGUAL SPEECH PRODUCTION

The developmental data raises a primary question: Why do successive bilingual children acquire the phonology of each of their languages in ways that are different to monolingual

children who acquire their language in isolation? The types of speech errors and pattern of use (i.e., atypical errors evident in Cantonese only following acquisition of English) suggest that the phonological systems of the two languages were interacting. The successive bilingual children's acquisition of the phonology of each language was slightly qualitatively different to the phonological acquisition for monolingual children of either language. The lack of atypical errors in the children's initial assessments of their Cantonese showed that they were developing normal phonological skills for a monolingual child. However, the introduction of atypical errors, in addition to the normal developmental process indicates that as the children were exposed to a second phonological system there was an effect on their first phonological system.

Most of the atypical errors can be plausibly explained as over-generalisations of language-specific rules (e.g., Cantonese: initial consonant deletion acceptable for /ŋ/; /l/ and /n/ act as allophones. English: aspiration not contrastive). It is possible that the emergence of atypical errors (although they are only atypical for monolingual children, the errors are normal for successive bilingual Cantonese-English children) results from underspecified phonological rules.

Duggirala and Dodd (1991) proposed a model of the speech processing chain. Realisation rules are key components of this model. When children generate speech, they select a word that expresses their ideas from their lexicon, and then the lexical phonological specification is fed through the existing set of realisation rules that forms a phonological plan for production (Dodd, 1995). Realisation rules are derived from information in the lexicon, reflecting children's implicit understanding of the nature of the phonological structure of the ambient language (Dodd, Leahy & Hambly, 1989; Leonard, 1985; Macken & Ferguson, 1983).

Leonard (1985) suggested that children with phonological disorder might have an impaired ability to abstract knowledge about the nature of the phonological system to be acquired. Unusual errors occur when children select the wrong parameters of the perceived speech signal as salient to their native phonology (Grundy, 1989). The successive bilingual children in the current study were not phonologically disordered (they had been acquiring their first phonological system appropriately), yet they made errors that are considered atypical for monolingual children.

Possibly, the cause of the atypical errors may be an inability to process adequately both phonological systems in enough detail to derive all the appropriate language-specific realisation rules. The generally transient and inconsistent nature of the atypical errors suggests that as each child was exposed to more English they were able to differentiate more clearly the realisation rules for each phonological system. For example, Max may have hypothesised that final consonants are unreleased because that is the case in Cantonese. His limited exposure to English had not yet allowed him to identify that a salient characteristic of the phonology is that final consonants are usually released, so he simply used the realisation rules governing the release of final consonants that he had extracted from exposure to Cantonese phonology.

The children's use of atypical processes in Cantonese is particularly interesting considering how well established the phonological systems were before exposure to English. If the hypothesis is true, then there may also be some negative interference following exposure to another phonological system. The over-generalisation of phonological rules appears to have been both across languages and within each language (e.g., although only syllable-initial /ŋ/ and /h/ can be deleted from Cantonese words, both children began to delete a range of initial consonants). Perhaps the burden of differentiating each system, and abstracting two sets of explicit rules, means that for a short period the established rules of

the first phonological system are temporarily confused. Both children had clearly established two systems and were marking differences between the systems. However, occasionally the precise, specific detail of the realisation rules was inaccurate or absent, resulting in unusual speech errors.

Watson (1991) suggests that the process of successive bilingual phonological acquisition involves superimposing one system on the other or mixing the two phonological systems together (averaging). The data presented in this chapter suggest that neither process is totally accurate. Catherine and Max did not simply use their Cantonese phonological system when they spoke English (superimposing) nor did they start mixing the two phonological systems together (averaging). They both kept the two phonological systems appropriately differentiated. However, the process of acquiring two phonological systems had an effect: both children had a developmental period of underspecified phonological realisation rules. This suggests that the children's efficiency at extracting and using the rules of each phonology was initially affected.

CHAPTER 4:
THE EFFECT OF DIFFERENT
LANGUAGE COMBINATIONS -
A DESCRIPTION OF THE
PHONOLOGICAL ACQUISITION
OF PUNJABI-ENGLISH
BILINGUAL CHILDREN

4.1 INTRODUCTION

The phonological development of successive Cantonese-English bilingual children is qualitatively different from that of monolingual children of either language. These qualitative differences were described in detail in Chapters 2 and 3. The types of speech errors and pattern of use (i.e., atypical errors evident only following acquisition of the second language) suggest that the phonological systems of the two languages were interacting.

An important issue is the nature of the two phonological systems that are interacting: Are the qualitative differences observed in the Cantonese-English bilingual children a specific phenomenon of the combination of those two languages? Alternatively, are these qualitative differences observed in *all* successive bilingual children regardless of the nature of the two phonological systems? This chapter investigates these questions and describes the normal phonological development of children acquiring a different language combination, Punjabi-English¹.

The investigation of the acquisition of Punjabi-English phonology was chosen for two reasons. The first reason is practical clinical need: the Linguistic Minorities Project (Stubbs, 1985) found that Punjabi was one of the most spoken minority languages in Britain. Therefore, there are areas of Britain where successive bilingual Punjabi-English speakers form the majority of children referred to a particular speech-language therapy service.

The second reason is one of theoretical interest: the phonological structure of Punjabi is significantly different to the structure of both English and Cantonese (the previous

language combination investigated in this thesis). The two languages contrasted in this thesis come from different language families to each other and to English (English - Germanic; Punjabi - Indo-Iranian; Cantonese - Sino-Tibetan). Yavas (1998) suggested that cross-linguistic phonological pattern similarities and differences cannot be solely accounted for by a “genetic” (language family) link. However, the nature of the ambient phonological structure has been shown to affect the types of errors made (Yavas, 1998).

Cross-linguistic comparisons of these two quite different language combinations would help to resolve the issues:

- a) are the differences identified in the Cantonese-English group language-specific interactions, or
- b) are there intralingual (bilingual) processes that result in differences in all bilingual children?

In order to resolve these issues normative information was needed regarding the phonological development of bilingual children acquiring specific language combinations.

4.2 METHOD

4.2.1 DEVELOPMENT OF THE ROCHDALE ASSESSMENT OF MIRPURI PHONOLOGY (RAMP)

At the time of the study, no phonological assessment procedure for Punjabi was available. The Rochdale Assessment of Mirpuri Phonology (RAMP) was developed for the current study². RAMP is a single word picture-elicitation procedure. It is a very practical

¹ In this thesis the term Punjabi encompasses the languages Punjabi, Mirpuri and Urdu - unless otherwise specified. The author acknowledges that these are individual languages. However, a rationale for investigating them as one group is provided in section 4.2.1. When referring to a specific child the specific language used is identified.

² The development of the RAMP was undertaken as a joint research project with two speech-language therapists, Carol Stow and Sean Pert, employed by Rochdale Healthcare NHS Trust.

procedure because (a) single word responses are easier to elicit and transcribe accurately; (b) adult target forms could be established for all the target words; and (c) the phonetic content of the sample collected could be controlled.

Fifty-nine different target words were chosen and illustrated in 35 colour pictures (there were 76 total target words: 13 words were elicited twice and 2 words were elicited three times). The list of target words and their phonetic transcriptions are shown in Appendix III. The words were chosen following an investigation into the structure of the phonology of the three languages, Mirpuri, Punjabi and Urdu. Young adult speakers of the three languages were recorded and their phonology was studied. The phonological contrasts used by the adult speakers were compared to Bhatia's (1993) and Heselwood's (1996) descriptions of Punjabi phonology. Table 4.1 presents the consonants elicited.

While this procedure was too limited to allow an in depth assessment of the phonology, it provided a guide to the regional variations used. Mirpuri, Punjabi and Urdu are different languages: speakers are not mutually comprehensible (although Mirpuri is often classed as a dialect of Punjabi). However, the languages share many words. The three languages are widely spoken in Rochdale, Lancashire (where the study was conducted). The assessment was designed to be widely applicable: it used target words that were the same (or with only minor differences such as vowel length) across the languages.

There were some areas of confusion when investigating the phonological contrasts used in the languages. In particular it was difficult to establish the significance of voicing and aspiration contrasts in some words. The speakers appeared to make phonemic contrasts based on voice-onset time for some lexical items (e.g., there are minimal pairs differentiated only by aspiration) while in other words the contrast did not seem as significant. Therefore, the words chosen appeared to have phonemic contrasts based on

voice-onset time. Words were chosen to elicit as many phonemes in as many different word positions as possible. A range of consonant clusters in different positions was included in the target words. The final target words chosen for the RAMP were therefore words that would be familiar to young children, were picturable, were common to the three languages, and contained as many of the phonemes in different positions and within clusters as possible.

The assessment was trialed on some adults who were bilingual speakers of the languages. A speech-language pathologist transcribed eight adult speakers' productions of the target words. The production of a further two adult speakers of each of the languages were transcribed by an experienced phonetician. The transcriptions were then compared and a decision about the target productions of the words and their variations was made.

Table 4.1 Summary of Punjabi consonants elicited in the RAMP

	Phonemes
Plosives	p p ^h b t̪ t̪ d̪ d̪ k k ^h k̪ ^h g
Fricatives	f v s z ʃ x h
Affricates	tʃ dʒ
Nasals	m n ŋ ŋ
Approximants	l ɭ r ɻ r̥

4.2.2 SUBJECTS

The phonological development of 35 Punjabi-English bilingual children was investigated. Most children were primarily monolingual until they started attending school at about four years. The children were recruited from an infants' school in Rochdale. Informed consent was gained from each child's parent/s before their participation in the study. In addition,

parents provided information about the language environment at home and the age at which the child started learning English. The children ranged in age from 4;8 years to 7;5 years. Although this age range is perhaps not theoretically the most interesting, clinically this is the age at which bilingual children are most frequently referred to speech-language therapy services for speech disorders. Of the languages assessed, 8 children spoke Mirpuri at home, 17 spoke Punjabi at home, and 10 spoke Urdu at home. No children included in the sample had sensory or cognitive deficits. No children included in the sample had been referred for speech or language therapy.

4.2.3 PROCEDURE

The children were assessed individually in a quiet room at their school. The speech-language pathologist, working with a bilingual assistant, administered the RAMP. To sample the children's English phonological acquisition, an English-speaking speech-language pathologist administered the South Tyneside Assessment of Phonology (STAP: Armstrong & Ainley, 1988). The STAP is an assessment used widely in Britain by speech-language pathologists. The assessment sessions were recorded using a Marantz CP 130 audiocassette recorder. The children were seen in two sessions of about 20 minutes so that the two language contexts could be differentiated clearly. Wherever possible the target words of both assessments were elicited spontaneously. If the child did not produce the word spontaneously, a phonetic and/or semantic cue was given. When the child did not respond to the cues, the word was provided and the child imitated the examiner.

An English-speaking speech-language pathologist transcribed the speech samples from both languages. To check the reliability of the transcriptions, another speech-language pathologist transcribed a selection of five recordings in each language. The point to point agreement of segments was 96 percent for the English samples and 89 percent for the

Punjabi samples. The majority of the differences between the transcriptions were of aspiration/voicing contrasts and final consonant release/deletion errors. The two phonological assessments provided the data for the phonological processes used, articulatory errors, and percentage of consonants correct for each child in both languages.

4.3 RESULTS

4.3.1 PHONOLOGICAL PROCESSES

Phonological processes were identified when there were at least two examples of each process in the speech sample. Although the criterion is less strict than often used, the reliance on single word naming, and the limited occurrence of some phonemes elicited, indicated that the occurrence of the process in the speech sample elicited would be more likely in a connected speech sample (Dodd, Leahy, & Hambly, 1989). Tables 4.2 and 4.3 show the phonological processes identified in the children's Punjabi and English.

An obvious limitation of the study is the lack of data from young (e.g., 2 and 3 year old) children acquiring the two languages (although the reasons for the decision to investigate the 4-7 year old age group were outlined earlier). This limitation means that we cannot know if there are other processes commonly used by younger children, that all the children in the current study had already suppressed. For example, it is possible that the use of fronting (only evident in the English speech of two children) is a common developmental process used by younger children. For this reason it is not possible to identify which of the processes would be *atypical* in the speech of Punjabi-English bilingual children based only on the data presented in this chapter.

Table 4.2 The number of bilingual Punjabi-English children (N=35) observed to use phonological processes in English when assessed on the South Tyneside Assessment of Phonology.

Process	Example	Process use
Cluster reduction*	<i>blue</i> - [bəlʊ], <i>spoon</i> - [səbun]	35
Stopping	<i>thumb</i> - [tʌm], <i>jam</i> - [dæm]	30
Final consonant deletion, glottalisation or non-release*	<i>teeth</i> - [ti], <i>fork</i> - [fɔʔ]	23
Voicing/aspiration errors*	<i>cars</i> - [gʌz], <i>dog</i> - [dɔk]	17
Gliding	<i>ring</i> - [wɪŋ], <i>letter</i> - [jɛtə]	13
Backing*	<i>teeth</i> - [kiə], <i>red</i> - [rɛg]	4
De-/Affrication*	<i>kitchen</i> - [kɪtsən], <i>measure</i> - [mɛdʒə]	4
Initial consonant deletion*	<i>scissors</i> - [ɪzəz], <i>pan</i> - [æn]	2
Fronting	<i>cap</i> - [tæp], <i>girl</i> - [dɜl]	2

Note:

* Denotes processes that are atypical (or some aspects of the bilingual children's application of the process were unusual) in comparison to monolingual children.

Table 4.3 The number of bilingual Punjabi-English children (N=35) observed to use phonological processes in Punjabi when assessed on the Rochdale Assessment of Mirpuri Phonology.

Process	Example	Process use
Voicing and aspiration errors	/bɪli/ - [pɪli], /kʌɾi/ - [gʌɾi]	29
Stopping	/tʌsvir/- [tʌsbir]	26
Backing	/huʃ/ - [kuʃ], /dud/ - [dug]	26
Cluster reduction	/zban/ - [bʌn], /draxt/ - [drax]	16
Weak syllable deletion	/pəkʌnʌ/- [kʌnʌ]	13
Initial consonant deletion	/seb/ - [eb], /hont/ - [ont]	9
Gliding	/ɾoti/ - [loti]	3
Final consonant deletion, glottalisation or non-release	/pul/ - [pu]	3
De-/Affrication	/dʒabi/ - [ʃabi]	3
Nasalisation	/gari/ - [gani]	2
Fronting	/gai/ - [dai]	1
Consonant addition	/dɔkri/ - [dɔkritʃ]	1

There were several differences in the children's process use across the two languages. A process present in one of the child's languages was not always present in their other language. For example, AK, aged 5;5 years, used the following processes in Urdu: weak syllable deletion, stopping, backing, voicing/aspiration errors, gliding, and initial consonant deletion. In English, however, she used the following processes: stopping, deleting final consonants, reducing clusters, and gliding. The processes that were common to the two languages were often not applied in the same way in both languages. For example, in English AK stopped final nasals (e.g., /kraun/ - [kraund]), yet in Urdu she stopped fricatives and affricates (e.g., /dʒʌn/ - [dʌn]). There were also particular differences in gliding errors across the two languages. Many children glided /r/ in English. However gliding errors in Punjabi were rarely of the /r/ variant phones; they were more often represented by variation in the use of /j/, /w/ and /l/.

Some of the phonological processes were more prevalent in English than in the other languages. All 35 bilingual children showed cluster reduction in English. However, only 16 showed cluster reduction in Punjabi. Gliding and final consonant errors (deletion/non-release/glottalisation) were more common in the children's English. The occurrence of stopping, fronting and de-/affrication errors was similar across both language groups.

There were marked differences in the frequency of use of some of the phonological processes across languages. For example, backing was evident in 26 of the 35 children's Punjabi; however, only 4 children made backing errors in English. Voicing and aspiration errors were also far more common in Punjabi (see Tables 4.2 and 4.3). This is possibly due to the normal acceptable variation in voice-onset time displayed by the adult speakers of the languages. Initial consonant deletion and weak syllable deletion were also more prevalent in Punjabi.

English phonological processes were applied differently when compared to developmental monolingual use. For example, the bilingual children reduced clusters in English by consistently inserting a schwa vowel between the two cluster elements (e.g., [fəlauwə]). Although monolingual children sometimes use this process, all 35 bilingual children reduced their clusters in this way.³ The process of stopping syllable-final nasals, used by 18 of the 35 children, is also unusual for monolingual children. Another stopping process where /θ/ becomes /t/ was very prevalent in the bilingual children (e.g., /θri / - [təri]) even when they could articulate the phoneme /θ/.

Some processes used by the bilingual children are atypical for monolingual English children (no normative developmental data exists for Punjabi). For example, the number of voicing and aspiration errors in the bilingual children's speech is unusual for a monolingual child. Many bilingual children did not release their final consonants or replaced them with glottal stops. This pattern is atypical in comparison to monolingual norms (e.g., Dodd, 1995; Grunwell, 1987). However, the use of final position glottal stops is an acceptable regional variation for the geographical area in which the children live. The failure to release final consonants is not a regional variation and suggests an interaction between the two phonological systems (final stops are not released consistently in Punjabi).

4.3.2 PHONEME ACQUISITION

Articulation errors and missing phonemes were rare in the group of children assessed. One expected error, which would be unusual in a monolingual child, was the use of the Punjabi /r/ variants in English. Many of the bilingual children used voiced alveolar or retroflex taps (and occasionally trills) in English. The use of the phonemes was inconsistent and

³ It is interesting to note that the bilingual children did not reduce their clusters in the same way in both languages. In contrast to the epenthetic schwa used in English, most of the children deleted one of the cluster elements in Punjabi.

suggests that the children used the variants as allophones rather than separate phonemes. Errors in the use of taps in Punjabi were uncommon. The other noticeable phonetic error was the use of [t] for /θ/ in English. The more common articulatory error involving /θ/ in English monolingual children is substitution of [f]. Four of the children in the group made articulatory errors, producing lateral or interdental /s/. Each of these children made identical /s/ errors in both of their languages. The sounds that the Punjabi-English children appeared to acquire later (/r/ variants, fricatives /s, z, ʒ, ʃ, x, θ, ð/ and affricates) are cross-linguistically later developing sounds (Locke, 1983).

4.3.3 SPEECH ACCURACY

Figure 4.1 shows the percent consonants correct (PCC) for the bilingual children. The children's speech accuracy did not change appreciably over the age group assessed. The phonological processes present in both languages were quite stable and did not change with increasing age. The accuracy of the children's speech thus did not improve either. One plausible explanation for this finding is that children are primarily exposed to adult and peer models of bilingual English. For example, at the school the children attended, there were very few monolingual English speakers. There was a close relationship between each child's accuracy in each language. The average difference between the two PCC scores across the two languages was 5.8 percent ($SD=4.83$). This indicates that a child with highly accurate speech in one language tended to have highly accurate speech in the other language.

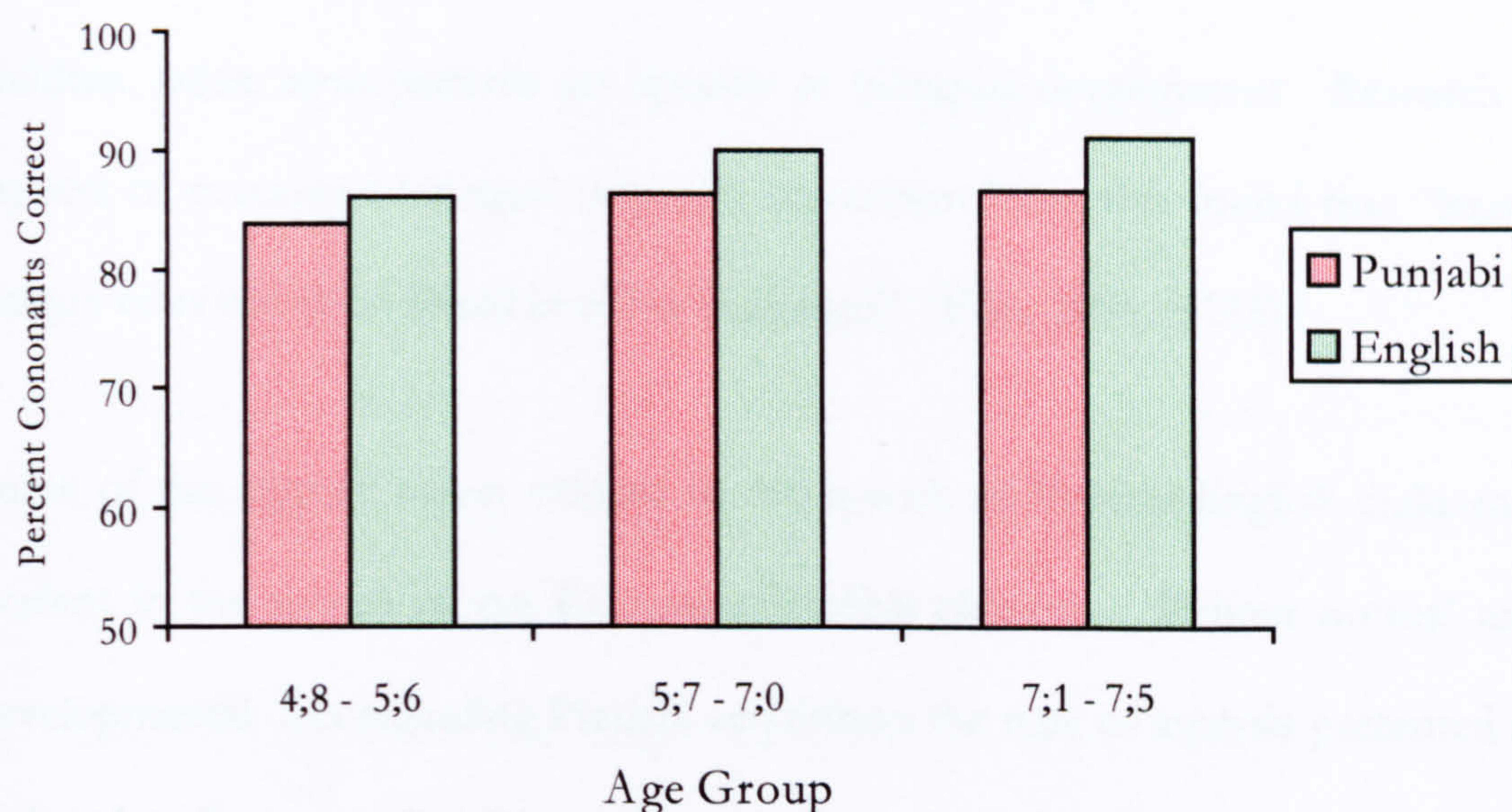


Figure 4.1 Punjabi-English children's speech accuracy.

4.4 DISCUSSION

The normal bilingual developmental data presented here have important theoretical and clinical implications. The preliminary data reported indicate that (i) bilingual children keep their phonological systems separate; and (ii) they do not acquire English phonology in exactly the same way as monolingual children (the monolingual acquisition of Punjabi has not been documented). These patterns were also found in the speech data of the Cantonese-English children.

The bilingual children used different phonological processes in each language. When phonological processes were shared across languages, they were not used in the same way. The children's surface speech errors were therefore specific to each language.

The data show that the normal phonological development of bilingual children is not the same as monolingual development (in comparison to the known development of English phonology). Some of the children's errors are atypical for monolingual English children.

Although monolingual children exhibit many of the error patterns observed in the bilingual children, other error patterns are specific to bilingual development. Research into other aspects of successive bilingual language acquisition have also found that “learners create unique rules not to be found in either [language]” (Ellis, 1994, p.115).

Some of the atypical errors evident in the speech of Punjabi-English children were also evident in the speech of the Cantonese-English children. Without normal monolingual developmental data regarding Punjabi acquisition the type of analysis presented in Chapter 3 for the Cantonese-English children is not possible. The development and use of Cantonese phonology has been described in detail. This information allows patterns to be identified that may be affecting the bilingual acquisition process. For instance, some initial phonemes can be deleted within certain constraints in Cantonese. This allowed the hypothesis that the bilingual children’s use of initial consonant deletion in both languages resulted from an underspecified rule. Unfortunately, the normal phonological variation within Punjabi has not been described. Therefore, it is not possible to make similar comparisons between the phonological systems of Punjabi and English.

There was some evidence that the use of some error patterns in English may have been related to the surface phonology of Punjabi. For example, aspiration and voicing errors may be related to the differences between the marking of voice-onset time contrasts across the two languages. The use of backing was common in the bilingual children’s Punjabi speech samples. It is possible that backing is a natural process used by monolingual Punjabi children. Therefore, the bilingual children’s use of backing in English could be explained with reference to the interaction of the two languages. Affrication and initial consonant deletion are two other error patterns that may be linked with normal monolingual Punjabi development.

4.5 COMPARISON OF CANTONESE-ENGLISH AND PUNJABI-ENGLISH CHILDREN

The normally developing successive bilingual children investigated all showed evidence of differences in their acquisition patterns when compared to monolingual children of either of their languages (for those language where monolingual data were available). This pattern was consistent across Cantonese-English children and Punjabi-English children. The differences appeared to be related to the ambient phonology of the two languages for both language-combination groups.

These results suggest that the bilingual children's use of atypical error patterns (different to monolingual children's) is an intralingual effect (a more general process of bilingual language development) rather than an interference effect (specific to the two languages involved). However, the specific error patterns themselves (e.g., initial consonant deletion in Cantonese) is an interference effect. In other words, although bilingual children appear to use unusual error patterns (intralingual effect) the types of errors are determined by the nature of the two phonological systems interacting (interference effect).

Ellis (1994) suggested that intralingual effects might be due to rule learning and applications: faulty generalisation, incomplete application of rules, and underspecified rules. Chapter 3 argued that the Cantonese-English children's error patterns could be due to the bilingual children's use of underspecified rules. It was suggested that the underspecification might be due to the burden of differentiating and processing two separate phonological systems. The Punjabi-English data appear to support this hypothesis. The nature of the specific rules can be determined by analysing specific aspects of the two target phonological systems. However, the specific difference between bilingual children and monolingual children is the inability to abstract the specific details about the

rules that govern the target phonological system. The patterns of over-generalisation and under-specification stem from the development of two phonological systems.

Further cross-linguistic research into successive bilingual children acquiring different language combinations is required to examine this hypothesis further. It is possible that the patterns described in this thesis are unique to the two language-combination groups investigated. The phonological systems of Punjabi and Cantonese are dramatically different from each other and they are different to English. It may be that languages that have very similar phonological systems (e.g., Dutch and German) will not have any intralingual effects but will still have some interference effects.

Yavas (1998) suggested that we go beyond examining the similarities and differences between the two phonological systems. He noted the importance of considering universal markedness constraints when accounting for the speech patterns of bilinguals. The error patterns observed in the bilingual children were also affected by universal markedness constraints. These patterns were generally evident in the normal developmental error patterns used by all the children (e.g., cluster reduction, more difficulty with liquid realisation, and predominant final devoicing patterns). However, the use of atypical error patterns could not be explained in terms of universal constraints. They are accounted for more plausibly by interaction effects between the two languages.

Failure to identify the normal patterns specific to a certain bilingual group may lead to inaccurate identification of disorder. Therefore, assessment of children with disorder requires: (i) investigation of whether the bilingual child *has* differentiated his/her phonological systems; and if so (ii) identification of the phonological error patterns for each language; and then (iii) comparison of these patterns with normal bilingual

developmental data for the child's specific language group. Section II of this thesis will investigate the nature of speech disorder in bilingual children.

SECTION II:
DIFFERENTIAL DIAGNOSIS
AND INTERVENTION FOR
BILINGUAL CHILDREN WITH
SPEECH DISORDER

CHAPTER 5:
REVIEW OF LITERATURE
REGARDING BILINGUALISM AND
THE DIAGNOSIS AND TREATMENT
OF SPEECH DISORDERS

5.1 INTRODUCTION

Bilingual language acquisition studies reveal the potential for, and limits of, language learning in early childhood. Bilingual and second language acquisition research, however, has focussed mainly on the potential of language acquisition in these children. The limitations or disorders of their acquisition have not been addressed. In Section II of this thesis, the identification and treatment of speech disorder in bilingual children are examined.

In speech-language pathology, theories of phonological development and disorder have not attempted to account for the multilingual acquisition environment. Developmental speech disorder affects approximately 10 percent of the pre-school and school age population (Gierut, 1998). Inadequate recognition of the bilingual population means that speech-language pathologists could be neglecting a significant number of children.

Bilingual acquisition research has also ignored children with speech and language disorders, probably because the path of “normal” bilingual development has yet to be described fully. However, disordered development could provide information as important as that provided by “normal” development. Bilingual children provide a unique opportunity for testing hypotheses about factors affecting language acquisition (de Houwer, 1995; Meisel, 1990). The various deficits hypothesised as underlying disorder can be investigated further by looking at the error patterns of bilingual children. If a single system serves both the bilingual child’s languages then the error patterns should show the same characteristics of disorder *in both* languages. Alternatively, evidence of different characteristics of disorder may identify deficiencies in current models of phonological processing.

Intervention studies of bilingual children with speech disorder offer another unique opportunity to investigate the process of treating disorders. A range of therapy outcomes could have implications for current theories of phonological disorder and the process of intervention: generalisation from one language to another; remediation of errors in only one language; acquisition or correction of phonemes in only one language.

In addition to these theoretical issues there are important clinical management issues regarding intervention for bilingual children with speech disorder:

- ◆ Do they have the same type of disorder in both languages?
- ◆ Is it important to assess both of their languages?
- ◆ Are their error patterns the same in both of their languages?
- ◆ Is therapy required in both the child's languages?
- ◆ Will therapy given in one language generalise to the other language?
- ◆ Which language should therapy target?

Without a basis for making decisions regarding these questions, clinicians cannot know whether the intervention they offer is the most efficient strategy for treating a bilingual child with disordered speech.

The remainder of this chapter provides a summary of the findings reported in Section I and a review of the literature pertaining to the differential diagnosis and treatment of speech disorder. Case studies of seven bilingual children with disordered speech are presented in Chapter 6. Chapter 7 describes the speech of 23 Punjabi-English children referred for assessment for speech disorder. Chapter 8 presents two intervention case studies.

5.2 SUMMARY OF NORMAL BILINGUAL PHONOLOGICAL DEVELOPMENT

The first section of this thesis described the normal phonological development of successive bilingual children. Children exposed to English through childcare or pre-school/nursery from two years of age were investigated. The phonological development of Cantonese and Punjabi children was described. Cross-sectional group studies as well as longitudinal studies were reported. The research presented in Chapters 2 to 4 of this thesis showed that:

- ◆ Bilingual children develop two separate phonological systems that interact. All the normally developing bilingual children described had evidence of clearly differentiated phonological systems. Evidence of this differentiation included: language-specific phonemes used only in the correct language; phonemes used correctly in only one language; use of phonological processes to simplify structures or sounds in only one language; and, the phonotactic constraints of each language were always obeyed.
- ◆ Phonological processes evident in each language can be different and sometimes contradictory. Most normally developing bilingual children used some shared processes (i.e., the process was evident in both of their languages). However, most children also used some processes that were specific to only one language. In some cases there was also evidence of contradictory processes between the two languages (e.g., fronting in one language while backing in the other).
- ◆ Normal bilingual phonological development is qualitatively different to monolingual development. The group studies of normally developing bilingual Cantonese-English and Punjabi-English children showed that there were processes used rarely by monolingual children in each of the languages that were used widely by the bilingual

children. For example, the Cantonese-English children backed initial consonants in both Cantonese and English although that error pattern is atypical of monolingual development of either language. Yavas (1998) reviewed the existing literature on bilingual phonological development and concluded that bilingual children “may show certain patterns that are erroneous with reference to the monolingual speakers of that language” (p.215).

- ◆ Error patterns indicative of disorder for monolingual children may not be indicative of disorder for bilingual children. The finding that bilingual children’s developmental patterns differ to monolingual children’s has important clinical implications for identifying children with disorder. The use of atypical error patterns in monolingual children is one factor that speech-language pathologists currently use to identify disordered development (Dodd, 1995; Yavas, 1998). However, normally developing Cantonese-English and Punjabi-English bilingual children evidence error patterns atypical of monolingual development. It is therefore necessary to establish what is normal for bilingual development for specific language combinations.
- ◆ Differences may be due to bilingual children’s under-specified phonological realisation rules. Analysis of the types of atypical errors made indicated that the errors may have been due to an inability to adequately process both phonological systems in enough detail to select all the appropriate language-specific realisation rules. The atypical errors were evident in both the bilingual children’s languages. Perhaps the burden of differentiating each system, and abstracting two sets of explicit rules, means that for a short period the rules of the first phonological system are affected.
- ◆ Unusual error patterns are transient and may result from over-generalisation of specific phonological patterns, both within and across languages. Some atypical error patterns

observed were normal processes in the bilingual child's other language. Other errors were possibly due to over-generalising some normal language- and context-specific rules (e.g., in Cantonese initial /h/ and /ŋ/ may be deleted - many of the bilingual children were deleting a range of initial consonants in both of their languages). The generally transient and inconsistent nature of the atypical errors suggests that as each child was exposed to each language they were able to differentiate the realisation rules for each phonological system more clearly. Limited exposure to English (the second language) had not yet allowed the children to identify the salient characteristics of each phonological system.

5.3 DIFFERENTIAL DIAGNOSIS OF SPEECH DISORDER

Developmental speech disorder is the most common form of communication impairment in children (Dodd, 1995; Gierut, 1998). Children with speech disorder do not form an homogeneous group: they differ in severity, aetiology, symptomatology, and response to treatment (Dodd, 1993; Shriberg, Kwiatkowski, Best, Hengst, & Terselic-Weber, 1986; Stackhouse & Wells, 1997). The classification of subtypes of speech disorder is controversial. Three perspectives are often evident in the literature:

- ◆ The medical perspective classifies speech difficulties according to aetiology and causal factors such as children with hearing impairment or cerebral palsy (Crystal & Varley, 1993). However, few children have an identifiable aetiology, or they may have multiple contributing factors to their speech difficulty.
- ◆ The linguistic perspective provides a description of the child's speech. Phonetic and phonological analyses are used to identify patterns in the child's speech (Grunwell, 1985). Although a thorough linguistic description is important, and can lead to the

generation of hypotheses about the nature of the disorder, it cannot provide an explanation of the disorder (Stackhouse & Wells, 1997).

- ◆ The psycholinguistic perspective views children's speech difficulties as a result of a deficit or impairment at one or more levels of the speech processing chain. Psycholinguistic models of the speech processing chain allow hypotheses regarding underlying deficits in perception, cognitive-linguistic and motor skills that result in different types of speech disorder.

One widely accepted dichotomy within the term 'speech disorders' is the differentiation of phonetic from phonemic errors (Elbert, 1992; Gierut, 1998). Phonetic errors are articulatory, with a motoric basis for a difficulty in producing specific sounds. Phonemic errors have a cognitive or linguistic basis: the processes of abstracting, storing or accessing phonological information are affected (Chiat, 1994; Dodd, Leahy & Hambly, 1989). Phonemic errors involve the way sounds are used contrastively to give meaning to words (Dinnsen, 1984). A child with a speech disorder may have both phonemic and phonetic errors (Elbert, 1992). In this thesis the term speech disorder refers to phonemic and/or phonetic errors, while phonological disorder is used to refer specifically to phonemic errors.

Most speech disorders do not have an obvious cause: the child has normal hearing, intelligence, social, emotional and behavioural skills (Gierut, 1998). Dodd (1995) outlined a differential diagnosis procedure for these children whose speech disorder has no known aetiology. A thorough description of the child's speech is the first step in this procedure. Fey (1992) identified five variables that a description of a child's speech should include:

- ◆ Phonetic repertoire: A description of the child's articulation skills - the range of sounds used.

- ◆ Phonemic repertoire: A description of the phonemic contrasts marked - the child's patterns of marking contrasts regardless of accuracy.
- ◆ Phonological processes: Analysis of the patterns of sound usage that predict how the child modifies the adult target (Elbert & Gierut, 1986).
- ◆ Phonotactics: A description of the phonotactic skills and constraints - the syllable shapes used.
- ◆ Consistency of production: A description of the consistency of a child's production of the same phonological unit in different and identical contexts.

A thorough description of the speech disorder in terms of these variables, in addition to consideration of possible causal factors (e.g., the child's communication environment) and the severity of the disorder (e.g., effect on intelligibility), allows a more specific diagnosis of the impairment. Previous research indicates four subgroups of children with speech disorder (Bradford & Dodd, 1994; Brierley, 1987; Dodd & McCormack, 1995). A psycholinguistic perspective has allowed hypotheses to be tested regarding the factor/s or deficit/s underlying the different types of disorder. The level of breakdown in the speech processing chain for each subtype has been identified. The four subgroups are:

- ◆ *articulation impairment*: an inability to produce a perceptually acceptable version of particular phonemes, either in isolation or in any phonetic context. Children may consistently produce a specific distortion (e.g., lateral lisp) or substitute another phoneme (e.g., [w] for /r/) (Grundy, 1989). Articulation errors are due to a peripheral problem where the wrong motor program for the production of specific speech sounds has been learned (Fey, 1992).
- ◆ *delayed phonological skills*: a phonological system similar to younger, normally developing children. Although most phonemes can be articulated, there is a discrepancy between

the phonological processes observed and the child's chronological age. The reasons for delayed phonological development include an impoverished language learning environment, slower neurological maturation, or general cognitive delay (Powers, 1971).

- ◆ *consistent deviant disorder*: systematic use of deviant phonological rules, i.e. error patterns that are atypical of normal phonological development (e.g., deleting all syllable initial consonants) (Ingram, 1989; Leonard, 1985). An impaired ability to abstract knowledge about the nature of the phonological system causes these errors (Dodd & McCormack, 1995). For example, Brierley (1987) found that children with consistent deviant phonology were poorer than other speech impaired children on tasks of phonological awareness, such as recognition of alliteration and rhyme. These children have poor understanding of the phonemic rules of the language when assessed on a legality awareness task (Dodd, Leahy & Hambly, 1989). This cognitive deficit arises at the internal organisational level of the speech processing chain (Grundy, 1989).
- ◆ *inconsistent speech disorder*⁴: variable production of the same words or phonological features in the same contexts. Children who make inconsistent errors have intact knowledge of the phonological system but find it difficult to plan motor sequences (Bradford & Dodd, 1996). For example, Bradford and Dodd (1994) found that children with inconsistent speech had difficulty formulating a plan for timing and sequencing phonetic segments when they were required to learn to produce novel words.

⁴ Inconsistent speech disorder is distinct from Developmental Verbal Dyspraxia - although both disorders are characterised by inconsistency (refer to Ozanne, 1995).

5.4 PHONOLOGICAL DISORDER IN LANGUAGES OTHER THAN ENGLISH

If categorisation in terms of type of surface speech errors is valid, then the patterns - articulation, delay, deviant consistent and inconsistent errors - should be apparent in the speech of phonologically disordered children learning languages other than English. Information is limited, however, about phonological disorder in other languages (see: Bortolini & Leonard, 1991: Italian; Yavas & Lamprecht, 1988: Portuguese; Nettelbladt, 1983: Swedish; Zhu, in preparation: Putonghua).

One study (So & Dodd, 1994) reported the speech error patterns of 17 monolingual Cantonese children consecutively referred for assessment of disordered speech. Two had difficulties articulating specific speech sounds (e.g., distorted production of /s, ts, ts^h/); eight showed delayed development (e.g., a child aged 5;1 years realising /s, ts/ as a plosive, /saj/ ⇨ [taj] when the process of stopping should be suppressed by 3;6 years, according to So & Dodd, 1995); five used non-developmental phonological rules (e.g., /s/ is realised as [h], /si/ ⇨ [hi]); and two made inconsistent errors (e.g., /kw/ ⇨ [gw, w, f, deleted/). Thus, the same distinctive surface error patterns of speech disorder occur in Cantonese and English. Similarly, Fox (1997) described the speech errors of monolingual German children on waiting lists for therapy. All four subgroups of speech disorder were identified. Further, Topbas and Konrat (1996) described cases of monolingual Turkish children with speech disorder whose errors reflect subgroups of inconsistency and the use of error patterns that are atypical of normal phonological acquisition.

This research indicates that the classification of subgroups of children with speech disorder is valid. The cross-linguistic similarities of the types of speech disorders suggests that the deficits underlying disorder are independent of the phonological system *per se*. The surface

speech errors reflect the underlying deficit/s in the speech processing mechanism regardless of the phonological system of the language being acquired. The effect of these deficits on the speech of bilingual children has not been investigated previously.

5.5 PHONOLOGICAL DISORDER IN BILINGUAL CHILDREN

The literature about bilingual children with phonological disorder is very scarce. This is probably due to the inherent difficulties facing monolingual English-speaking speech-language pathologists required to assess bilingual children: they can only speak one of the child's languages; they have difficulty eliciting important case history information; they lack knowledge about the linguistic structure of the child's other language; there are no norms for monolingual development of many languages; there are few norms for bilingual children acquiring two languages (although see Chapter 2: Cantonese-English and Chapter 4: Punjabi-English); and there is often minimal knowledge about issues arising from bilingual language development (Yavas, 1998). Romaine (1989) points out for example, "many professionals such as speech therapists view normal language mixing as harmful and are therefore liable to give advice to parents which is not in keeping with the realities of normal bilingual development" (p.213).

The diagnosis of disorder requires differentiation of:

- ◆ difficulty due to inadequate or minimal exposure to either or both of the languages (Roseberry-McKibbin, 1994), versus
- ◆ normal bilingual differences to monolingual development of either or both languages (discussed in Section I of this thesis) versus
- ◆ difficulty that "stems from a fundamental language impairment mechanism" (Stokes & Duncan, 1989). Diagnosis of disorder requires that evidence of disorder be established for both languages (Juarez, 1983; Long, 1994).

Without understanding the process of normal bilingual development it is difficult to make the differentiation between these three circumstances.

Yavas (1998) discussed the difficulty of differentiating normal bilingual differences from error patterns indicative of disorder in bilingual children. He suggested that errors should be analysed with reference to the phonology of the ambient languages. He said that “it is imperative for the speech-language pathologist to have accurate information regarding the variety of the first language of the child and have access to the normative data on this variety” (p.226). However, there is often limited information about the nature of the languages, and normative monolingual data is even more rare. Yavas also considers that “data on the normal development of the two languages separately, although necessary, will not be adequate, and the important information will come from further data on the normal development of the bilingual children” (p.227).

Despite the inherent difficulties, bilingual children provide a unique opportunity for testing hypotheses about factors affecting language acquisition (de Houwer,1995; Meisel, 1990). The various deficits hypothesised as underlying speech disorder in monolingual children can be tested by looking at bilingual children with speech disorder. If there is a single speech processing mechanism that processes both of the bilingual child’s languages then the error patterns should be characteristic of the *same subgroup* of disorder *in both* languages. Alternatively, evidence of different characteristics of disorder may identify inadequacies in current models of phonological processing.

Gierut (1998) states, “The most appropriate diagnostic and treatment procedures for children with phonological *differences* due to native language differences, dialect differences, or bilingualism are concerns receiving increased research attention” [italics added] (p.S86). However, the need for *diagnosis* and *treatment* of normal phonological differences is

questionable. That is not to say that a speech-language pathologist could not have a valid role in working with this client group, but as Gierut acknowledges “these children do not necessarily have a phonological “disorder”” (p.86). The danger for bilingual children is that their disorder may not be recognised, and that the speech-language pathologist with a large caseload will not consider their needs fully.

In the United States of America it is mandated in law that children must be evaluated in their ‘native language’ (Public Law 94-142, cited in Mann & Hodson, 1994). Bilingual children in the USA must have a disorder in their native language in order to qualify for speech services (position paper of ASHA, 1985). Despite these requirements there are few formal speech or language assessments for bilingual children.

Literature available regarding the assessment of bilingual children concentrates largely on the ‘challenge’ of working with bilingual children and the practical issues of working with interpreters, cultural differences, and admonitions not to simply modify assessments designed for monolingual populations (see special issue of *Seminars in Speech and Language*, Vol 15(2), 1994). Although most guidelines for working with bilingual children advocate providing intervention in the child’s stronger (usually their first) language or both languages simultaneously, there has been almost no research into the effect of, efficacy of, or rationale for, different strategies of treating bilingual children with speech disorders. However, there has been some research into the effect of therapy for bilingual children with language disorders.

5.6 BILINGUAL LANGUAGE INTERVENTION

For a child diagnosed with language delay or disorder, bilingualism is usually considered to be an aggravative, if not causative, factor (Thordardottir, Weismer & Smith, 1996). One of

the consequences of this view is often advice to either eliminate one of the child's languages or at least target the language required for education. There are conflicting opinions regarding the language that should be targeted in intervention for bilingual children with language delays or disorders. Carrow-Woolfolk and Lynch (1982, pp.441-442) recommend that:

The severely language disordered child should be taught one language only and the language of the home and the school should be the same whenever possible. For children with moderate language disorder a single language should be used for instruction, but the language of the home may differ.

Duncan and Gibbs (1989) argue strongly against this view because of the implicit assumptions on which it is based: (a) that language disorder ameliorates more efficiently when language input is restricted and monolingual; and (b) that language is independent of social and cultural environments - where bilingualism is an 'optional extra' rather than a necessary component of living within a bilingual community. The elimination of one of the child's languages has also been criticised because the child's first language is often viewed as an important tool in the development of the second language. According to this view, elimination of the first language would actually make the task of acquiring the second language more, rather than less, difficult (Thordardottir, Weismer & Smith, 1996).

The literature indicates two strategies for successfully facilitating language development in bilingual children with language delay or disorders. The first intervention strategy involves targeting both of a bilingual child's languages. This strategy has been shown to promote learning in both languages (Bruck, 1978, 1982, 1984; Duncan & Gibbs, 1989; Thordardottir, Weismer & Smith, 1996). An alternative strategy involves targeting the child's native or more proficient language. This strategy has also been shown to be more efficient in terms of length of treatment required and the strategy facilitated language

development in the child's other language (Anderson, 1994; Cummins, 1987; McLaughlin, 1984; Perozzi, 1985; Perozzi & Sanchez, 1992).

5.7 PHONOLOGICAL INTERVENTION

The aim of speech pathology intervention is to facilitate either accurate articulation of sounds, and/or conceptual re-/organisation of phonological information. (Gierut, 1998). Intervention for children with speech disorders can be evaluated in terms of treatment efficiency (comparison of different treatment methods) and treatment effects (the type and extent of change) (Gierut, 1998).

5.7.1 TREATMENT EFFICIENCY

As discussed in Section 5.3, research has shown that different deficits underlie the different surface error patterns of children with different types of speech disorder (Bradford-Heit, 1996; Dodd, 1995). Therefore, intervention targeting the primary area of deficit is likely to be more effective than other treatment techniques (Elbert, 1992). There are a wide range of treatment programs that have been developed that differ in terms of structure, implementation and focus (reviewed by Gierut, 1998).

Treatment programs can be divided along the two broad diagnostic categories outlined earlier: sensory-motor approaches that target phonetic errors (e.g., Costello & Onstine, 1976; Van Riper & Emerick, 1984; Winitz, 1975) and cognitive-linguistic approaches that target phonemic errors (e.g., Dean, Howell, Waters & Reid, 1995; Gierut, 1989; Hodson & Paden, 1991; Weiner, 1981). However, as Elbert (1992) stated, "treatment procedures have not focused on the type of error presented by the child" (p.244). In reports of new treatment methods or efficacy studies, the effectiveness of different therapy programs for children making different types of errors has not been evaluated routinely.

Bradford-Heit (1996) investigated different therapy approaches with children with different types of disorder. This study showed that *phonological contrast* therapy (metaphonological approach: teaching rules through targeting contrastive use of phonemes) was most successful with children who make consistent non-developmental phonological errors. A *core vocabulary* approach (teaching a small set of words to be produced consistently) markedly enhanced the consistency of production in children with inconsistent speech. Dodd and Iacono (1989) and Dodd, McCormack and Woodyatt (1994) have also reported the effectiveness of core vocabulary therapy for increasing consistency of production. Bradford-Heit's study also highlighted the possibility that "management of some children with speech disorder may not simply involve choosing one appropriate intervention approach, but selecting and sequencing a range of approaches to address different underlying deficits" (p.357).

Another study has evaluated the effect of a specific treatment approach, a *whole language* approach, with children with speech disorder due to different underlying deficits (Alcorn, Jarrett, Martin & Dodd, 1995). The results of this study and another by Hoffman, Norris and Monjure (1990) indicated that children with delayed phonological development could benefit from a *whole language* approach. However, children with other types of speech disorder do not specifically benefit from a general whole language approach.

The different response of children with different types of speech disorder to a specific treatment approach is one way of evaluating the process of remediation. The various treatment approaches are all based on different theoretical assumptions, and target different sensory-motor, cognitive-linguistic or phonological planning skills in differing ways. For example, it seems reasonable to assume that a child diagnosed with a sensory-motor deficit will not specifically benefit from a treatment program targeting re-organisation of linguistic information. In this way the response to treatment can be used as

a validation of theoretical diagnostic assumptions. The response to treatment can also be used to evaluate the effectiveness of a treatment approach in targeting the specific skill or deficit it has been designed to target.

5.7.2 TREATMENT EFFECTS

The changes in a child's speech production following intervention are investigated to determine whether treatment has had any effect. Treatment of monolingual children with speech disorder is often evaluated in terms of generalisation of the effect of treatment.

Gierut (1998) differentiated types of generalisation effects:

- across lexical items: a sound taught in a small number of words generalising to other untaught words that contain the target sound;
- across phonetic contexts: a sound taught in a given phonetic context (e.g., syllable-initial position) generalising to other phonetic contexts;
- across levels of linguistic complexity: a sound taught in a specific linguistic context (e.g., elicited single words) generalises to other linguistic contexts (e.g., conversational speech);
- across settings: a sound taught in one physical or communicative environment (e.g., with a clinician in a clinical room) generalising to another environment (e.g., with same-age peers during play);
- across sound categories: treating one aspect of a sound generalising to other sounds that share that aspect (e.g., teaching continuous airflow for one fricative resulting in generalisation to all other fricatives);
- across error patterns: teaching one sound pattern contrast generalising to all words in error due to that pattern (e.g., targeting final consonant deletion by teaching words with final /t/ can generalise to use of all final consonants);

- across sounds with implicational relationships: teaching sounds in one category (e.g., fricatives) generalising to sounds from another category (e.g., stops).

The generalisation effect of phonological therapy provided in only one of a bilingual child's languages has not been investigated. This unique treatment effect may provide some interesting insights into the process of remediation of specific deficits. The effect of treatment on a bilingual child may indicate the level of remediation: is the treatment targeting language-specific phonological patterns or underlying deficits in the phonological processing mechanism.

There is only one report of research that has specifically looked at generalisation across bilingual children's languages. McNutt (1994) reported evidence from seven bilingual French-English children. A motor based articulation therapy program provided in English, generalised into French for all the children. The children in the study had phonetic errors that were identical across their languages. Intervention successfully resolved the motoric errors - indicating that the errors were peripheral and not embedded in language-bound constraints. Intervention for a range of children with different speech disorders is required to investigate this effect further.

5.8 AIMS OF THE INVESTIGATION

This chapter has reviewed the literature pertinent to an investigation of the nature and treatment of speech disorder in bilingual children. Case studies of children from a range of language-combinations with disordered speech are presented and discussed in Chapters 6 and 7. The efficiency and effects of treatment for two bilingual children with different underlying deficits are presented in Chapter 8.

The general aim of the study (Chapters 6 to 8) was to provide detailed quantitative and descriptive data on the speech skills of children with speech disorder in both of their languages, and to document any changes occurring during the intervention program. In addition to the clinical management questions outlined in section 5.1, several theoretical questions were addressed:

1. Are the same subgroups identified in monolingual children evident in bilingual children with speech disorder?
2. Is there a single-underlying deficit (that will result in the same type of disorder in each language)? Alternatively, are there language-specific deficits (that will result in different types of disorder in the two languages, or disorder in one language but not in the other)?
3. If a child has the same type of speech disorder in both languages, do they make identical errors in each language?
4. Are there unique types of speech disorder in bilingual children due to specific bilingual processing?
5. Will intervention generalise across languages? And if so, are the same types of generalisation evident in monolingual children evident across languages?

5.9 HYPOTHESES

It was hypothesised that:

1. A bilingual child will have the same type of speech disorder evident in both languages because of a single underlying deficit.
2. Although a bilingual child will have the same type of speech disorder, the error patterns may be language-specific depending on the level of the breakdown in the speech-processing chain.
3. The same subgroups of children with speech disorder identified for monolingual children will be evident in bilingual children with speech disorder.

4. There may be a specific type of speech disorder unique to bilingual children (although similar to children making deviant consistent errors), resulting from an inability to differentiate the two phonological systems due to a cognitive-linguistic deficit in abstracting language-specific information.
5. Intervention will generalise across languages when the deficit in the speech processing chain is targeted directly. Intervention treating language-specific surface errors will not generalise across languages.

CHAPTER 6:
DESCRIPTION OF
SPEECH DISORDER IN BILINGUAL
CHILDREN

6.1 INTRODUCTION

Detailed case studies of seven successive bilingual children are presented in this chapter. Three language combinations were included in the study: Italian-English, Cantonese-English and Punjabi-English. The questions addressed are:

- Are the speech errors characteristic of a particular subgroup of speech disorder?
- Do the speech errors indicate the same underlying deficit for both languages?
- Is there evidence of differentiation of the phonological systems?
- Are the error patterns typical of monolingual children in each language?

6.2 BILINGUAL ITALIAN-ENGLISH CHILDREN WITH SPEECH DISORDER

Normal monolingual acquisition of Italian has been described (Bortolini, 1995). Information is also available about speech *disorder* in children acquiring Italian (Bortolini & Leonard, 1991). The phonological development of English and Italian is similar; there are normal simplification processes used by children learning both languages (e.g., assimilation, weak syllable deletion). Phoneme acquisition order for each language is also quite similar (comparing norms presented by Grunwell (1987) for English and Bortolini (1995) for Italian). However, two important differences are evident: the phonotactic structures allowed (e.g., lack of final consonants in Italian); and specific error-patterns (e.g., [l] substituted for /r/ in Italian rather than the common English substitution of [w]; more frequent use of migration and metathesis in Italian due to large number of polysyllabic words). These differences reflect the characteristics of Italian phonology. Phonologically *disordered* monolingual Italian and English children's errors are similar (e.g., unusual cluster deletion, initial consonant deletion and backing) (Bortolini & Leonard, 1991). There are no bilingual Italian-English normal phonological development data available.

6.2.1 CASE STUDY 1: GIUSEPPE

6.2.1.1 BACKGROUND INFORMATION

Giuseppe was assessed by the investigating speech-language pathologist at the age of 4;2 years. His birth history was without incident and he has experienced no major medical problems. Giuseppe's hearing is within normal limits. His parents reported that his developmental milestones were normal. No family history of speech, language or academic problems was reported. Giuseppe's parents are fluent speakers of both Italian and English. Giuseppe was exposed to both Italian and English from birth. His grandparents who live in the family home only speak Italian. Until he started attending kindergarten at age 3;8 years Giuseppe's grandmother cared for him during the day while his parents worked. The kindergarten language environment was English. Giuseppe's parents estimated that equal proportions of English and Italian are used at home. Giuseppe has a seven year old sister with whom he always speaks English. Giuseppe's parents are not concerned about his language comprehension in either language, however, they find that most people outside the family have difficulty understanding his speech in either Italian or English.

6.2.1.2 SPEECH THERAPY HISTORY

Giuseppe was first referred to a speech-language pathologist when he was aged 3;2 years because of his unintelligible speech. The initial assessment of Giuseppe's English phonology showed that he used mainly the sounds /p, b, m, n/ and a range of vowels. The speech-language pathologist was concerned that exposure to two languages might be confusing Giuseppe and suggested that the family stop speaking Italian. Giuseppe's parents were not prepared to do this as Giuseppe's grandparents do not speak English.

They were angered by the speech-language pathologist's response to the difficulties Giuseppe was having and decided not to continue attending the clinic.

Giuseppe started attending kindergarten at age 3;8 years. The teacher was very concerned about Giuseppe's speech and referred him to another speech-language pathologist. Assessment at this stage showed that Giuseppe had added the consonants /t, d, l, j/ to his phoneme repertoire. The speech-language pathologist was concerned about his variable productions of words (e.g., Giuseppe pronounced his own name as /dɛpi/, /ɛpi/, /bɛpi/ within the same session). The speech-language pathologist only assessed Giuseppe's English speech, however, she was aware that he was also unintelligible in Italian. She encouraged Giuseppe's parents to maintain his Italian because they thought he was more confident in Italian.

Intervention concentrated on introducing some of Giuseppe's missing phonemes. Intervention was provided only in English. Articulation of /s, k, w/ was targeted as well as the phonological process of final consonant deletion. The speech-language pathologist was concerned that Giuseppe remained very unintelligible after 6 months of weekly therapy, although he had started using the additional phonemes. She referred Giuseppe for assessment by the investigating speech-language pathologist at age 4;2 years.

6.2.1.3 ASSESSMENT

6.2.1.3.1 *Language Screen*

The Test of Auditory Comprehension of Language-Revised (Carrow-Woolfolk, 1985) was given to measure Giuseppe's understanding of English. The results indicated that his receptive language skills were within normal limits. Expressive language was difficult to

assess because of the unintelligibility of Giuseppe's speech. Giuseppe's Italian language comprehension was not assessed formally, although neither his parents nor the Italian-speaking speech-language pathologist who transcribed his speech were specifically concerned about his language comprehension.

6.2.1.3.2 Oro-motor Skills

Performance on an informal oro-motor assessment suggested age-appropriate oro-motor skills. No struggle or groping behaviour was observed during spontaneous speech.

6.2.1.3.3 Speech Assessment

Giuseppe was assessed in his home by a fluent Italian-speaking speech-language pathology assistant and an English-speaking speech-language pathologist. Spontaneous speech samples were elicited in both languages but Giuseppe was mainly unintelligible in connected speech so most of the connected speech data could not be analysed. Single word responses were needed to ensure that the target word was identifiable. The Prove per la Valutazione Fonologica del Linguaggio Infantile (PFLI; Bortolini, 1995) that samples all phonemes in Italian was administered to assess his Italian phonological system. The Goldman Fristoe Test of Articulation (GFTA; Goldman & Fristoe, 1986) was given in English. The assessors attempted to repeat what Giuseppe said for transcription purposes and to check their understanding. Giuseppe was not frustrated by his unintelligibility and would often repeat the words until the right word was interpreted.

The assessment session with Giuseppe was recorded using a Marantz CP130 audio cassette recorder and a Sony lapel microphone. A bilingual Italian-English-speaking speech-language pathologist transcribed both the English and Italian speech samples collected. The English-speaking speech-language pathologist also transcribed the English speech

elicited. The few differences in the transcription were discussed and consensus reached between the two transcribers. A phoneme was considered to be absent if it was not produced in either elicited, spontaneous or imitated speech contexts in any word position. Phonological processes were considered present if there were at least five examples of the process in the speech sample.

6.2.1.4 RESULTS

6.2.1.4.1 Italian Phonological Error Data

Intelligibility of single words was fair, however, connected speech was very difficult to understand. Giuseppe used a wide range of phonotactic structures. His phonetic inventory included 15 of the 23 consonants. The phonemes missing from his phonetic inventory were those that usually develop later in monolingual Italian children: /dz, ts, dʒ, tʃ, r, ɲ, ʎ, w/. Giuseppe also used a bilabial fricative, a non-Italian phoneme, on several occasions.

Phonological analysis of Giuseppe's speech was difficult due to his unpredictable error pattern. However, inspection of the speech data revealed the inconsistent use of the following phonological processes: stopping, voicing, devoicing, assimilation, epenthesis, weak syllable deletion, backing, fronting, and liquid deviation. Exceptions to all error patterns were evident in Giuseppe's speech. There were also numerous examples of contradictory substitutions (e.g., /t/ → [k] and /k/ → [t]). Cluster reduction was the only phonological process applied consistently. Giuseppe's speech contained no clusters, however, the way that he simplified the clusters varied.

The percentage of consonants, vowels and phonemes produced correctly in the two speech assessments are presented in Table 6.1.

Table 6.1 Percent correct in Italian and English: Giuseppe

	Consonants	Vowels	All Phonemes
PFLI: <i>Italian</i>	42%	90%	63%
GFTA: <i>English</i>	40%	92%	58%

The inconsistency of Giuseppe's errors was extreme (see Figure 6.1). For example, of the 8 words elicited with word initial /k/, 4 words started with /k/, 2 with /t/, 1 with /l/ and the other with /p/. Another example of inconsistency appeared in words containing the phoneme /l/. For example, Giuseppe produced 18 words with word medial /l/: 11 of these words had a correct /l/ production, 3 were replaced with /m/, 2 with /n/, and 2 with /b/. The only consistent substitution pattern in the data was [l] for /r/. All the other phonemes had at least two different substitutions; no sound was consistently produced correctly.

Giuseppe produced 18 words in the sample more than once. Across his productions of the same word his speech was also inconsistent. Each of the 18 words was produced differently, however, these data may be misleading. Giuseppe repeated words when the assessor had mistaken the word he was targeting: possibly he was changing his production because he had been misunderstood. When Giuseppe imitated words his production was closer to the target word than his spontaneous production had been. Unfortunately specific assessment of consistency (e.g., eliciting a set of words on several occasions in the same linguistic context) was not undertaken.

ʁ															
k/g			■			■								■	■
ɲ															
j		■								■		■			■
tʃ/ɟʃ															
ʃ				■		■				■	■				
r															
l/n		■	■					■	■			■	■	■	■
s/z				■			■			■					
ts/dz															
t/d	■			■	■	■	■			■	■			■	
f/v				■	■							■			
m	■		■				■	■			■		■		
w															
p/b	■	■			■			■				■		■	
	p/b	w	m	f/v	t/d	ts/dz	s/z	l/n	r	ʃ	tʃ/ɟʃ	j	ɲ	k/g	ʁ

Bilabial/Anterior

Target Phonemes

Glottal/Posterior

Figure 6.1 Matrix of Italian phoneme substitutions.

Giuseppe's realisation of individual phonemes in Italian are shown in this figure. The target phonemes are along the horizontal axis and the phonemes Giuseppe used are along the vertical axis. A child with consistent accurate speech would just have a single horizontal line (darker squares). An articulation error, or consistent phonological substitution would result in an uneven line but only one box would be shaded for each target sound. A child with inconsistent speech will have a range of boxes shaded for each of their variable errors. For example, the figure shows that Giuseppe used p/b, m, and t/d when attempting to produce p/b in various positions in various words.

6.2.1.4.2 *Comparison with monolingual Italian children*

The Prove per la Valutazione Fonologica del Linguaggio Infantile (Bortolini, 1995) provides information about the normal acquisition of Italian phonology. A normally developing child has usually acquired all but three of the 23 phonemes of Italian at Giuseppe's age. Giuseppe's phoneme inventory was made up of the earliest developing sounds.

It is difficult to compare Giuseppe's phonology with the normative data because of his inconsistency. Bortolini (1995) indicated that by four years of age only the developmental phonological process of consonant harmony is still commonly used by normally developing children. The other processes commonly used by children at age 3;6 years include weak syllable deletion, metathesis, epenthesis, vowel harmony, backing and devoicing. Most of the processes that Giuseppe applied inconsistently were developmental. For example, Giuseppe most commonly substituted a nasal for the phoneme /l/. Bortolini and Leonard (1991) found that normally developing children usually substitute either [r] or [n] for /l/. However, there was also evidence of atypical processes. For example, Giuseppe often omitted the stop rather than the sibilant from clusters. Bortolini and Leonard found that only children with disordered phonology reduced clusters in this way. They also cited contradictory processes as indicative of disorder in Italian children. Giuseppe had several contradictory processes: backing and fronting; voicing and devoicing; substitution of /n/ ⇔ [ŋ], yet /l/ ⇔ [n].

The key indicator of disorder in Giuseppe's speech was his inconsistency. Even though the general order of phoneme acquisition and the application of generally developmental phonological processes were similar to normally developing younger children, inconsistency of the severity and nature evident in Giuseppe's speech is not a characteristic

of normal development (Bortolini, 1995). Improvement in production in an imitation condition has also been shown to be a characteristic of inconsistent deviant speech disorder (Bradford-Heit, 1996). As stated earlier, Giuseppe's speech was closer to the target when he imitated the assessor.

6.2.1.4.3 English Phonological Error Data

Giuseppe's English phonetic inventory contained 16 of the 24 consonants. The phonemes missing were /f, v, θ, ð, ʒ, r, tʃ, dʒ/. He used all the vowels of English. He also had a wide range of phonotactic structures.

Giuseppe's connected speech was very rapid and his unintelligibility made accurate phonological analysis difficult. For this reason the data presented will be from his productions on the GFTA. Giuseppe was less willing to repeat his production of the target words in the GFTA than he was while doing the PFLI. Possibly his reluctance was due to there being only one item to be named on each page and therefore it was obvious what he was trying to say. There were also several items in the GFTA that Giuseppe did not know so a number of his responses were imitations of the assessor.

Giuseppe inconsistently applied the following phonological processes in his English speech: stopping, fronting, gliding, assimilation, weak syllable deletion, and final consonant deletion. As in Giuseppe's Italian phonology there were exceptions to all the error processes evident. Cluster reduction was consistent, however, the way the clusters were reduced varied (e.g., /skw/ ⇒ [b], /st/ ⇒ [k], /sl/ ⇒ [t]). Table 6.1 presents the percent consonants, vowels and phonemes correct. Considering the high number of consonants in error the low number of vowel errors is significant.

The inconsistency evident in Giuseppe's Italian was also evident in his English phonology (see Figure 6.2). Most of the phonemes had a range of up to four different realisations. For example, /l/ ⇒ [l], [b], [j], or [w]; or /f/ which was absent from his inventory was replaced by [s], [p], [b], [l] and [z]. Not all of Giuseppe's phonemes had such a wide variability: the phonemes that Giuseppe acquired first tended to be more stable than recently acquired phonemes. However, only /d/, /m/ and /h/ were correct in all positions targeted.

Unlike the sample of Giuseppe's Italian speech there were only a few English words that he said more than once so it was difficult to determine the consistency of his productions across the same lexical item. Seven words were said twice: only two of the words were said exactly the same way each time. These limited data suggest that Giuseppe's English phonology reflected the variable productions of the repeated words evident in his Italian.

6.2.1.4.4 Comparison with monolingual English children

Grunwell (1987) and Dodd (1995) described the normal developmental process of English phonological acquisition. A normally developing child of 4 years of age would usually have acquired most of the phonemes except /θ, ð, r/. Giuseppe should have, but had not, acquired /f, v, ʒ, tʃ, dʒ/ by age 4;2 years. The information from his previous assessments suggests that he acquired the phonemes in a similar order to normally developing children, but that his acquisition was delayed. The phonemes /w, k, s/ were specifically taught to him in speech therapy.

The phonological processes that Giuseppe used were all normal developmental processes. Grunwell (1987) indicated that the processes still common in the speech of a 4 year old are

6.2.1.5 COMPARISON OF GIUSEPPE'S ITALIAN AND ENGLISH PHONOLOGICAL PATTERNS

Across his two languages Giuseppe had a total phonemic inventory of 16 phonemes. Table 6.2 presents the distribution across both languages. There were three phonemes present in one language but absent in the other: /f/ and /v/ present only in Italian; and /w/ present only in English. It is possible that /w/ was part of his inventory in Italian but because it only occurs as the second element in a cluster Giuseppe might have always simplified the cluster by omitting the /w/. He was missing 14 phonemes. Of these 11 phonemes, 9 of the phonemes were specific to one of the languages (i.e., not shared phonemes), and the other 2 phonemes were missing in both languages: /tʃ/ and /dʒ/.

The data presented in Table 6.1 shows that Giuseppe was having equal difficulty with the consonantal system in both languages. He was very difficult to understand in either language.

The phonological processes that Giuseppe used in his two languages were similar. As Table 6.2 shows there were six phonological processes that were the same in both languages and four that were specific to only one language. Even though some of the processes were the same the errors were not necessarily identical in each language. For example, in Italian, Giuseppe substituted [l] or [n] for /r/ because of liquid deviation. In English, however, Giuseppe usually substituted /r/ with [w] under the process of gliding. Giuseppe, therefore, used different substitution patterns, that reflected the ambient phonology, in each of his languages. These error differences also indicate that Giuseppe had two separate phonological systems.

Table 6.2 Comparison of Giuseppe's Phoneme Inventory and Phonological Processes in Italian and English

	Italian	English
Phoneme Inventory		
Present - <i>shared</i>	m, n, p, b, t, d, k, g, s, z, ʃ, l, j, f, v	m, n, p, b, t, d, k, g, s, z, ʃ, l, j, w
Absent - <i>shared</i>	tʃ, dʒ, r, w	tʃ, dʒ, r, f, v
Present - <i>specific</i>		h, ŋ
Absent - <i>specific</i>	dz, ts, ɲ, ʎ	θ, ð, ʒ
Processes		
<i>Shared</i>	Cluster Reduction Stopping Fronting Assimilation Weak Syllable Deletion Liquid Deviation	Cluster Reduction Stopping Fronting Assimilation Weak Syllable Deletion Liquid Gliding
<i>Specific</i>	De-/Voicing Epenthesis Backing	Final Consonant Deletion

NB Phonemes in bold are shared phonemes used in only one language.

Four phonological processes were apparent in only one language. Their presence may also relate to the ambient phonology; for example, final consonant deletion was evident only in English, however, Italian doesn't have final consonants (except in occasional loan words). One possibility is that final consonant deletion may be prevalent in many bilingual Italian-English children as a normal interaction between the two phonologies but without normative bilingual data this cannot be determined.

The other, very significant pattern in both of Giuseppe's languages was his inconsistency. In both languages he was inconsistent across phonemes and across repeated word productions. Inconsistent deviant speech disorder is thought to be caused by a phonological planning deficit. The phonological plans that these children store may be

incorrect or underspecified: “although they may be able to physically produce the required phonological string, they do not appropriately specify the sequence in the lexicon for later production” (Bradford-Heit, 1996, p.205). A phonological planning deficit may underlie Giuseppe’s inconsistent speech in each of his languages.

6.2.2 CASE STUDY 2: STEPHANIE

6.2.2.1 BACKGROUND INFORMATION

Stephanie was assessed by the investigating speech-language pathologist at the age of 4;4 years. Stephanie’s birth and medical histories were without incident and early developmental milestones were reached at appropriate ages. Her hearing was within normal limits. Two of Stephanie’s five sisters were seen for speech therapy when they were pre-schoolers. Stephanie’s mother was not overly concerned about her speech because it was not severe in comparison to the difficulties her sisters had experienced. Stephanie’s mother is a fluent speaker of Italian and English. Stephanie’s father does not speak Italian. Stephanie’s parents separated when she was 6 months old. Her primary carers, in addition to her mother, were her older sisters (aged 12, 15, 18, 20 and 21), and her grandmother.

Stephanie was exposed to both Italian and English from birth. Stephanie’s mother estimated that 50 percent of the language spoken in the home is Italian. Stephanie mainly speaks Italian with her mother and grandmother and English with her sisters. Stephanie started attending kindergarten at age 3;6 years. The kindergarten language environment is English. Neither her mother nor her teacher were concerned about Stephanie’s language comprehension or speech. Stephanie had not been referred to a speech-language pathologist. She was assessed as part of a larger research project assessing bilingual children’s normal phonological development.

6.2.2.2 ASSESSMENT

6.2.2.2.1 *Language Screen*

The Test of Auditory Comprehension of Language-Revised (Carrow-Woolfolk, 1985) was given to measure Stephanie's understanding of English. Results indicated receptive language skills within normal limits. Informal analysis of a spontaneous language sample indicated age appropriate expressive language. Stephanie's Italian language skills were not assessed formally although neither her mother nor the Italian-speaking speech-language pathologist who transcribed her speech were specifically concerned about her language development.

6.2.2.2.2 *Oro-motor Skills*

Performance on an informal oro-motor assessment suggested age-appropriate oro-motor skills. No struggle or groping behaviour was observed during spontaneous speech.

6.2.2.2.3 *Speech Assessment*

The same assessment procedure that was used with Giuseppe was used to assess Stephanie's speech.

6.2.2.3 RESULTS

6.2.2.3.1 *Italian Phonological Error Data*

Intelligibility of connected speech and of single words was good. Stephanie had a wide range of phonotactic structures. Her phonetic inventory included 21 of the 23 consonants. The phonemes missing from her phonetic inventory were the later developing phonemes

/ʃ, ʁ/. Stephanie also had a consistent phoneme distortion: the /r/ was not trilled as is required in Italian.

Phonological analysis of Stephanie's speech revealed the use of the following phonological processes: stopping, epenthesis, weak syllable deletion, fronting, cluster reduction, and liquid deviation. All the errors in Stephanie's speech were attributable to the phonological processes present. However, apart from cluster reduction, there were examples of correct productions of all phonemes in all positions apart from the two missing phonemes.

The percentage of consonants, vowels and phonemes produced correctly in the two speech assessments are presented in Table 6.3.

Table 6.3 Percent correct in Italian and English: Stephanie

	Consonants	Vowels	Total Phonemes
PFLI: <i>Italian</i>	68%	91%	78%
GFTA: <i>English</i>	61%	93%	73%

6.2.2.3.2 *Comparison with monolingual Italian children*

The two phonemes that were missing from Stephanie's phonemic inventory were the two phonemes that are usually acquired last in normally developing monolingual children.

All the phonological processes that Stephanie used were developmental. For example, Stephanie reduced most of her clusters in ways typical of normally developing children or she added an epenthetic vowel between the cluster elements. The only way that Stephanie's speech was different to that of a normally developing, younger, monolingual

child is her occasional gliding of liquids (e.g., /r/ ⇒ [w]), instead of the [l] substitution that Giuseppe used.

6.2.2.3.3 English Phonological Error Data

Stephanie's English phonetic inventory contained 20 of the 24 consonants. The phonemes missing were /θ, ð, tʃ, dʒ/. She used all the vowels of English. She also used a wide range of phonotactic structures.

Stephanie used the following phonological processes in her English speech: stopping, fronting, gliding, cluster reduction, weak syllable deletion, and final consonant deletion. As in her Italian phonology, Stephanie had examples of correct production of all the phonemes apart from the ones absent from her inventory. When applying the processes Stephanie consistently substituted the same phoneme for another (e.g., /k/ ⇒ [t] if in error). Table 6.3 presents the percent consonants, vowels and phonemes correct.

6.2.2.3.4 Comparison with monolingual English children

The phonemes missing from Stephanie's phonemic inventory were later developing phonemes in normal monolingual development (Grunwell, 1987). Stephanie had acquired /r/, which is often missing in a child her age, but she was still missing /tʃ, dʒ/ which she should have acquired.

The phonological processes that Stephanie used were all normal developmental processes. Grunwell (1987) indicated that the processes still common in the speech of a 4 year old are stopping and gliding. The other processes that Stephanie used are appropriate for younger children.

6.2.2.4 COMPARISON OF STEPHANIE'S ITALIAN AND ENGLISH PHONOLOGICAL PATTERNS

Stephanie had delayed phonological development in both languages. Her phonetic inventories and phonological processes in both languages were similar to younger, normally developing monolingual children. Across her two languages Stephanie was only missing three phonemes (/ʌ, θ, ð/) She also had three phonemes present in one language but not in the other: /ʃ/ present only in English; /tʃ, dʒ/ present only in Italian. Table 6.4 presents the distribution across both languages.

The data presented in Table 6.3 shows that Stephanie was having equal difficulty with the consonantal system in both languages. The phonological processes that Stephanie used in her two languages were similar. As Table 6.4 shows there were five phonological processes that were the same in both languages and two that were specific to only one language. The processes often realised similar error patterns in each language (e.g., /k/ ⇒ [t] in both English and Italian). Unlike Giuseppe, who had different error patterns for his errors for the phoneme /r/, Stephanie occasionally substituted [w] for /r/ in her Italian speech sample. She also used the same pattern of gliding evident in Giuseppe's speech: /r/ ⇒ [l]. It is possible that this error was due to Stephanie's inability to distinguish phonetically between the Italian trilled /r/ and the English alveolar approximant /r/. She used the same phone for both languages and when it was in error she used the same substitution.

Bortolini and Leonard (1991) discussed the influence of the ambient phonology on the ways that children acquire liquids. In English, liquids are often replaced with glides (e.g., /r/ ⇒ [w]). In Italian, where /j/ and /w/ occur only in a limited number of contexts, children substitute [l] for /r/. Bortolini and Leonard might consider her non-differentiation as an indication that she was unaware of the ambient phonology, however, it is likely that this is simply an example of under differentiation across her two phonological

systems. It is interesting to note that final consonant deletion was evident in Stephanie's speech also for the reasons mentioned earlier.

The data from Stephanie's phonology in Italian and English indicate that she had delayed phonological development. Bradford-Heit (1996) suggested that no specific deficit underlies delayed phonological development. However, you would expect the cause of the delay to affect both of a bilingual child's languages. Evidence suggested that, generally, Stephanie had differentiated her phonological systems: phonemes acquired in one language were not used in the other. However, there were great similarities between the simplification processes and errors in both languages.

Table 6.4 Comparison of Stephanie's Phoneme Inventory and Phonological Processes in Italian and English

	Italian	English
Phoneme Inventory		
Present - <i>shared</i>	m, n, p, b, t, d, k, g, s, z, l, j, f, v, r, w, tʃ, dʒ	m, n, p, b, t, d, k, g, s, z, l, j, f, v, r, w, ʃ
Absent - <i>shared</i>	ʃ	tʃ, dʒ
Present - <i>specific</i>	dz, ts, ɲ	h, ŋ, ʒ
Absent - <i>specific</i>	ʌ	θ, ð
Processes		
<i>Shared</i>	Cluster Reduction Stopping Fronting Weak Syllable Deletion	Cluster Reduction Stopping Fronting Weak Syllable Deletion
<i>Specific</i>	Liquid Deviation Epenthesis	Liquid Gliding Final Consonant Deletion

6.3 BILINGUAL CANTONESE-ENGLISH CHILDREN WITH SPEECH DISORDER

The normal bilingual phonological development of Cantonese-English children was presented in Chapters 2 and 3 of this thesis. Monolingual phonological development of each language has been well documented. Comparisons to monolingual and bilingual development for each language are therefore possible. Phonologically disordered Cantonese and English monolingual children's error patterns are similar, irrespective of language (So & Dodd, 1994).

6.3.1 CASE STUDY 3: JASON

6.3.1.1 BACKGROUND INFORMATION

Jason was born at full term after a normal pregnancy. He has had no serious illnesses or accidents; no serious ear infections or hearing problems. His parents report that his developmental milestones were normal. Jason's parents are fluent speakers of both Cantonese and English, although his mother's speech is characterised by a lateral articulation of /s/. Cantonese is the only language spoken at home, although Jason occasionally addresses his ten month old sister in English. Jason has acquired English through ten hours a week attendance, from age 3;3 years, at a childcare centre where English is spoken. When he turned four, he began attending the centre for 25 hours per week. Jason's only other exposure to English has been through television. His parents reported no concerns about his development of speech or language in either English or Cantonese. Although he has a history of stuttering, judged by his mother as quite severe, he has little difficulty with fluency now. Jason was assessed as part of a research project

into bilingual children's normal speech development. He was 5;2 years at the time of assessment.

6.3.1.2 ASSESSMENT

6.3.1.2.1 Language Screen

The Test of Auditory Comprehension of Language-Revised (Carrow-Woolfolk, 1985) was given to measure Jason's understanding of English. His results indicated that his receptive language skills were delayed: his age equivalent score was 45-47 months (at 62 months). Jason's Cantonese language comprehension was not formally assessed, although neither his parents nor the Cantonese speech-language pathologist that assessed his speech were specifically concerned about his language development.

6.3.1.2.2 Oro-motor Skills

Performance on an informal oro-motor assessment suggested age-appropriate oro-motor skills. No struggle or groping behaviour was observed during spontaneous speech.

6.3.1.2.3 Speech Assessment

Jason was assessed at his childcare centre by a native Cantonese-speaking speech-language pathologist (trained in Hong Kong) and then on a different day by an English-speaking speech-language pathologist. In both assessment sessions spontaneous language samples were elicited using picture books. The Cantonese Segmental Phonology Test (CSPT, So, 1992) that samples all phonemes in Cantonese was administered to assess his Cantonese phonological system. The Goldman Fristoe Test of Articulation (GFTA) was given in English.

The assessment session with Jason was recorded using a Marantz CP130 audio cassette recorder and a Sony lapel microphone. The reliability of the phonetic transcription of Jason's assessors was measured as part of the large group study reported in Chapter 2 (the same speech-language pathologists were involved in Jason's assessment). A phoneme was considered to be absent if it was not produced in either elicited, spontaneous or imitated speech contexts in any word position. Phonological processes were considered present if there were at least five examples of the process in the speech sample.

6.3.1.3 RESULTS

6.3.1.3.1 Cantonese Phonological Error Data

Jason's speech was intelligible, however, his frequent errors were noticeable. Jason used all the appropriate phonotactic constructions of Cantonese. His phonetic inventory was only missing one phoneme /l/, however, he consistently distorted the production of the phonemes /s, ts, ts^h/. Table 6.5 summarises the results of quantitative analyses of Jason's phonological errors in Cantonese. Table 6.6 summarises the results of qualitative analyses of Jason's phonological errors in Cantonese.

Phonological analysis of Jason's Cantonese speech data revealed the use of the following phonological processes: cluster reduction, consonant harmony, affrication, backing, nasalisation, and the blending of two words (e.g., /wui hoey/ ⇒ [hui]; /so ji/ ⇒ [soi]). The only process consistently applied was nasalisation of /l/ ⇒ [n], all the other processes were inconsistently applied. However, Jason's speech was consistent in that he produced words in exactly the same way each time he used them.

Table 6.5 Percent correct in Cantonese and English: Jason

	Consonants	Vowels	Total Phonemes
CSPT: <i>Cantonese</i>	86%	98%	92%
GFTA: <i>English</i>	58%	96%	72%

Table 6.6 Comparison of Jason's Phoneme Inventory and Phonological Processes in Cantonese and English

	Cantonese	English
Phoneme Inventory		
Absent	l	θ, ð, r
Distorted	s, ts, ts ^h	s, z, ʃ
Processes		
<i>Shared</i>	Cluster Reduction ^a	Cluster Reduction ^a
<i>Specific</i>	Consonant Harmony ^a Affrication ^a Backing ^b Nasalisation ^b Blending of two words ^b	Liquid Gliding ^c Deaffrication ^b Fronting ^a Stopping ^c Final Consonant Deletion ^a Voicing ^a

Notes:

a - delayed developmental phonological process

b - atypical (monolingual) phonological process

c - appropriate phonological process

6.3.1.3.2 Comparison with Monolingual Cantonese Children

So and Dodd's (1995) study of monolingual Cantonese-speakers using the CSPT (So, 1992), assessed 34 children aged between 60 and 65 months. It is possible, therefore, to compare Jason's performance with the performance of children of the same age. Only 1.4 percent of words were in error in the normative sample compared to 29 percent of the words pronounced by Jason. Only 11 percent of Jason's errors affected vowels, which is similar to the normative study's finding of 14.8 percent of errors affecting vowels. Jason's phoneme repertoire lacked only one phoneme, /l/, which is usually acquired by 48

months of age. Further, his articulation of the phonemes /s, ts, ts^h/ was distorted. In contrast, 90 percent of monolingual Cantonese children have acquired adequate articulation of all phones by 60 months of age. Jason also made a tone error which is unusual because tone acquisition is usually complete by two years in a monolingual context.

Jason used three atypical error patterns in Cantonese - patterns either *not* occurring, or evident for less than 10 percent of the large monolingual sample (So & Dodd, 1995). Jason also used three developmental error patterns that were inappropriate for his chronological age (see Table 6.6).

6.3.1.3.3 Comparison with Bilingual Cantonese-English Children

Two of Jason's phonological error patterns (nasalisation of the phoneme /l/, and blending two words into one), that are atypical of monolingual Cantonese and English children's phonological development, were not evident in the speech of the normative Cantonese-English sample (see Tables 2.4 and 2.5). This suggests that these processes may be atypical for Cantonese-English bilingual children.

Jason's speech accuracy was also slightly poorer than his bilingual peers. In comparison to the data presented in Chapter 2 for bilingual children in the same age group as him, Jason produced 86 percent consonants correct in his Cantonese speech, this is 9 percent lower than his age-group peers.

6.3.1.3.4 English Phonological Error Data

Jason's English phonetic inventory contained 21 of the 24 consonants: he was missing /θ, ð, r/. His articulation of the phonemes /s, z, ʃ/ was consistently distorted. His inability to articulate perceptually acceptable versions of these frequently occurring speech sounds

accounted for Jason's low PCC score. He used all the vowels of English. He also had a wide range of phonotactic structures. Table 6.5 summarises the results of quantitative analyses of Jason's phonological errors in English. Table 6.6 summarises the results of qualitative analyses of Jason's phonological errors in English.

Jason used the following phonological processes in his English speech: gliding, stopping, cluster reduction, final consonant deletion, voicing, fronting, and deaffrication. Jason's productions of the same lexical item were consistent although none of the processes were always applied.

6.3.1.3.5 Comparison with Monolingual English Children

Most monolingual English children at age 62 months have acquired a complete phone repertoire with errors confined to stopping of /θ, ð/ and gliding of /r/ Grunwell (1987). These are the same sounds that Jason had failed to acquire. However, articulatory distortions are not normal for monolingual children: Jason distorted the production of /s, z, ʃ/. In comparison to the monolingual English group data reported in Chapter 2, Jason's speech accuracy is considerably lower. His phoneme correct score was 24 percent lower than his monolingual age-group peers.

Jason's English included one atypical error pattern in comparison to monolingual norms (Dodd & Iacono, 1989) and four developmental error patterns that were inappropriate for his chronological age. Two error patterns were appropriate for Jason's chronological age (see Table 6.6).

6.3.1.3.6 *Comparison with Bilingual Cantonese-English Children*

The one atypical (for monolingual English children) process evident in Jason's speech is a normal bilingual Cantonese-English process. All the other processes evident in Jason's English speech were also normal bilingual processes. Although Jason's English phoneme repertoire was almost complete, unlike any children in the normative sample, his articulation was characterised by distortion of two phonemes.

Jason's English speech accuracy was also slightly poorer than his bilingual peers. In comparison to the data presented in Chapter 2 for bilingual children in the same age group, Jason produced 72 percent phonemes correctly in his English speech, this is 17 percent lower than his age-group peers.

6.3.1.4 COMPARISON OF JASON'S CANTONESE AND ENGLISH PHONOLOGICAL PATTERNS

Jason's phonological patterns were quite distinct in each language. Only one developmental pattern, cluster reduction, was evident in both Cantonese and English. None of Jason's atypical patterns were evident in both languages. Although Jason consistently substituted [n] for /l/ in Cantonese, when he was speaking English, initial /l/ was correct while he substituted [w] for /l/ in other word positions. Another example of the distinction of Jason's phonological systems is that he used the atypical process of consistently backing /t/ to [k] word finally in Cantonese but not in English.

The only phonemes distorted in both languages were the grooved fricatives and affricates related to /s/: Jason's distortion of this phoneme was perceptually the same in both his languages. Given his mother's lateral /s/, and his similar distortion of the sound in both languages, a plausible explanation for this error is that he had learned the wrong motor program for its production.

Jason's speech errors suggested that he was making both phonetic and phonemic errors. His articulatory distortion of /s/ was evident in both his languages. He consistently used the same production of this sound. In contrast, there was also evidence of phonological processes in both Jason's languages. However, these processes were language specific and were not consistently applied. Two of the processes Jason used in his Cantonese were atypical for his age bilingual peers.

6.3.2 CASE STUDY 4: CHRIS

6.3.2.1 BACKGROUND INFORMATION

Chris was born at full term after a normal pregnancy. At birth his head circumference size was considered small and he has been followed up by a paediatrician regularly to monitor his development. A CT scan revealed no brain abnormality and his paediatrician reports no concerns regarding Chris's development. He has had no serious illnesses or accidents. His parents report that his developmental milestones were somewhat delayed. He has a history of ear infections (otitis media with effusion) but his mother reported that audiological testing revealed no hearing loss. However, he may have had a fluctuating hearing loss at the time of the infections. Chris's parents, who own a shop, speak Cantonese and functional English; his elder sister speaks English fluently. The primary language spoken at home is Cantonese.

6.3.2.2 SPEECH THERAPY HISTORY

Chris was first referred for speech therapy assessment when he was 35 months old. His parents were concerned that he was not acquiring English as quickly as his sister had done, although they were not concerned about his Cantonese language skills. His mother

reported that she was able to understand most of what Chris said, and that his comprehension of Cantonese was adequate. Informal testing of his symbolic play skills during the assessment session indicated delayed development, although some aspects of his play were near age-appropriate level. His parents were advised on how best to encourage language acquisition and a nursery placement was arranged to accelerate his acquisition of English. Chris was reassessed at age 3;9 years by the paediatric speech language pathology service to monitor his progress.

6.3.2.3 ASSESSMENT

Chris was assessed in a speech-language pathology clinic by a native Cantonese speaker (a teacher) who administered the assessments under the direction of the speech-language pathologist. Chris's parents attended the session. Spontaneous speech samples were elicited in both languages using toys and pictures. The CSPT (So, 1992) was administered. Chris was first asked to name the pictures in Cantonese and then in English. The assessment session was audio-recorded. A Cantonese-speaking linguist and a phonetician specialising in speech disorder transcribed the speech samples collected.

6.3.2.4 RESULTS

6.3.2.4.1 Cantonese Phonological Error Data

Chris's phonetic inventory was missing the phonemes /l, n, ts, ts^h/ and his production of /s/ was distorted. Table 6.7 summarises the results of quantitative analyses of Chris's phonological errors in Cantonese. Table 6.8 summarises the results of qualitative analyses of Chris's phonological errors in Cantonese.

Table 6.7 Percent correct in Cantonese and English: Chris

	Consonants	Vowels	Total Phonemes
CSPT: <i>Cantonese</i>	46%	100%	72%
GFTA: <i>English</i>	20%	81%	42%

Table 6.8 Comparison of Chris's Phoneme Inventory and Phonological Processes in Cantonese and English

	Cantonese	English
Phoneme Inventory		
Absent	l, n, ts, ts ^h	ɔ̃, w
Distorted	s	m, n, p, t, k, s, z, f, ʃ
Processes		
<i>Shared</i>	Cluster Reduction ^d Stopping ^c Fronting ^a Final Consonant Deletion ^a Affrication ^a Initial Consonant Deletion ^b Backing ^b Addition ^b	Cluster Reduction ^d Stopping ^a Fronting ^a Final Consonant Deletion ^a Affrication ^b Initial Consonant Deletion ^b Backing ^b Addition ^b
<i>Specific</i>	Consonant Harmony Deaffrication Gliding	Nasalisation Weak Syllable Deletion

Notes:

a - delayed developmental (monolingual) phonological process

b - atypical (monolingual) phonological process

c - appropriate (monolingual) phonological process

d - atypical pattern of cluster reduction (cluster marked by bilabial fricative)

Phonological analysis of Chris's Cantonese speech data revealed the use of the following phonological processes: cluster reduction (sometimes marking the cluster with a bilabial fricative), stopping, consonant harmony, fronting, final consonant deletion, affrication, deaffrication, initial consonant deletion, backing, addition, and gliding. All the processes were inconsistently applied. However, Chris's speech was consistent in that he produced words in exactly the same way each time he used them.

6.3.2.4.2 Comparison with Monolingual Cantonese Children

Chris's performance on the CSPT can be compared to the 33 children aged between 42–47 months included in So and Dodd's (1995) of monolingual children. Their mean score for percentage of words in error was low (8.4) compared to Chris's score (58). Their mean score for percent of errors that affected vowels was 3.8, lower than Chris's score of 12. Chris performed comparatively better in terms of his phone repertoire. Although 75 percent of monolingual Cantonese children have acquired all phones by 42 months, if a 90 percent criterion is used, Chris performed within normal limits for his age apart from missing the phone /n/ which is usually acquired very early. Chris made no tone errors.

Chris's spoken Cantonese was characterised by five patterns that would be considered atypical errors for a monolingual child (see Table 6.8). Chris also used five developmental error patterns that were inappropriate for his chronological age. Two of Chris's error patterns were appropriate for his chronological age.

6.3.2.4.3 Comparison with Bilingual Cantonese-English Children

All but one of the atypical error patterns Chris used were evident in the speech of the normative bilingual sample (see Tables 2.4 and 2.5). The exception was Chris's occasional marking of some consonant clusters with a bilabial fricative in both languages. However,

the number of atypical error patterns used was significant. Chris used five Cantonese atypical error patterns. The children in the normative bilingual group had a mean of 2 atypical processes in their speech. The processes may have mainly been normal bilingual processes but there were a lot of them being used simultaneously.

Chris's speech accuracy was also significantly worse than his bilingual peers. In comparison to the data presented in Chapter 2 for bilingual children in the same age group as him, Chris produced 72 percent phonemes correct in his Cantonese speech, this is 20 percent lower than his age-group peers.

6.3.2.4.4 English Phonological Error Data

Chris's English phonetic inventory contained 22 of the 24 consonants: he was missing /dʒ, w/. His articulation of the phonemes /m, n, p, t, k, s, z, f, ʃ/ were all consistently distorted (e.g., excessive aspiration of voiceless stops). His inability to articulate perceptually acceptable versions of these frequently occurring speech sounds accounted for Chris's extremely low PCC score. He used all the vowels of English, however he made a significant number of vowel errors. Chris used a wide range of phonotactic structures. Table 6.7 summarises the results of quantitative analyses of Chris's phonological errors in English. Table 6.8 summarises the results of qualitative analyses of Chris's phonological errors in English.

Chris used the following phonological processes in his English speech: cluster reduction, stopping, fronting, final consonant deletion, affrication, initial consonant deletion, backing, addition, nasalisation, and weak syllable deletion. Although Chris's productions of the same lexical item were consistent, none of the processes were always used.

6.3.2.4.5 Comparison with Monolingual English Children

Grunwell (1987) suggested that by 45 months, monolingual English children's speech is intelligible with errors confined to deletion of some unstressed syllables, stopping of affricates and some fricatives, and gliding. Vowels are rarely in error. Phones missing from 25 percent of children's repertoires include /v, z, ʃ, ʒ, tʃ, dʒ, θ, ð/. Chris was only missing two phonemes, however he misarticulated a range of sounds. Chris's performance in English was poor in comparison: 90 percent of his words were in error, and a high proportion of his errors affected vowels. In comparison to the monolingual English group data reported in Chapter 2, Chris's speech accuracy is considerably lower. His phoneme correct score was 48 percent lower than his monolingual age-group peers.

Chris's spoken English was characterised by six atypical error patterns (Dodd and Iacono, 1989) and three developmental error patterns that were inappropriate for his chronological age. Two error patterns were appropriate for Chris's chronological age.

6.3.2.4.6 Comparison with Bilingual Cantonese-English Children

The atypical patterns of occasionally marking some consonant clusters with a bilabial fricative was the only atypical process evident in Chris's English that was not evident in the normal Cantonese-English group (see Tables 2.4 and 2.5). However, similar to his Cantonese speech the number of processes evident was much higher than in the normal group data: Chris used six English atypical (monolingual); the group mean was 2.2 English atypical processes. Chris's articulatory distortions of several phonemes was unlike any children in the normative sample. The high proportion of vowels errors was not similar to the bilingual group data either.

Chris's English speech accuracy was also significantly poorer than his bilingual peers. In comparison to the data presented in Chapter 2 for bilingual children in the same age group as him, Chris produced 42 percent phonemes correct in his English speech, this is 36 percent lower than his age-group peers.

6.3.2.5 COMPARISON OF CHRIS'S CANTONESE AND ENGLISH PHONOLOGICAL PATTERNS

There were several similarities between Chris's English and Cantonese error patterns. Eight of Chris's phonological processes were evident in both Cantonese and English. The extent of this pattern of common processes across languages was not evident in the group data reported in Chapter 2. The phonetic distortions evident in Chris's English speech were not evident in his Cantonese. One explanation for Chris's phonetic distortions might be that he was attempting to distinguish between the two languages phonetically, rather than phonologically, by marking some English phones differently from the same phones in Cantonese.

Chris's errors suggest that he was having difficulty abstracting the phonological information specific to the two languages. It is possible that he was even having difficulty differentiating the two languages - hence the use of so many shared processes. However, his articulatory distortions in only one language suggest that he was trying to mark the difference between the two systems.

6.4 BILINGUAL PUNJABI/URDU-ENGLISH CHILDREN WITH SPEECH DISORDER

The bilingual phonological development of Punjabi-English children was presented in Chapter 4 of this thesis. Monolingual phonological development of Punjabi, Mirpuri or

Urdu has not been documented. Comparisons are therefore restricted to monolingual English and bilingual Punjabi-English development. Patterns of speech disorder in monolingual Punjabi children have not been described either.

6.4.1 CASE STUDY 5: HAFIS

6.4.1.1 BACKGROUND INFORMATION

Hafis was referred to the study by the speech-language pathologist that had been involved with him at school. Hafis's parents had been concerned about his speech development since he was about two years old. However, they had not sought advice regarding his speech because he was primarily exposed to Punjabi at home, and they did not think an English-speaking speech-language pathologist would be helpful. Hafis started attending childcare at 3;0 years and then nursery when he was 4;0 years. Before attending childcare Hafis had not had any significant exposure to English (although he did watch some English television, and his older sister spoke some English to him). Once Hafis had acquired some English at childcare his parents started using some English with him at home also. When Hafis started nursery his teacher identified that he was having difficulty with his speech. However, he was not seen by a speech-language pathologist until he was 4;6 years. He was immediately referred to the current study.

Hafis was born 4 weeks premature after a normal pregnancy. There were no medical complications. He has had no serious illnesses or accidents, and no serious ear infections or hearing problems. His parents reported that his developmental milestones were normal. His parents are both employed, university-educated professionals. They are fluent speakers of both Punjabi and English. At the time of the study Punjabi and English were spoken at home in approximately equal amounts. Hafis's sister is two years older than him and is

fluent in Punjabi and English. Hafis's parents reported that their daughter did not have any of the difficulties with her speech that Hafis had experienced.

6.4.1.2 ASSESSMENT

6.4.1.2.1 Language Screen

The British Picture Vocabulary Scales (Dunn, Dunn, Whetton & Pintillie, 1982) and Test for Reception of Grammar (Bishop, 1983) were given to measure Hafis's understanding of English. The results of these assessments indicated age-appropriate English receptive language skills. Hafis's Punjabi language comprehension was not assessed formally, although his parents were not specifically concerned about his language comprehension.

6.4.1.2.2 Oro-motor Skills

Performance on an informal oro-motor assessment suggested age-appropriate oro-motor skills. No struggle or groping behaviour was observed during spontaneous speech.

6.4.1.2.3 Speech Assessment

Hafis was assessed in a quiet room at his school by an English-speaking speech-language pathologist. His mother elicited speech in Punjabi during the assessment. The Goldman Fristoe Test of Articulation (Goldman & Fristoe, 1986), the 25 Word Test for Inconsistency (Dodd, 1995), and the Rochdale Assessment of Mirpuri Phonology (RAMP; Punjabi Version: Stow & Pert, 1998) were administered to ensure that a wide variety of phonemes and phonetic contexts were attempted, and to measure consistency of production. A selection of 20 words from the RAMP were elicited three times in a similar

procedure to the 25 Word Test to determine the consistency of Hafis's production in Punjabi.

Connected speech samples were not elicited in either language. The difficulties involved in non-native speakers transcribing and analysing the Punjabi connected speech, even with the help of a bilingual assistant made this impractical. It was therefore decided to only use single word speech samples in both languages, where the target words were known and transcriptions of these target words were available. In addition, Hafis's parents preferred not to have his speech audio recorded. On-line transcription of severely disordered speech was difficult even at single word level.

Permission was obtained for audio recording of Hafis's post-intervention assessment to allow reliability of the assessor's transcription to be determined. Point-to-point comparison of the reliability of the assessor's on-line and audiotaped consonant transcription was 89 percent consistent for the English sample and 84 percent for the Punjabi sample. An independent transcription of the audiotaped session was compared to the assessor's transcription from the tape. The transcriptions were 93 percent consistent for the English sample and 87 percent consistent for the Punjabi sample. Both of the transcribers were native English-speakers.

Four measures were taken from the speech data: (i) The percentage consonants correct (PCC) on words in the two phonology assessments were calculated as measures of severity. (ii) The percentage of words produced inconsistently was calculated from the 25 Word Test and the 20 RAMP words elicited three times. A word was classified as inconsistent if the production of the word was not identical across the three trials. (iii) The child's phonetic inventory was calculated: A phoneme was noted as present if it occurred in any word position, on at least two occasions. Phonemes used only in imitated responses were

not included. (iv) The speech samples were also inspected for the use of developmental and non-developmental phonological processes. However, the validity of this type of analysis for children with inconsistent speech is questionable (Ball, 1994). A process was considered to be present if there were at least three examples of the process in different words.

6.4.1.3 RESULTS

6.4.1.3.1 Punjabi Phonological Error Data

Table 6.9 presents Hafis's speech assessment data for both English and Punjabi. Hafis's speech indicated that his phonetic development was age-appropriate. He had acquired all the phonemes used in Punjabi. Hafis used a wide range of phonotactic structures.

Phonological analysis of Hafis's speech was difficult due to his unpredictable error pattern. However, inspection of the speech data revealed the inconsistent use of the following phonological processes: cluster reduction; stopping; affrication; backing; nasalisation; de-voicing/aspiration; and initial consonant deletion. Exceptions to all error patterns were evident in Hafis's speech.

Hafis's speech was characterised by inconsistency. Of the 20 RAMP words elicited three times, 9 were produced differently over the three trials. Although there was poor consistency in Hafis's substitution patterns, his degree of inconsistency was consistent (e.g., he did not produce all the words accurately in one trial and then make a large number of errors on the next trial). The PCC scores on the three pre-intervention administrations of the 20 RAMP words revealed that overall consonant accuracy was relatively stable. Comparison of the PCC for each set of 20 words revealed only a 7.8 percent variation even

though Hafis produced many of the individual words differently. Hafis was more accurate when he imitated a word than when he produced it spontaneously.

Table 6.9 Comparison of Hafis's Speech Accuracy, Inconsistency, Phoneme Inventory and Phonological Processes in Punjabi and English

	Punjabi	English
<i>Consonants Correct</i>	57.7%	44.9%
<i>Inconsistency</i>	45%	56%
<i>Phones missing</i>		/θ, ð, ʒ/
<i>Processes</i>	Cluster reduction Stopping Affrication Backing Nasalisation De-/voicing/aspiration Initial consonant deletion	Cluster reduction Stopping De-/affrication Backing/Fronting Gliding Medial consonant deletion Final consonant deletion/non-release De-/voicing/aspiration Consonant addition

6.4.1.3.2 Comparison with bilingual Punjabi-English children

The normal development of bilingual Punjabi-English children was reported in Chapter 4. Normally developing bilingual children of Hafis's age usually have 85 percent of their consonants correct when speaking Punjabi. Hafis's accuracy was much lower than this (57.7 percent) even though he was able to articulate all the sounds used in the language accurately. His severely inconsistent substitution patterns meant that although he could produce all the sounds he was unable to organise them in his phonological output correctly. Inconsistency is indicative of disorder in Punjabi-English bilingual children (Holm, Dodd, Stow & Pert, in press).

The phonological processes evident in Hafis speech are difficult to interpret due to the high level of inconsistency. All but two of the processes evident are normal developmental processes for bilingual Punjabi-English children. For example, stopping, a normal bilingual developmental process, was evident in Hafis's Punjabi speech sample: /zuban/ ⇨ [dubab]. The processes of affrication and nasalisation, however, are atypical in the speech of bilingual children. For example, Hafis produced /dud/ as [dʒud]; /pu1/ as [bun]. In comparison to the normal developmental data for 4;6 year old children the number of processes evident in Hafis's speech is high. Hafis's increased accuracy in imitation is characteristic of inconsistent deviant speech disorder (Bradford-Heit, 1996).

6.4.1.3.3 English Phonological Error Data

Hafis's English phonetic inventory contained 21 of the 24 consonants. The phonemes missing were /θ, ð, ʒ/. He used all the vowels of English. He also used a wide range of phonotactic structures.

Hafis inconsistently applied the following processes in his English speech: cluster reduction; stopping; de-/affrication; backing/fronting; gliding; medial consonant deletion; final consonant deletion/non-release; de-/voicing/aspiration; and consonant addition. As in Hafis's Punjabi speech sample there were exceptions to all the error processes evident.

Figure 6.3 shows that there was no clear pattern to Hafis's substitution patterns in English. Although there was poor consistency in Hafis's substitution patterns, his degree of inconsistency was consistent. The PCC scores on the three administrations of the 25 Word Test revealed that overall consonant accuracy was relatively stable. The PCC varied with a 9.4 percent range in English over the three trials.

h															
ŋ															
k/g															
tʃ/dʒ															
j															
ʃ															
r															
l/n															
s/z															
t/d															
θ/ð															
f/v															
m															
w															
p/b															
	p/b	w	m	f/v	θ/ð	t/d	s/z	l/n	r	ʃ	j	tʃ/dʒ	k/g	ŋ	h

Bilabial/Anterior

Target Phonemes

Glottal/Posterior

Figure 6.3 Matrix of English phoneme substitutions.

Hafis's realisation of individual phonemes in English are shown in this figure. The data for this matrix was taken from the three productions of the 25 Word Test. The target phonemes are along the horizontal axis and the phonemes Hafis used are along the vertical axis. A child with consistent accurate speech would just have a single horizontal line (darker shaded squares). An articulation error, or consistent phonological substitution would result in an uneven line but only one box would be shaded for each target sound. A child with inconsistent speech will have a range of boxes shaded for each of their variable errors. For example, the figure shows that Hafis used p/b, m, t/d, l/n, and k/g when attempting to produce p/b in various positions in various words.

6.4.1.3.4 *Comparison with monolingual English- and bilingual Punjabi-English children*

The overall pattern of Hafis's speech production in English was similar to his Punjabi pattern. The few English phonemes Hafis was missing are later developing phonemes in monolingual English children and are phonemes not used in Punjabi (Prather, Hendrick & Kern, 1975; Holm, Dodd, Stow & Pert, in press). His speech accuracy was considerably lower (40 percent) than other Punjabi-English bilingual children his age.

The phonological processes evident were inconsistently applied. The majority of the processes were normal developmental processes evident in the speech of other Punjabi-English bilingual children. However, the use of fronting, medial consonant deletion and consonant addition are not typical (e.g., /kofi/ ⇒ [dobi]; /ʃugə/ ⇒ [buə]; /skai/ ⇒ [haib]). It is possible that the process of fronting is a normal developmental process for younger Punjabi-English bilingual children. However, in the age range investigated in Chapter 4 there were only two children who made errors due to fronting.

Hafis's substitution patterns were very inconsistent in his English speech. Inconsistency was not evident in the normally developing bilingual children's speech.

6.4.1.4 COMPARISON OF HAFIS'S PUNJABI AND ENGLISH PHONOLOGICAL PATTERNS

His speech accuracy was poor in both languages, although he was more accurate in Punjabi than English. Normally developing bilingual children of Hafis's age usually have PCC scores of about 85 percent (Holm, Dodd, Stow & Pert, in press). Hafis's speech was inconsistent in both languages. Inconsistency is indicative of disorder in both Punjabi and English monolingual and bilingual children (Holm, Dodd, Stow & Pert, in press)].

Some phonological processes were identified in each language, however few of these processes were always applied. The phonological processes identified were primarily processes evident in normally developing bilingual Punjabi (Holm, Dodd, Stow & Pert, in press). However there were also some error patterns that were atypical (e.g., medial consonant deletion in English).

There was no clear pattern to Hafis's substitution patterns in English or Punjabi. However there were some possible trends in his substitutions across both languages: (i) He used anterior sounds more often than posterior (e.g., /b/ more common sound than /k/); (ii) When posterior sounds were used they were more likely to substitute other posterior sounds rather than anterior sounds (e.g., /h/ not used for any bilabial or labiodental sounds; (iii) Nasals, liquids and glides were more likely to be replaced with other nasals, liquids or glides rather than plosives; (iv) Stops were more frequently used than other sounds.

Hafis was inconsistent in both languages: he was inconsistent across phonemes and across repeated word productions. Inconsistent deviant speech disorder is thought to be caused by a phonological planning deficit. The phonological plans that these children store may be incorrect or underspecified: "although they may be able to physically produce the required phonological string, they do not appropriately specify the sequence in the lexicon for later production" (Bradford-Heit, 1996, p.205). A phonological planning deficit may underlie Hafis's inconsistent speech in each of his languages.

6.4.2 CASE STUDY 6: SABA

6.4.2.1 BACKGROUND INFORMATION

Saba was assessed at the age of 11;2 years. Her developmental history was without incident and she had experienced no major medical problems. A family history of speech disorder was reported. Saba is a fluent speaker of Urdu and English. She attends an Islamic school in Britain and is achieving well academically. Saba has experienced no difficulty with language acquisition. She acquired Urdu as her first language until age 4 years when she started school where she was also exposed to English. Saba was referred to the speech-language pathologist by the school nurse.

6.4.2.2 ASSESSMENT

Saba was assessed following referral to the Rochdale Healthcare NHS Trust Speech and Language Therapy Department. The South Tyneside Assessment of Phonology (Armstrong & Ainley, 1988) was administered by an English-speaking speech-language pathologist to sample her English phonological acquisition. The Rochdale Assessment of Mirpuri Phonology (Stow & Pert, 1998) was administered by a bilingual assistant to assess Saba's Urdu. The assessment session was recorded using a Marantz CP 130 audio cassette recorder. The speech samples from both languages were transcribed by an English-speaking speech-language pathologist.

6.4.2.3 RESULTS

6.4.2.3.1 Urdu Phonological Error Data

The only errors evident in Saba's Urdu speech sample were a lateral distortion of the phonemes /s, z/, and the substitution of [k] for /h/ in word initial position. The distortion of the /s/ and /z/ phonemes was consistent. The /h/ ⇔ [k] substitution was consistent in initial position, however correct production of /h/ was evident in other word positions. Ninety percent of Saba's Urdu consonants were correct over the entire sample of RAMP words.

6.4.2.3.2 Comparison with Bilingual Punjabi-English Children

Normally developing bilingual children do not make articulatory distortions of specific phonemes in the same way that Saba did (see Chapter 4). However, the phonological pattern of backing /h/ ⇔ [k] was evident in the normal bilingual population. Some of the oldest children in the normative group used this pattern, however it is not used by Urdu adults. It is possible that Saba should have suppressed this substitution pattern by the age of 11 years, but without more detailed normative data it is not possible to know when most bilingual children begin to mark the contrast appropriately.

6.4.2.3.3 English Phonological Error Data

The same lateral distortion of the /s/ and /z/ phonemes evident in Urdu was also evident in Saba's English speech. The distortion was consistent and perceptually identical to the distortion in Urdu. There were no other errors in her English speech sample. The percent consonants correct in English was 85 percent.

6.4.2.3.4 *Comparison with Bilingual Punjabi-English Children*

Articulatory distortions were not evident in the speech of the much younger normally developing bilingual Punjabi-English group presented in Chapter 4. Saba's distorted production can therefore be considered disordered.

6.4.2.4 COMPARISON OF SABA'S URDU AND ENGLISH PHONOLOGICAL PATTERNS

Saba's speech was almost error free in both languages. The one significant error was the articulatory distortion of /s/: she used a lateral airstream when producing this phoneme in both languages. The production of this phoneme was perceptually identical in both languages. The normal bilingual pattern of backing /h/ ⇔ [k] was not evident in Saba's English speech.

6.4.3 CASE STUDY 7: ZAHEEDA

6.4.3.1 BACKGROUND INFORMATION

Zaheeda was referred to the speech-language pathologist by the school nurse, who was concerned about her speech development. She was 5;0 years when initially assessed. Zaheeda was primarily exposed to Punjabi until she was aged 4;2 when she started attending nursery where she was exposed to English. However, Zaheeda has three older siblings (and one younger) who all used some English within the home before she started attending school. Both English and Punjabi are used at home: the children often speak English; the parents mainly use Punjabi although they both have functional English skills.

Zaheeda's birth and medical histories were without incident and early developmental milestones, including babbling, were reached at appropriate ages. However, Zaheeda did not start to use words until she was two years old, and did not combine words until she

was three years of age. Her hearing was within normal limits. Zaheeda's family were not concerned about her speech or language skills, although they were aware that she made some speech errors.

6.4.3.2 ASSESSMENT

The same assessment procedure that was used with Saba was used to assess Zaheeda's speech.

6.4.3.3 RESULTS

6.4.3.3.1 Punjabi Phonological Error Data

Intelligibility of connected speech and of single words was fair. Zaheeda had a wide range of phonotactic structures. Her phoneme inventory was missing /ʃ, ʈ, ɾ/. Table 6.10 summarises the results of quantitative analyses of Zaheeda's phonological errors in Punjabi. Table 6.11 summarises the qualitative analyses of Zaheeda's phonological errors in Punjabi.

Phonological analysis of Zaheeda's Punjabi speech data revealed the use of the following phonological processes: cluster reduction, voicing/aspiration, stopping, backing, weak syllable deletion, gliding (/ʈ, ɾ/ ⇒ [l]), and affrication. The only processes always applied were gliding and cluster reduction. However, Zaheeda's speech was consistent in that she produced words in exactly the same way each time she used them.

Table 6.10 Percent correct in Punjabi and English: Zaheeda

	Consonants	Vowels	Total Phonemes
RAMP: <i>Punjabi</i>	62%	100%	76%
STAP: <i>English</i>	68%	96%	78%

Table 6.11 Comparison of Zaheeda's Phoneme Inventory and Phonological Processes in Punjabi and English

	Punjabi	English
Phoneme Inventory		
Absent	ʃ, t, r	θ, ð, f, r
Processes		
<i>Shared</i>	Cluster Reduction Voicing/Aspiration Stopping Gliding Affrication	Cluster Reduction ^a Voicing/Aspiration ^b Stopping ^{a/b} Gliding ^a De-/Affrication ^b
<i>Specific</i>	Backing Weak Syllable Deletion	Fronting ^a Final Consonant Deletion/Glottalisation ^a

Notes:

a - delayed developmental (monolingual) phonological process

b - atypical (monolingual) phonological process

6.4.3.3.2 Comparison with Bilingual Punjabi-English Children

All the phonological processes evident in Zaheeda's Punjabi were evident in the speech of the normative Punjabi-English group (see Table 4.2). However, Zaheeda used a large number of processes for her age. The seven processes, although normal developmental patterns, resulted in a larger number of errors in her speech than evident in normally developing children. Her accuracy, 62 percent consonants correct, was 20 percent lower

than her age-group peers (see Figure 5.1). This suggests that Zaheeda's phonological development was delayed.

6.4.3.3.3 English Phonological Error Data

Zaheeda's English phonetic inventory included 20 of the 24 consonants: she was missing /θ, ð, ʃ, r/. She used a wide range of phonotactic structures. Table 6.10 summarises the quantitative analyses of Zaheeda's phonological errors in English. Table 6.11 summarises the qualitative analyses of Zaheeda's phonological errors in English.

Zaheeda used the following phonological processes in English: cluster reduction, voicing/aspiration, stopping (of fricatives and of word-final nasals), gliding (in contrast to Punjabi pattern - /r/ ⇔ [w] in English), de-/affrication, fronting, final consonant deletion/glottalisation. The processes of gliding and cluster reduction were the only consistently applied processes, although her productions of the same lexical item were consistent.

6.4.3.3.4 Comparison with monolingual English and bilingual Punjabi-English children.

The phonemes missing from Zaheeda's phoneme inventory are later developing sounds for monolingual English children, although most monolingual children complete their phonetic acquisition before the age of 5 years (Prather, Hendrick & Kern, 1975). Her speech accuracy was considerably lower (18 percent) than other Punjabi-English bilingual children her age.

The phonological processes evident in Zaheeda's speech were all normal developmental processes evident in the speech of other bilingual Punjabi-English children (see Table 4.1). In comparison to monolingual English children, the processes of voicing/aspiration,

stopping (of word-final nasals, e.g., crown: [kaund]) and de-/affrication would be considered atypical (Dodd & Iacono, 1989). Although the processes were all normal bilingual processes, the use of seven different processes within the speech sample was unusually high in comparison to the normative group reported in Chapter 4.

6.4.3.4 COMPARISON OF ZAHEEDA'S PUNJABI AND ENGLISH PHONOLOGICAL PATTERNS

Zaheeda's phonological development appeared delayed in both languages. Her systems appeared to be clearly differentiated: she used some shared phonemes in one language but not the other (/ʃ/ only in English, /f/ only in Punjabi); she used two processes that were specific to each language; she was realising processes differently in each language (stopping final nasals only in English; gliding /r/ ⇒ [w] in English but /r/ ⇒ [ɽ] in Punjabi). She used a large number of processes in both of her languages - and five of these processes were shared across languages. Zaheeda's speech accuracy was uniformly poorer than her bilingual peers'.

6.5 GENERAL DISCUSSION

The disordered speech data of two Italian-English, two Cantonese-English, and three Punjabi-English bilingual children were presented. The data was examined in relation to the four questions raised in the introduction.

6.5.1 PATTERN OF SPEECH DISORDER ACROSS LANGUAGES

All the bilingual children made errors indicative of the same type of speech disorder in both of their languages. The speech errors indicated that:

- Giuseppe and Hafis's speech was inconsistent in both languages;
- Stephanie and Zaheeda's speech was delayed in both languages;

- Jason and Chris's speech included consistent deviant errors; and
- Jason and Saba had articulation errors in both languages.

The children's error patterns were not identical in both of their languages, however the nature of their disorder was the same. This pattern across languages suggests that there is a single underlying deficit in the speech processing chain that results in the same type of disorder evident in both languages. For example, the children making consistent deviant errors are hypothesised to have a deficit in abstracting phonological information. This deficit results in the bilingual children using consistent deviant error patterns in both of their languages.

6.5.2 DIFFERENTIATION OF SYSTEMS

The results indicated that the bilingual children had language-specific phonological systems. Evidence that their two phonological systems were distinct was provided by two phenomena:

1. Phoneme acquisition - Language-specific phonemes only used in the correct language, and use of a phoneme in only one language that should occur in both languages. For example, while Giuseppe was producing /f/ and /v/ in Italian these phonemes were absent from his English phonemic repertoire. Similarly, /ʃ/ was part of Stephanie's English phonemic repertoire but was absent from her Italian. Zaheeda also used two shared phonemes in only one language (/ʃ/ only in English, /f/ only in Punjabi). Chris appeared to be trying to differentiate the two languages phonetically - shared phonemes were often distorted in English but not in Cantonese.
2. Phonological processes - Analysis of the error patterns revealed that while some patterns were often shared across the two languages, the children also had language-

specific error patterns. For example, Giuseppe made voicing, epenthetic and backing errors in Italian that were not observed in English. Jason only had one shared phonological process - all the others were language-specific. Another example of distinct error patterns was the substitution of [w] for /r/ in English, but [l] or [n] for /r/ in Italian by both Italian-English children. The Punjabi-English children used similar /r/ substitution patterns to the Italian-English children⁵. There was also evidence of contradictory patterns in some of the children's speech. For example, Jason backed /t/ ⇒ [k] in Cantonese, but fronted /k/ ⇒ [t] in English.

All the bilingual children with speech disorder used error patterns either atypical of normal bilingual development (when this information was available) or atypical of monolingual development in each language (e.g., inconsistent productions appear to be indicative of disorder regardless of language). The use of a large number of error patterns (and the resulting effect on low accuracy ratings) is indicative of delayed phonological development (as evident in the speech of Zaheeda and Stephanie).

6.5.3 THEORETICAL AND CLINICAL IMPLICATIONS

The data from the bilingual children with disordered speech supports current psycholinguistic models of (monolingual) speech processing (e.g., Dodd & McCormack, 1995; Stackhouse & Wells, 1997). The bilingual children have a speech-processing mechanism that is language-independent. This mechanism differentiates and processes two separate language-specific phonological systems. The level of breakdown in the speech processing mechanism affects the error patterns evident in each language:

⁵ Across the three language combinations examined all the children were more likely to use /r/ ⇒ [l] than /r/ ⇒ [w] in the non-English language. The normal developmental substitution of /r/ ⇒ [n] in Italian was documented by Bortolini and Leonard (1991). However, in English, Portuguese and Swedish liquid nasalisation is considered atypical (Yavas, 1998).

- a deficit in the process of abstracting phonological information will result in consistent deviant error patterns in each language - but the error patterns will be differentiated and language-specific;
- a deficit in using phonological plans will result in inconsistent errors in both languages;
- a deficit in the execution of a motor plan will result in articulation errors that will be evident in both languages if the phoneme in error is a phoneme used in both languages - the child will only have one language-independent motor plan for that specific phoneme.

Apparent articulation errors need special consideration since they might reflect either an impaired articulatory motor program for production of a particular sound or an attempt to distinguish between the two languages. There has been considerable debate concerning whether speech disordered children's surface errors are phonetic or phonological in origin. The case studies provide interesting new data relevant to this issue. Jason and Saba lisped in both languages; perceptually the distortion that marked /s/ was identical in both languages and in all word positions. In contrast, Chris distorted the production of several phones in English that he produced perfectly well when speaking Cantonese. Thus, Chris's distortions cannot be easily classed as articulatory errors. This finding raises doubts about the classification of distortion errors made by both bilingual and monolingual children (cf., Dodd, 1995).

The data from the bilingual children with disordered speech indicate that it is imperative that the phonological systems of both languages are assessed. The error patterns may be language-specific, however the underlying deficit will be the same for both languages: to accurately identify the level of breakdown in the bilingual child's speech processing chain the type of disorder must be identified in each language. The difficulty for speech-language

pathologists is the lack of both assessment tools in the child's non-English language, and the lack of normative data on the development of bilingual children with specific language combinations (Yavas, 1998).

Lahey (1992) suggested an alternative to this dilemma: the development of assessment techniques that are based on children's ability to learn aspects of a new language (e.g., a different phonological system). She also suggests that nonword imitation tasks may be another way of assessing bilingual children's speech skills. The possibility of developing tasks that will accurately identify children with disordered speech, and specifically discriminate the type of disorder, requires further research.

The process of identification of speech disorder in bilingual children is complex and difficult for speech-language pathologists (Yavas, 1998). However, the majority of children referred to speech-language pathology services have been identified by other professionals as having particular difficulty with their speech. Yavas (1998) suggested that bilingual children are at risk of being inappropriately labelled as speech disordered due to either lack of knowledge about the child's first language or lack of understanding of normal bilingual phonological differences to monolingual children. However, speech-language pathologists working with bilingual children often feel that children are *less* likely to be identified as having speech disorders, because of the assumption that any difficulties are simply a part of the bilingual environment (C. Stow & S. Pert, personal communication).

CHAPTER 7:
THE PATTERN OF REFERRAL OF
BILINGUAL CHILDREN FOR SPEECH
ASSESSMENT

7.1 INTRODUCTION

The case studies presented in Chapter 6 showed that the same subgroups evident in monolingual children are also evident in bilingual children with speech disorder. In this chapter the speech error patterns of 23 Punjabi-English children referred for assessment of disordered speech are described. The aim of the study was to examine the nature of the speech patterns of bilingual children identified by referring agents as having *speech sound* difficulties. It was hypothesised that the bilingual children identified would have severe speech disorders - on the basis that children with less than severe difficulties would not have been identified as having a speech disorder because of misconceptions regarding the negative effects of bilingualism (Duncan, 1989).

7.2 METHOD

7.2.1 SUBJECTS

The subjects were 23 children who were on the Rochdale Health Care NHS Trust Speech-Language Therapy assessment waiting list following referral for suspected speech disorder (as opposed to expressive/receptive language difficulties, dysfluency, feeding difficulties, hearing problems, or medical/genetic causes e.g., Down syndrome, cerebral palsy). Referral sources included teachers, health visitors, general practitioners, school nurses and parents. There were 13 boys and 10 girls, aged between 2;5 and 11;2 years. All the children were primarily exposed to either Punjabi (10 children), Mirpuri (7 children) or Urdu (6 children) at home. They had all been exposed to English either at home or at school. None of the children had any hearing impairment according to health visitor screening assessments. Table 7.1 provides a summary of the subjects' characteristics, including the percentage consonants correct for each language as an indication of severity, as well as the diagnostic classification to which each child was assigned.

Table 7.1 Punjabi-English children referred for speech assessment

Subject	Age	Sex	VMI*	% Consonants Correct		Diagnosis
				English	Punjabi	
UT	5;3	M	98	77.3	87.4	Normal
NB	4;9	F	93	79.8	83.7	Articulation
SA	11;2	F	-	85.1	90.4	Articulation
ZF	5;0	F	89	68.4	62.3	Delayed
HK	5;2	F	91	74.3	68.9	Delayed
NB	5;4	F	92	66.8	61.7	Delayed
AN	5;5	M	83	58.2	54.9	Delayed
MS	7;10	M	87	91.5	87.4	Delayed
UD	8;1	M	-	77.8	76.1	Delayed
QM	3;5	M	-	53.7	56.8	Deviant
AM	3;10	M	85	56.2	54.4	Deviant
HL	4;6	M	85	48.9	54.3	Deviant
RI	5;2	F	83	48.6	44.6	Deviant
ZZ	3;10	M	96	30.2	22.6	Inconsistent
NF	5;3	M	93	38.2	43.8	Inconsistent
NS	2;5	F	-			Language
IR	2;5	F	-			Language
SJ	2;11	M	-			Language
HH	3;2	M	-			Language
KM	4;3	M	82			Language
MK	6;11	F	73			Language
TS	10;9	M	78			Language
UG	5;10	M	93			Fluency

* VMI standard scores, mean of 100, normal range 85-115.

7.2.2 PROCEDURE

The assessments were conducted within a speech-language pathology clinic. Detailed case histories were taken from the parents while the child played with toys, drew pictures or looked at books. An informal language screening assessment was administered in both languages by an experienced speech-language pathologist with a bilingual co-worker. More detailed language assessments were then administered if the child appeared to have difficulty with expressive or receptive language tasks. The Developmental Test of Visual-Motor Integration (Beery & Buktenica, 1989) was administered to most of the children (except those children outside the age range of 3-8 years) to monitor non-verbal cognitive development.

The South Tyneside Assessment of Phonology (Armstrong & Ainley, 1988) was administered by an English-speaking speech-language pathologist to assess the child's English phonological acquisition. The Rochdale Assessment of Mirpuri Phonology (Stow & Pert, 1998) was administered by a bilingual co-worker to assess the child's Punjabi. The assessment session was recorded using a Marantz CP 130 audio cassette recorder.

7.2.3 ANALYSES

The speech samples from both languages were transcribed by an English-speaking speech-language pathologist. Five recordings in each language were transcribed by another speech-language pathologist to check the reliability of the transcriptions. The point-to-point segment agreement was 93 percent for the English samples and 91 percent for the Punjabi samples. The majority of the differences between the transcriptions were of aspiration/voicing contrasts and final consonant release/deletion errors. The phonological processes used (three examples of process in different lexical items), articulatory errors,

absent phonemes, and percentage of consonants correct for each child in both languages were derived from the two phonological assessments.

The children were assigned to the different subgroups of speech disorder based on the following criteria:

- ◆ *articulation* - children who consistently distorted a particular phoneme irrespective of phonetic environment as well as in isolation
- ◆ *delayed* - children using developmental phonological processes (used by the normally developing bilingual Punjabi-English children described in Chapter 4) that were considered to be inappropriate for their age. The lack of sufficient normative data for younger children meant that children were also considered delayed if their speech accuracy was more than 20 percent below their normative age-peers, and the children used more than five developmental processes. These criteria were arbitrary.
- ◆ *disordered: deviant consistent* - children using at least two error patterns not evident in the normative bilingual group, and/or considered to be unusual in terms of markedness constraints and universal patterns (Yavas, 1998).
- ◆ *disordered: inconsistent* - specific words or phonological segments (in identical phonetic contexts) elicited more than once were produced differently.

Children were identified as having language difficulties based on the information provided by the parent in the case history and the informal language screen. For example, when the child was unable to carry out receptive language tasks in their first language that were considered to be age-appropriate (e.g., carrying out commands including two or three information carrying words “brush dolly’s hair”). The speech skills of the children identified as experiencing general language difficulties were not specifically assessed further.

7.3 RESULTS

The children with disordered speech were representative of the four subgroups of speech disorder proposed by Dodd (1995). Of the 23 children that were assessed following referral for *speech* difficulties, 8 children presented with non-speech communication difficulties (language and dysfluency). One child was considered to have age-appropriate language and speech skills. Of the 14 speech disordered children, 2 children had articulation disorders, 6 children had delayed phonological development, 4 children used atypical error patterns, and 2 children made inconsistent errors. Each case is briefly outlined below.

7.3.1 NORMAL

1. *UT*: This 5;3 year old boy was referred by his teacher because of his “difficult to understand speech”. However, assessment showed that his speech was only marginally less accurate than other normally developing Punjabi-English bilingual children. He had acquired all the age-appropriate sounds in each language, and the errors he was making were all normal bilingual error patterns. He produced 77.3 percent consonants correct in English and 87.4 percent correct in Punjabi.

7.3.2 ARTICULATION

2. *NB*: The only significant error pattern in this 4;9 year old girl’s speech was a lateral distortion of sibilants evident in both languages. The distorted phonemes were perceptually identical in both languages. The other error processes evident (English: cluster reduction, gliding, fronting and stopping; Mirpuri: backing, voicing, stopping) were all normal developmental bilingual error patterns. Her speech accuracy scores

were only slightly lower than her bilingual peers': English - 79.8 percent consonants correct; Mirpuri - 83.7 percent consonants correct. NB was referred by her teacher.

3. SA: This 11;2 year old girl was concerned about her speech errors. Her sibilant productions in both languages were lateralised. There were no other error patterns in her speech other than the normal developmental process of backing /h/ ⇒ [k] in Urdu. Her speech accuracy ratings reflect the overall accuracy of her speech production as well as the specific effect of the articulatory distortion: English - 85.1 percent consonants correct; Urdu - 90.4 percent consonants correct. The phonetic distortion was identical in the two languages.

7.3.3 DELAYED

4. ZF: All the phonological error patterns evident in this 5;0 year old girl's speech were normal developmental bilingual patterns. She was referred by the school nurse. The phonological error patterns evident were: English - cluster reduction, voicing/aspiration, stopping (of fricatives and of word-final nasals), gliding (/r/ ⇒ [w]), de-affrication, fronting, final consonant deletion/glottalisation; Punjabi - cluster reduction, voicing/aspiration, stopping, backing, weak syllable deletion, gliding (/ɽ, r/ ⇒ [l]), and affrication. Although these patterns were all evident in the normal bilingual children's speech ZF's development was considered delayed. The number of processes evident in ZF's speech affected her intelligibility. Her PCC scores were 68.4 percent in English and 62.3 percent in Punjabi. These are significantly lower than her bilingual age-peers'. The use of patterns such as fronting and weak syllable deletion also suggested that ZF's development was delayed as these are cross-linguistically early simplification patterns (Yavas, 1998). There were a few phonemes missing from her

phonemic repertoires: /θ, ð, f, r/ - English; /ʃ, r, ɽ/ - Punjabi. These are usually later developing sounds.

5. *HK*: The consonants missing from this 5;2 year old girl's phoneme repertoires were: English - /θ, ð, r/; Urdu - /x, ʃ, h/. These are later developing sounds, however the asymmetry of phoneme use is interesting (shared phonemes used in only one language). All the error processes used by *HK* were normal bilingual developmental patterns: English - backing, final consonant deletion/unrelease, assimilation, stopping of fricatives and nasals, fronting of velars and nasals; Urdu - backing, final consonant deletion/unrelease, stopping, weak syllable deletion. *HK*'s speech accuracy was poorer than her normal bilingual age-peers: English - 74.3 percent consonants correct; Urdu - 68.9 percent consonants correct. *HK*'s mother reported that she was late starting to talk (2;6 years) however, she had developed appropriate language skills, and her VMI score was within the normal range.
6. *NB*: This 5;4 year old girl, referred by her teacher, presented with delayed phonological development in both languages. All but one of the phonological processes evident in her speech were patterns used by normally developing Punjabi-English bilingual children: English - cluster reduction, stopping, fronting, backing, voicing, final consonant deletion/glottalisation, af-/frication errors, gliding; Mirpuri - assimilation, stopping, voicing, consonant addition, initial consonant deletion, de-/af-/frication errors, final consonant deletion, backing. The one unusual error was the addition of initial consonants to form clusters in some English words (e.g., rocket ⇒ /brɒtɛt/, thumb ⇒ /stum/) - all the target words with initial clusters were reduced to single consonants. *NB*'s speech accuracy was poorer than her normative age-peers': English - 66.8 percent consonants correct; Mirpuri - 61.7 percent consonants

correct. The use of such a large number of processes and the effect on NB's intelligibility indicate that her phonological development was delayed.

7. *AN*: The phonological development of this 5;5 year old boy was delayed in both languages. He was referred by the Health Visitor. He had acquired most of the phonemes of each language but was missing /ʃ, ʒ, θ, ð, r/ in English and /f, x, ɽ/ in Mirpuri. AN used a large number of phonological processes in each language: English - cluster reduction, stopping fricatives, final consonant deletion, gliding, voicing, fronting; Mirpuri - backing, fronting, cluster reduction, stopping, weak syllable deletion. All these are normal Punjabi-English developmental processes. AN's speech accuracy was significantly poorer than his normative age-peers: English - 58.2 percent consonants correct; Mirpuri - 54.9 percent consonants correct. The large number of processes evident and the low speech accuracy indicate phonological delay.
8. *MS*: All the phonological error patterns evident in this 7;10 year old boy's speech were normal developmental bilingual patterns. He was referred by his teacher. The phonological error patterns evident were: English - gliding (/r/ ⇒ [l]), fronting, deaffrication, and substituting /θ/ ⇒ [f]; Punjabi - voicing/aspiration, stopping, and gliding, (/ɽ, r/ ⇒ [l]). Although these patterns were all evident in the normal bilingual children's speech MS's development was considered delayed. The number of processes still evident in MS's speech at age 7;10 years affected his intelligibility. Most children's speech is virtually error free by this age. MS's PCC scores were 91.5 percent in English and 87.4 percent in Punjabi.. There were a few phonemes missing from his phonemic repertoires: /θ, ð, r/ - English; /ɽ, ɽ/ - Punjabi. These are usually late developing sounds, although MS should have acquired them. MS's mother reported that he was late starting to talk. He did not use single words until 2;6 years, and did

not combine two words until 3;6 years. However, his language development was considered to be age-appropriate and he is not experiencing specific difficulty at school.

9. *UD*: This 8;1 year old boy's phonological development was delayed in both languages. He had acquired all the phonemes of each language, however the use of a few normal bilingual processes remained evident in his speech. His mother reported that he did not start using words in either Punjabi or English until he was four years old. His language development was rapid and he is not considered to have learning difficulties or receptive or expressive language difficulties. However, his speech accuracy remained poor for his age: English - 77.8 percent consonants correct; Punjabi - 76.1 percent consonants correct. The phonological processes evident were all normal developmental patterns: English - cluster reduction, stopping fricatives, fronting; Punjabi - voicing, weak syllable deletion, cluster reduction, backing of fricatives. By 8 years of age most children have completed their speech development and only make rare errors. *UD*'s speech was delayed in comparison to normally developing bilingual children.

7.3.4 PHONOLOGICAL DISORDER - DEVIANT CONSISTENT

10. *QM*: This 3;5 year old boy had the following consonants missing from his phoneme repertoires: English - /s, r, ʃ, v, ʒ, θ, ð/; Urdu - /s, ɽ, r, ʃ, x/. Many of the error patterns evident in *QM*'s speech were normal developmental bilingual processes: English - stopping, cluster reduction, gliding, substitution of /θ/ ⇔ [f], de-/voicing, fronting, affrication, final consonant deletion/non-release; Urdu - stopping, final consonant deletion/glottalisation, weak syllable deletion, af-/frication, initial consonant deletion, fronting, gliding. However, some of the specific rules that *QM*

used were unusual. In both languages QM substituted glides for a range of sounds (e.g., /s, l, v, m, z/ ⇒ [w] or [j]). In contrast the normal bilingual children usually restricted the substitution of glides to other approximant sounds. The other unusual error, evident in both languages, was the addition of extra consonants. QM often added a consonant to form clusters (e.g., leg /la^ht/ ⇒ [pja^ht]; bus /bus/ ⇒ [blut]) or to close a syllable structure to a CVC form (e.g., cow /gɑ:/ ⇒ [gɑn]; car /ka/ ⇒ [tab]). Neither of these error patterns were evident in the speech of normally developing Punjabi-English children. QM also deleted a wider range of initial consonants in Urdu than the normative sample. QM was younger than the children assessed for the normative sample, however the error patterns seem unlikely to be simply delayed processes not evident in the older children's speech. The error patterns significantly affected his speech accuracy: English - 53.7 percent consonants correct; Urdu - 56.8 percent consonants correct. However, his productions of words were consistent. The use of unusual phonological rules in both languages indicated that QM's phonological development was disordered.

11. *AM*: The error patterns evident in both of AM's languages were identical. This 3;10 year old boy had not acquired any of the language-specific phonemes of either language. This pattern suggests the possibility that AM used a single phonological system for both languages. The phonological processes evident were largely normal bilingual processes: stopping, gliding, cluster reduction, final consonant deletion, voicing/aspiration errors, assimilation. However, there were also several patterns, evident in both language that were not used by the normative bilingual group: backing of a range of sounds (e.g., /b, dʒ, t, f, s/ ⇒ [k]), a high number of vowel errors (e.g., 47 percent English vowels correct), unusual cluster reduction patterns (e.g., deleting plosive from plosive + approximant clusters), liquid nasalisation (e.g., cat /bɪli/ ⇒

[bini]). There was no evidence of inconsistent word productions - all the words produced more than once in both languages were produced in the same way each time. AM's speech accuracy was poor: English - 56.2 percent consonants correct, Urdu - 54.4 percent consonants correct. The use of unusual error patterns and the symmetry of AM's phonological systems indicate consistent deviant speech disorder.

12. *HL*: A Health Visitor referred this 4;6 year old boy. His intelligibility was poor: English - 48.9 percent consonants correct; Mirpuri - 54.3 percent consonants correct. He had acquired all the phonemes used in both languages. There was a dominant unusual error pattern that was evident in both languages: HL substituted the fricative /f/ for a range of plosives and other fricatives (e.g., /s, k, b, θ, t/ ⇒ [f]). There were some language specific unusual error patterns also: English - /f, ʃ/ ⇒ [h]; initial consonant deletion of approximants /l, r, w, j/; Mirpuri - backing of affricates; substitution of /n/ ⇒ [ŋ] in final position. In addition to these unusual patterns there were also normal developmental patterns in use, however, the consistent use of patterns not used by normally developing bilingual Punjabi-English children indicated phonological disorder.

13. *RI*: This 5;2 year old girl presented with a consistent deviant phonological disorder. She had acquired all the phonemes of each language apart from /θ, ð/ in English. Her speech intelligibility was poor: English - 48.6 percent consonants correct; Punjabi - 44.6 percent consonants correct. The majority of the processes evident in RI speech were normal Punjabi-English developmental patterns: English - cluster reduction, stopping, fronting, voicing; Punjabi - cluster reduction, fronting, voicing, stopping, weak syllable deletion. However, RI made a large number of vowel errors in both languages (68 percent English vowels correct; 77 percent Punjabi vowels correct).

This pattern was not evident in the speech of the normally developing children. RI also used an unusual affrication process in Punjabi: syllable-initial fricatives were affricated (e.g., /sa^hp/ ⇒ [tsa^h], although there were examples of all the fricatives in other word positions in the speech sample. RI also backed a larger number of alveolar sounds in English than was evident in the bilingual normative group. There was no evidence of inconsistency in RI's speech in either language. The presence of unusual error patterns indicated phonological disorder.

7.3.5 PHONOLOGICAL DISORDER - INCONSISTENT

14. ZZ: Inconsistency was the dominant feature of this 3;10 year old boy's speech. His speech accuracy was very low in both languages: English - 30.2 percent consonants correct; Punjabi - 22.6 percent consonants correct. His phoneme repertoires were both restricted: he used only 8 of the consonants of Punjabi and 11 of English. He also used a bilabial fricative (a non-English sound) in his English speech. ZZ did not use any consistent error patterns other than cluster reduction in both languages. There was also evidence of very unusual error patterns (e.g., /p/ ⇒ [s]; /k/ ⇒ [f]; /l/ ⇒ [k]). He did not realise phonemes in identical phonetic contexts in the same way, nor did he produce the same lexical items identically (e.g., word-initial /p/ ⇒ [p, m, s]; /zban/ ⇒ [mam], [ka], [ban]). An informal oro-motor assessment indicated appropriate oro-motor skills, and there was no evidence of oral groping during speech. ZZ was referred by a Health Visitor.

15. NF: This 5;3 year old boy's speech was very unintelligible in both languages. He was referred by his general practitioner. There were no identifiable consistent patterns or rules governing his speech production. However, cluster reduction, initial consonant deletion, stopping and backing were all dominant errors in both languages. The

inconsistency in NF's speech was extreme. All the words, in both languages, produced more than once were produced differently. Phonemes were not consistently realised in the same way in the same phonetic context. His speech accuracy was very poor: English - 38.2 percent consonants correct; Mirpuri - 43.8 percent consonants correct. There were only two phonemes missing from the phoneme repertoire of each language: English - /ʒ, r/; Mirpuri - /x, h/. These are later developing phonemes.

7.3.6 COMMUNICATION DIFFICULTY OTHER THAN SPEECH

16. *NS*: This 2;5 year old girl presented with general language delay in both Mirpuri and English. She was only able to identify a few objects in each language in a receptive language task. Her expressive language was limited to single words. She did not appear to have any specific speech sound difficulties. *NS* was referred by her general practitioner.
17. *IR*: A Health Visitor referred this 2;5 year old girl. She had only just started using a few words in both Punjabi and English. Her mother reported that she used about five words in each language. Her receptive language skills also appeared delayed - she was not able to complete some simple one-step commands, and no two-step commands. *IR* did not use any speech during the assessment session but appeared to have a general language delay rather than specific speech difficulties.
18. *SJ*: This 2;11 year old boy presented with general language delay in both Urdu and English. He was only able to identify a few objects in each language in a receptive language task. His expressive language was limited to single words. He did not appear to have any specific speech sound difficulties. *SJ* was referred by a Health Visitor.

19. *HH*: A Health Visitor referred this 3;2 year old boy. He was only using a few words in Punjabi and English. He was not using any two-word combinations. His receptive language skills appeared slightly better than his expressive language skills in the language tasks administered. *HH* only imitated a few words during the assessment session but he appeared to have a general language delay rather than specific speech difficulties.
20. *KM*: This 4;3 year old boy was referred by a Health Visitor. His mother was not concerned about his speech development in either Punjabi or English. *KM* presented as an elective mute. The clinician overheard him talking with his mother outside the clinic room in mature connected sentences. However, *KM* will not talk at school or with non-family members. He would not produce any speech inside the clinic room.
21. *MK*: This 6;11 year old girl was referred by the school nurse. She presented with general language delay rather than specific speech sound difficulties. Her mother reported that she was late starting to talk and had always been quiet. *MK*'s speech was characterised by errors common for a younger normally developing Punjabi-English bilingual child. Her comprehension skills appeared stronger than her expressive language skills - she could understand concepts and structures not evident in her expression.
22. *TS*: This 10;9 year old boy presented with significant language difficulties. He had not been referred to a speech-language pathologist previously. His teacher was concerned about his intelligibility. Informal language testing indicated that *TS*'s language skills were approximately four years delayed - he was not using pronouns correctly, prepositions and other concept words were minimal, he could not complete tasks involving temporal or spatial relations. His speech development was slightly delayed

for his age: there was evidence of voicing errors, /θ/ ⇔ [t], /f/ ⇔ [p], and /h/ ⇔ [k]. However, his speech was intelligible and not affecting his language development.

23. *UG*: This 5;10 year old boy, referred by the school nurse, presented with mild dysfluency. His speech and language development appeared age-appropriate and his mother was not concerned about his speech development.

7.4 DISCUSSION

7.4.1 REFERRAL PATTERN

The 23 children referred for assessment of their speech skills were not all appropriate referrals. One child's speech and language skills were not considered to be either delayed or disordered. Although he was making errors in his English speech that may be considered unusual for a monolingual English child, all of his errors were in fact age-appropriate normal Punjabi-English developmental errors.

Eight of the children referred for speech sound problems presented with another form of communication difficulty. Although the children were appropriately identified by the referring agent as having communication difficulties they were not able to accurately discriminate the nature of the difficulty (e.g., speech sound problems as opposed to expressive/receptive language difficulties or dysfluency).

Several children identified as having specific language difficulties were quite old for the initial detection of language acquisition difficulties (e.g., a 3 year old only using single words; 6 and 10 year olds with significant language delays). Monolingual English children would usually be identified as soon as they enter school if their language skills were not age-appropriate. It is possible that because the children reported in this study were

bilingual their language difficulties were not discerned because of the expectation that a bilingual child will experience more difficulty with their language acquisition (Duncan, 1989).

Fourteen of the children were appropriately referred for speech assessment. The age of initial referral of many of these children was also higher than usual for monolingual children. However, the children with more severe speech disorders (consistent deviant and inconsistent) were all identified by age 5 years. The expectation that only children with severe disorders would be identified by the referring agents was not apparent. Conversely, the referral of a normally developing child suggests that some referring agents are over-sensitive to error patterns of bilingual children. The pattern suggests that children with speech difficulties are being identified, but not until they are older than the age at which most monolingual children are identified.

The pattern of referrals suggests that education of referring agents is essential to improve the referral process. Referring agents require information about normal bilingual acquisition, how to identify speech and language difficulties in younger bilingual children, and how to discriminate different types of communication difficulties.

7.4.2 SUBGROUPS OF SPEECH DISORDER

The four subtypes of speech disordered children identified in the case studies presented in Chapter 6 and in the monolingual speech disorder literature (e.g., Dodd, 1995; Fox, 1997; So & Dodd, 1994; Topbas and Konrat, 1996) were also evident in the speech patterns of the Punjabi-English children with speech disorder. The distribution of children appears similar to the pattern reported for monolingual children:

- ◆ Dodd, Leahy and Hambly (1989) found that in a sample of 55 English children 14 percent had articulation errors; 56 percent were delayed in their phonological

development; 12 percent made consistent deviant errors; and 16 percent made inconsistent errors.

- ◆ So and Dodd (1994) found that in a sample of 17 Cantonese children 12 percent had articulation errors; 47 percent were delayed in their phonological development; 29 percent made consistent deviant errors; and 12 percent made inconsistent errors.

The distribution between the subgroups in the current study was 14 percent had articulation errors; 43 percent were delayed in their phonological development; 29 percent made consistent deviant errors; and 14 percent made inconsistent errors.

7.4.3 BILINGUAL SPEECH DISORDER

All the Punjabi-English bilingual children with speech disorder described in this chapter supported the findings presented in Chapter 6 regarding the nature of speech disorder in bilingual children. The children made the same *type* of errors in both languages and used differentiated phonological systems. There was one child, however (AM) who was not clearly using two separate phonological systems. He had not acquired any language-specific phonemes and used identical processes in both languages. He was also making atypical errors in both languages. It is possible that there is a different type of speech disorder specific to bilingual children.

All the normally developing and other speech disordered children described in this thesis had clearly marked the differences between the two phonological systems they were developing. An inability to separate the two systems and mark the differences between them may be a specific bilingual disorder. However, there was only one child who appeared to have difficulty differentiating his phonological systems - more research is required to examine this possibility further.

The results of the investigation into the nature of speech disorder in bilingual children presented in Chapters 6 and 7 have clinical implications not only for the assessment and differential diagnosis of speech disorder, but also for the treatment of speech disorder in this population. For example, if children with different patterns of surface errors have different underlying deficits, they will respond differently to therapy methods that target different deficit areas. The level of breakdown in the speech processing chain may also effect the pattern of generalisation across languages. Chapter 8 will address these issues in greater detail.

CHAPTER 8:
THE TREATMENT OF
BILINGUAL CHILDREN WITH
SPEECH DISORDERS

8.1 INTRODUCTION

Intervention case studies of two children with disordered speech are presented. The children were both described in Chapter 6. The speech of Jason was characterised by articulation errors and consistent use of developmental and non-developmental phonological processes. The speech of Hafis was characterised by inconsistency.

8.2 TREATMENT CASE STUDY - JASON

The first case study reported investigates the effect of articulation and phonological therapy with a bilingual child. Jason was a 5;2 year old Cantonese-English successive bilingual. He had an articulatory distortion evident in both languages, as well as language-specific developmental and atypical phonological processes. It was hypothesised that therapy given in English would result in:

- remediation of the error pattern in both languages when the therapy targeted an articulatory distortion;
- remediation of the error pattern in English only when the therapy targeted a phonological process.

8.2.1 PRE-INTERVENTION ASSESSMENT

A detailed description of Jason's articulation errors and pattern of phonological processes was presented in Chapter 6. He was assessed at his childcare centre by a native Cantonese-speaking speech-language pathologist and then on the next day by an English-speaking speech-language pathologist. The following communication skills were assessed:

- Receptive Language - Results of the Test of Auditory Comprehension of Language-Revised (Carrow-Woolfolk, 1985) indicated delayed receptive English language skills. Jason's Cantonese language comprehension was not assessed formally, although neither

his parents nor the Cantonese-speaking speech-language pathologist were concerned about his language development.

- Oro-motor Skills - Performance on an informal oro-motor assessment suggested age appropriate oro-motor skills.
- Speech Production - The Cantonese Segmental Phonology Test (So, 1992) and Goldman Fristoe Test of Articulation (Goldman & Fristoe, 1986) were administered. Spontaneous language samples in both languages were collected.

Jason's assessment results were discussed in Chapter 6 in comparison to other normally developing monolingual children as well as normally developing bilingual (Cantonese-English) children. Table 8.1 summarises the results of Jason's initial assessment and the conclusions are outlined below.

- In comparison to monolingual Cantonese children of the same age: Jason's speech accuracy was poor; his phoneme repertoire was missing the phoneme /l/; articulation of the phonemes /s, ts, t^hs/ was distorted; three atypical error patterns were evident; three delayed developmental error patterns were used.
- In comparison to monolingual English children of the same age: Jason's speech accuracy was poor; his phone repertoire was missing /r, θ, ð/; he misarticulated /s/, /z/ and /ʃ/; one atypical error pattern, four delayed developmental processes, and two age-appropriate error patterns were evident.
- In comparison with Cantonese-English bilingual children Jason's speech accuracy was poor; two of Jason's phonological error patterns were atypical of bilingual Cantonese-English children's phonological development (nasalisation of the phoneme /l/, and blending two words into one). His errors could not simply be attributed to normal interaction between the two developing phonological systems.

- Jason's phonological patterns were quite distinct in each language. Only one developmental pattern (cluster reduction) was evident in both Cantonese and English. Neither of Jason's atypical (for the bilingual children) patterns were evident in both languages. Jason used some contradictory processes. The phonemes within the class related to /s/ were distorted in both languages.

Table 8.1 Summary of Error Data - Jason

	Cantonese	English
<i>Consonants Correct</i>	86%	58%
<i>Phones Missing</i>	/l/	/θ, ð, r/
<i>Phone Distortion</i>	/s, ts, ts ^h /	/s, z, ʒ/
<i>Phonological Processes</i>	Cluster Reduction* Consonant Harmony* Affrication* Nasalisation^ Backing^ Blending of two words^	Cluster Reduction* Gliding Stopping of affricates Final Consonant Deletion* Voicing* Fronting* Deaffrication^

Notes:

1. Quantitative data is based on the 31 words from the Cantonese Segmental Phonology Test and 43 words from the Goldman Fristoe Test of Articulation. Five of the items from the Goldman Fristoe were imitated.
2. Qualitative data is based on the spontaneous samples as well as the articulation test responses.
3. Expected and delayed* processes were determined to be present if there were at least five examples of the process on different lexical items. Atypical^ processes were noted if there were at least three examples of the process.

8.2.2 BASELINE DATA

To establish the stability of Jason's phonological system, baseline data was collected before intervention. Jason was assessed three times, at two week intervals, by the English-speaking speech-language pathologist; and twice, with a four week interval, by the Cantonese-speaking speech-language pathologist. Single word naming responses on the Goldman Fristoe Test of Articulation and the Cantonese Segmental Phonology Test were compared across the assessments. Jason's speech sound systems were relatively stable before intervention, with no notable differences between the error profiles (see Figure 8.1).

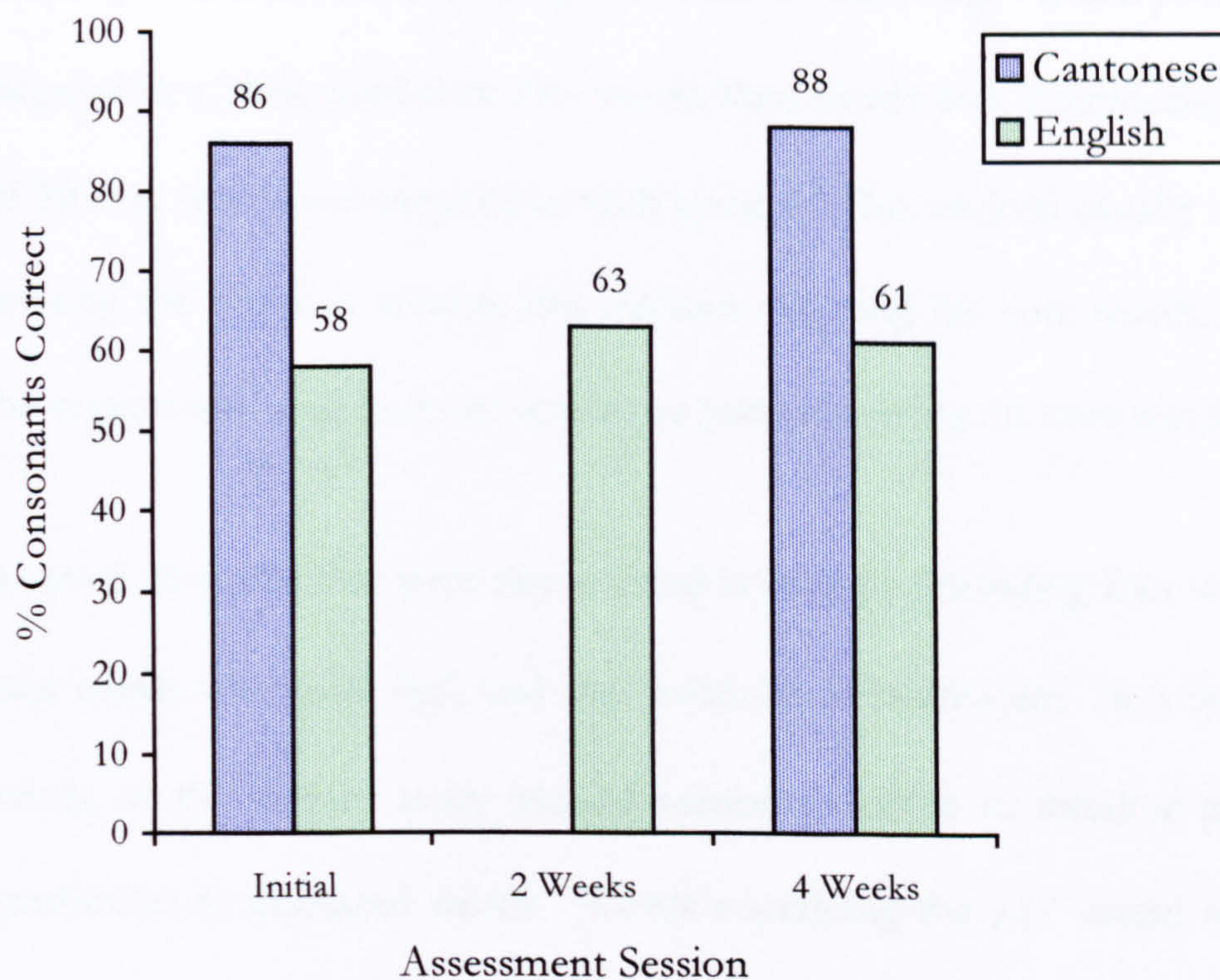


Figure 8.1 Baseline data

Notes:

1. Quantitative data collected from the Goldman Fristoe Test of Articulation and the Cantonese Segmental Phonology Test.
2. Three English assessments were made every two weeks. However, there were only two Cantonese assessments, with a four week interval.

8.2.3 PHASE I: ARTICULATION THERAPY

A traditional articulation program was used to elicit correct /s/ production. Intervention was conducted entirely in English. Therapy was provided on an individual basis with the clinician twice weekly. Therapy sessions were held at Jason's childcare centre in the morning and were approximately 20 minutes in length. Although Jason's parents did not attend the sessions, they were given feedback on his performance and activities for him to do at home.

The articulation program involved progressive stages: production of /s/ in isolation; in syllables; in words; in phrases and sentences; and in conversation. A criterion of 90 percent

accuracy was reached before progression to the next stage. Initial position /s/ words were targeted first, then word-final /s/ words, then words with intervocalic /s/. A different set of 10 core words was targeted in each session. The sessions usually involved five minutes revising the previous session, five minutes targeting the core words, and then the rest of the session was used to do an activity or game involving the core words.

A set of 20 words that were not targeted in therapy (including four words with initial /s/, four words with final /s/, and two words with intervocalic /s/) were elicited, as single words, at the end of every second session in order to monitor generalisation of /s/ production to untreated words. Words containing the /ʃ/ sound were also included to assess generalisation of therapy to this sound. Jason's productions of /s/ and /ʃ/ were similar in that he used an atypical oral position (a labiodental lip position with palatalisation of the tongue). It was expected, therefore, that once Jason had been taught to use a correct articulatory posture for the production of /s/, he would also be able to articulate /ʃ/ more clearly. The phonological processes of gliding and cluster reduction were also monitored throughout the therapy phase by including words in the generalisation probe set that allowed Jason to show evidence of these patterns.

8.2.3.1 PROGRESS DURING ARTICULATION THERAPY

Jason required two sessions of practice and feedback before he was able to produce /s/ accurately and consistently in isolation. The next two sessions of therapy targeted initial /s/ in nonsense syllables. Sessions 5-8 focused on initial /s/ single syllable words and introduced final /s/ nonsense syllables. Session 9 involved using the core words in carrier phrases. Jason then missed two weeks due to asthma. Sessions 10-11 continued to use carrier phrases and introduced final /s/ words. Sessions 12-14 involved longer sentences

with initial /s/ words, final /s/ words in short phrases and the introduction of medial /s/ words. Session 15 was a reassessment of Jason's speech in both Cantonese and English. A four week break from therapy occurred over the Christmas holidays. Following the break Jason was again reassessed to monitor the stability of his productions.

Figure 8.2 shows Jason's accuracy on the 10 /s/ targets within the 20 words elicited to measure generalisation. Over the 14 sessions of articulation therapy Jason's ability to produce an acceptable version of the /s/ phoneme in various positions in single words improved. His production accuracy of /ʃ/ also improved even though it was not targeted directly in therapy. The lack of change in the pattern of phonological processes that were monitored indicated that Jason's phonology was not developing spontaneously.

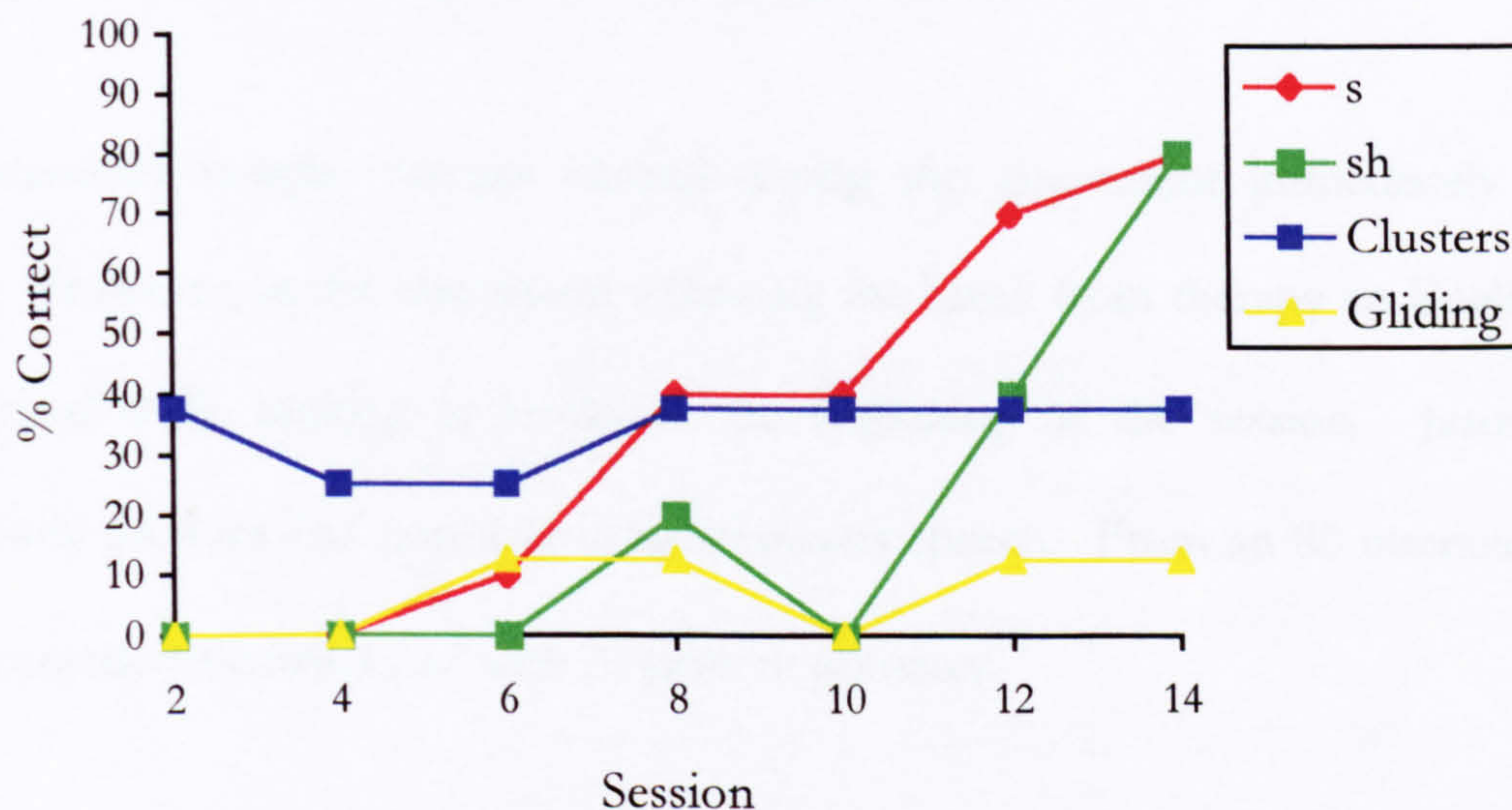


Figure 8.2 Progress on untreated generalisation probes during articulation therapy

Notes:

1. Quantitative data collected from 20 word generalisation probe collected at every second therapy session.
2. Clusters were counted as correct if both elements of the cluster were marked.
3. There was a two week interval between Sessions 9 and 10.

8.2.3.2 CHANGES IN CONSONANT ACCURACY FOLLOWING ARTICULATION THERAPY AND AFTER A BREAK FROM THERAPY

Pre-treatment and post-treatment accuracy of consonants in Cantonese and English elicited by the standardised speech assessments were compared to consonant accuracy following a four week withdrawal from therapy (see Figure 8.3).

An improvement in accuracy of consonants in the standardised assessments was observed during the therapy period. This improvement was maintained over the four week break from intervention. This improvement was evident in both Jason's languages, even though the therapy was only given for English words. In the assessment session immediately following articulation therapy Jason produced /s/, /z/, and /ʒ/ with 90 percent accuracy in the Goldman Fristoe Test of Articulation and /s/, /ts/ and /ts^h/ with 87.5 percent accuracy in the Cantonese Segmental Phonology Assessment.

A spontaneous sample was not elicited during the assessment immediately following therapy. However, in the assessment following the break from therapy an English sample was elicited while looking at books at the beginning of the session. Jason did not consistently produce /s/ correctly in spontaneous speech. From an 80 utterance sample, Jason correctly articulated /s/ with 72 percent accuracy.

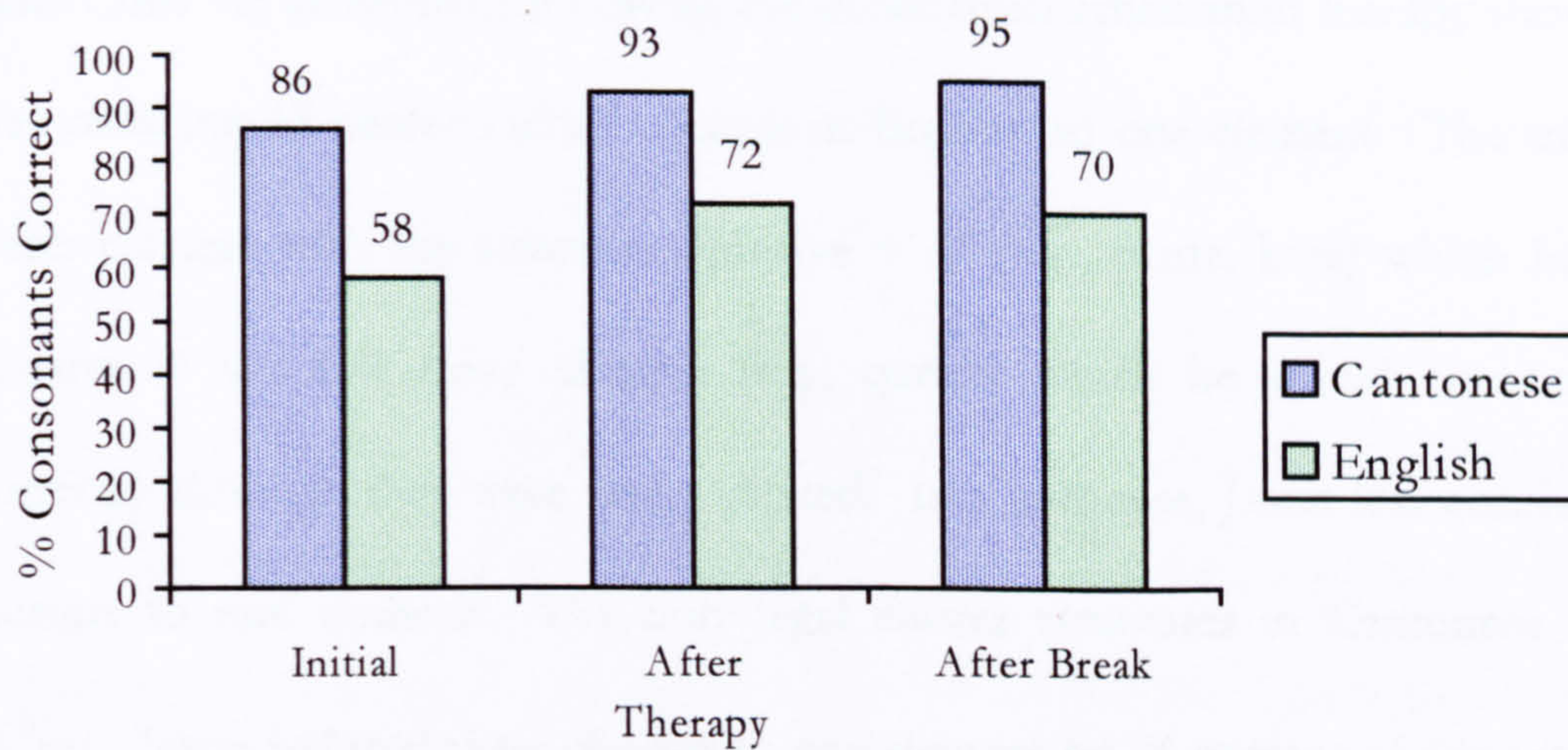


Figure 8.3 Consonant accuracy before articulation therapy, at the conclusion of therapy, and after a four week break from therapy

Notes:

1. Quantitative data collected from the Goldman Fristoe Test of Articulation and the Cantonese Segmental Phonology Test.
2. The only changes in qualitative error patterns were correct articulation of the phonemes targeted in therapy. Other error patterns were still evident.

8.2.4 PHASE II: PHONOLOGICAL THERAPY

Following the successful remediation of Jason's articulation errors in Cantonese and English, Jason's mother requested the continuation of therapy to target some of the other errors in his speech. Cluster reduction was the only process that Jason used in both Cantonese and English. For this reason it was chosen as one of the targets for phonological therapy. The other process targeted was gliding of /r/ and /l/ to [w]. This process was chosen because baseline data had been kept on the stability of this process during the articulation therapy (see Figure 8.2). Both cluster reduction and gliding were consistent and stable processes in Jason's speech. This was important to establish because rules that are not frequently or consistently used are not good candidates for phonological contrast therapy (Dodd & Iacono, 1989).

Data from the assessment following the break from articulation therapy showed that Jason was reducing 62 percent of all clusters in English to one element. The main exceptions were: clusters with the structure /plosive + l/ (e.g., plane, blue) which he simplified to [plosive + w]; and /kw/ clusters (e.g., queen) which he would occasionally produce correctly although they were rarely elicited. In Cantonese, Jason less consistently reduced clusters to one element. The only legal cluster structures in Cantonese are /kw/ and /k^hw/. Jason reduced these clusters to one element on 36 percent of opportunities.

Jason commenced primary schooling in the new year so therapy was provided on a weekly basis either at Jason's home or in a university clinic. The therapy sessions were approximately 45 minutes long. Jason's mother attended the therapy sessions and was actively involved in providing feedback to Jason.

Phonological contrast therapy, based on the concept of making the child aware that speech sounds convey meaning, was used to target Jason's phonological processes. Line drawings of minimal pairs and triplets were used as stimuli. The first stage of therapy involved highlighting the differences between the words, ensuring that Jason could discriminate both the sounds and the meaning between them (e.g., lip vs. whip or ski vs. sea vs. key). Each target process used 10 sets of words. The next stage involved the production of the target words in order to signal appropriate meanings. Words in phrases were then targeted. A 90 percent criterion was reached before progression to the next stage. Both cluster reduction and gliding were targeted in each session. Activities were provided for Jason's mother to do with him at home.

The clusters chosen for therapy were restricted by Jason's vocabulary. Ideally it would have been good to work on /kw/ clusters in English so that a direct comparison to the clusters in Cantonese could be made. Unfortunately Jason only had a couple of words in

his English vocabulary that included a /kw/ cluster and he was able to imitate word-initial /kw/ words correctly. Therefore, it was not possible to include /kw/ clusters as therapy targets.

The same words used as the generalisation probes in the articulation therapy were used to monitor generalisation of the phonological therapy to untreated words. This also meant that Jason's production of /s/ and /ʃ/ could be monitored. These words were elicited at every second therapy session.

8.2.4.1 PROGRESS DURING PHONOLOGICAL THERAPY

Jason required only one session of discrimination training. Sessions 2-4 concentrated on single word production discrimination between the words. Sessions 5-8 consolidated accurate single word production and the production of the target words in carrier phrases and sentence construction activities. This therapy approach was successful in targeting cluster development and accurate production of /r/ and /l/. Generalisation to untreated words and clusters occurred (see Figure 8.4). The production of /s/ and /ʃ/ also remained stable reflecting the specificity of the intervention method. A spontaneous speech sample was collected at the end of the eighth session. Jason was assessed on the standardised tests following a three week break from the phonological therapy. Spontaneous speech samples were also collected at this session.

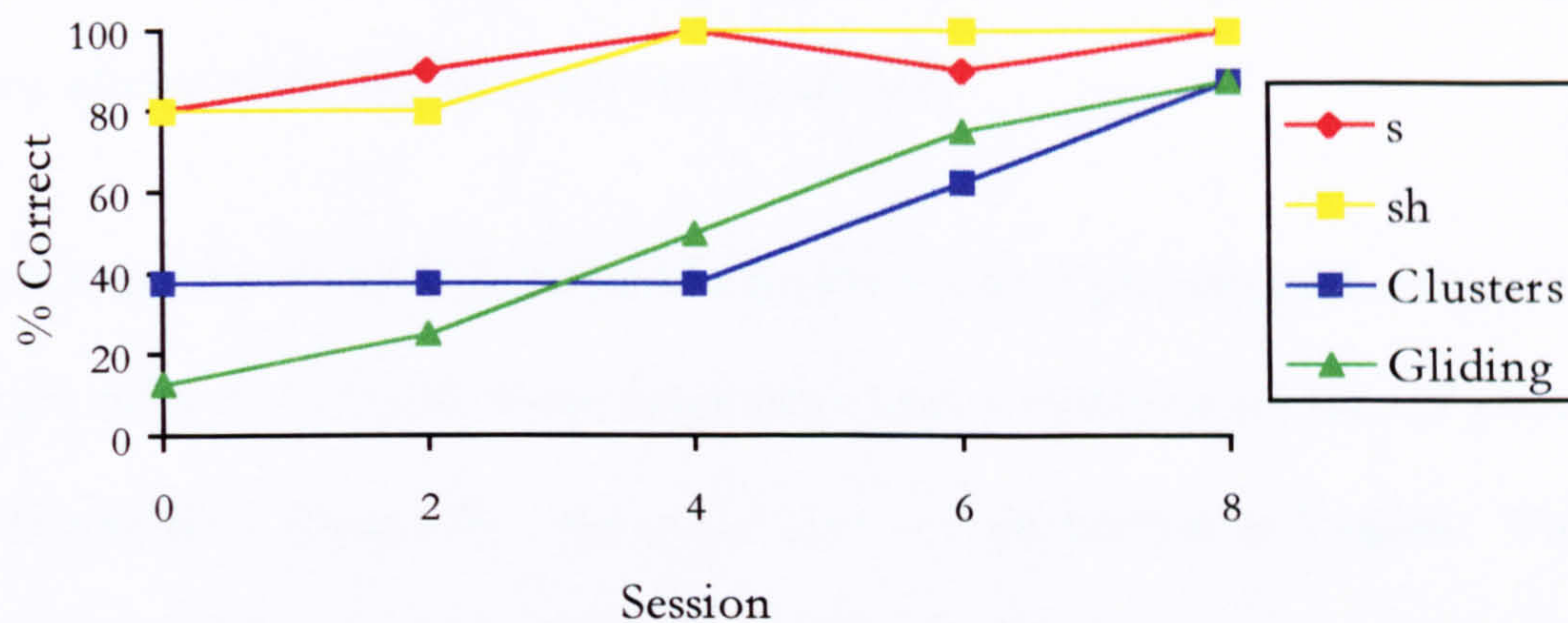


Figure 8.4 Progress on untreated generalisation probes during phonological therapy

Notes:

1. Quantitative data collected from 20 word generalisation probe collected at every second therapy session.
2. Clusters were counted as correct if both elements of the cluster were present. The words in the generalisation probe only contained one /s/ cluster.
3. 6 of the 8 /r/ and /l/ sounds probed for evidence of gliding were also in clusters.

8.2.4.2 CHANGES IN CONSONANT ACCURACY FOLLOWING PHONOLOGY THERAPY AND AFTER A BREAK FROM THERAPY

Specific consonant accuracy scores can be compared between spontaneous speech samples collected following the break from articulation therapy and immediately following the phonological therapy (see Figure 8.5).

Overall consonant accuracy scores can also be compared between Jason's productions on the standardised assessments and in spontaneous speech in both languages following the break from articulation therapy and following the break from phonological therapy (see Figure 8.6).

The data shows that Jason's English consonant accuracy improved following the phonological therapy. However, unlike the generalisation to Cantonese observed from the articulation therapy, there was no notable change in Jason's Cantonese consonant accuracy following phonological therapy. Jason's only shared phonological process, cluster

reduction, was suppressed significantly in English, but he showed no notable change in the accuracy of his clusters in Cantonese (see Figure 8.5).

Figure 8.5 also shows the clear distinction between Jason's phonological systems in regard to the phoneme /l/. In Cantonese Jason continued to substitute [n] for /l/ consistently, even though after therapy he achieved correct /l/ production in English. The other processes evident in Jason's initial assessments in Cantonese and English were still present following phonological therapy.

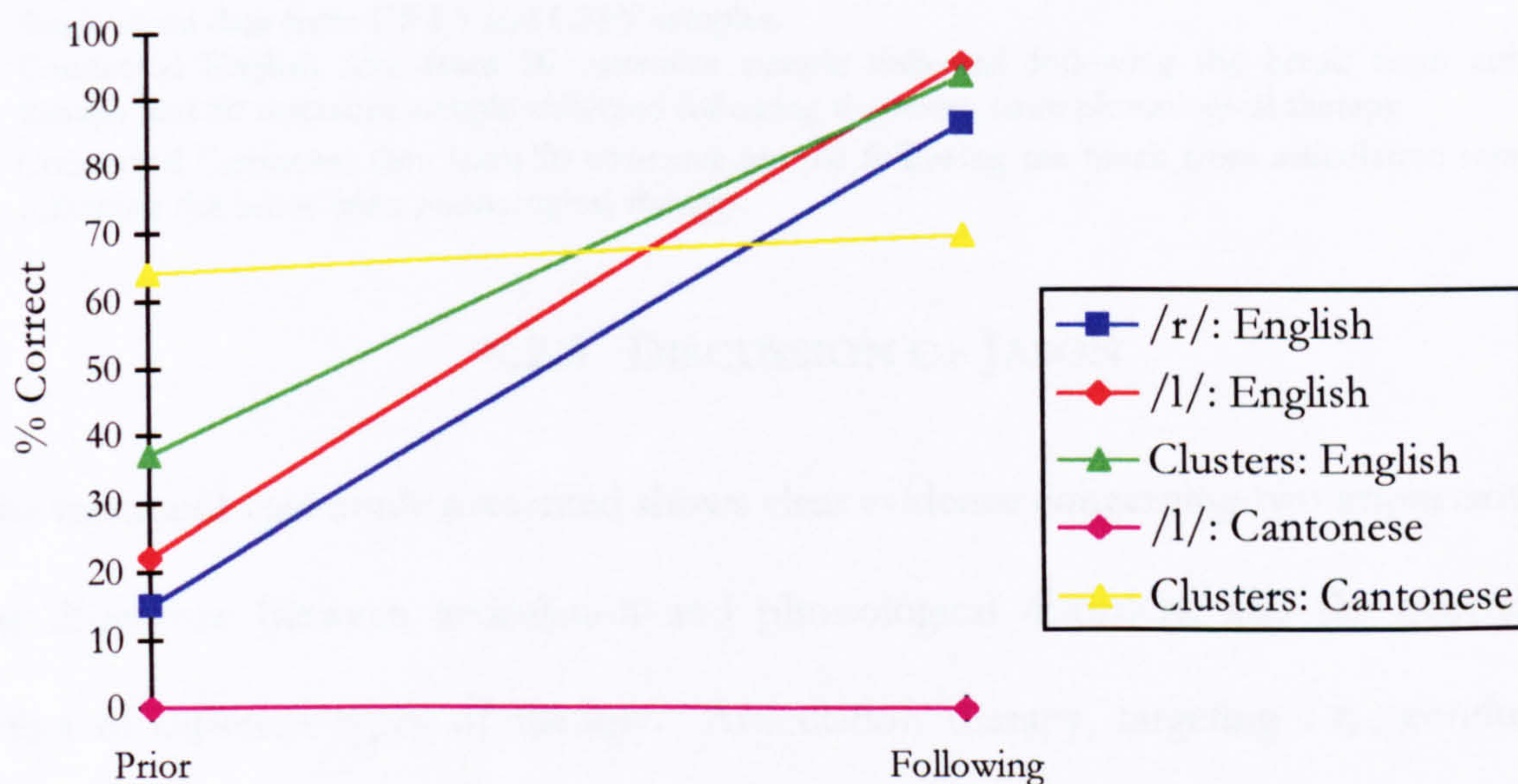


Figure 8.5 Accuracy in spontaneous English speech before phonological therapy and immediately following therapy

Notes:

1. Data from 80 utterance spontaneous speech collected following the break from articulation therapy and 50 utterance sample collected at the end of Session 8 of phonological therapy.
2. Clusters were counted as correct if both elements of the cluster were marked.

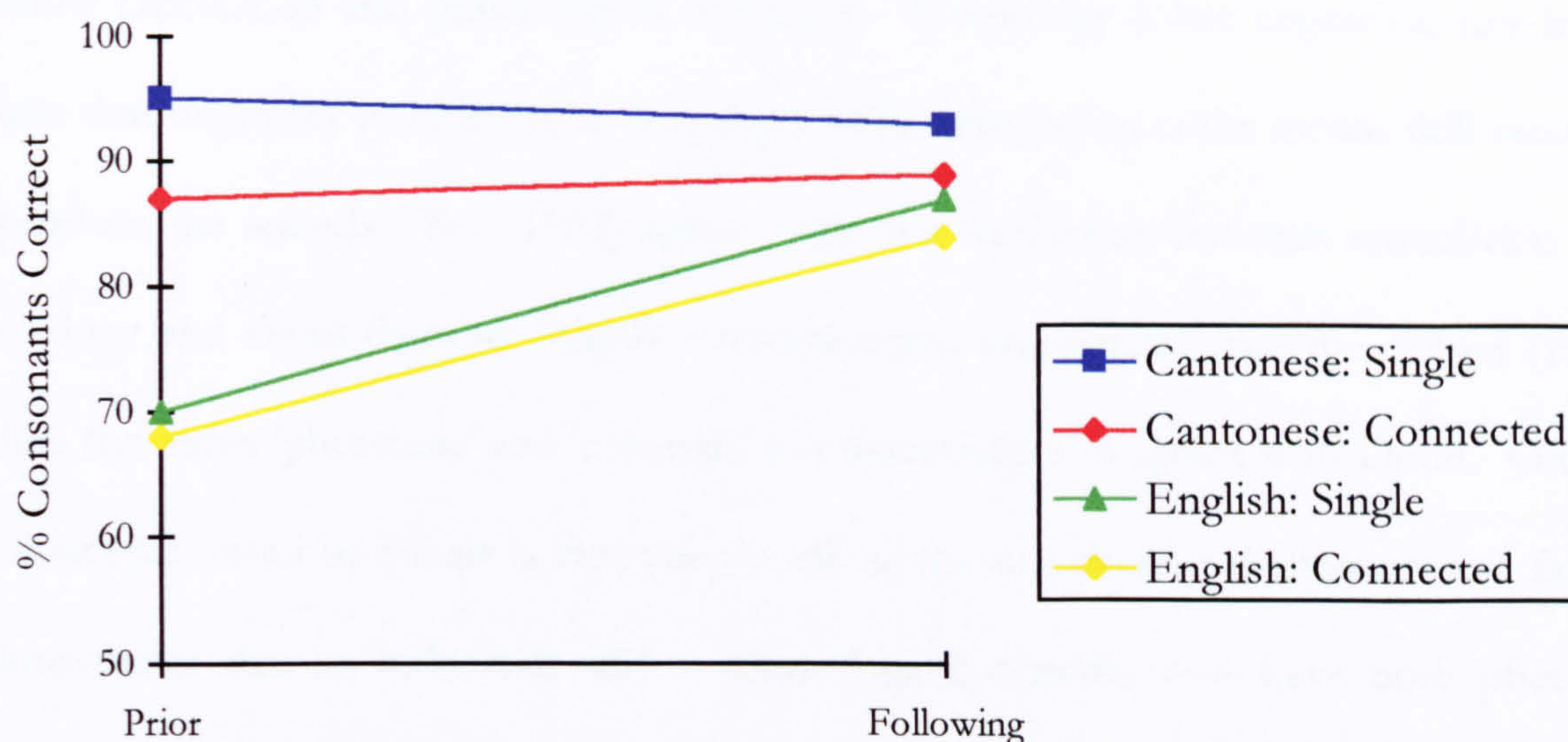


Figure 8.6 Consonant accuracy before phonological therapy and after a three week break from therapy

Notes:

1. Single word data from GFTA and CSPT samples.
2. Connected English data from 80 utterance sample collected following the break from articulation therapy and 50 utterance sample collected following the break from phonological therapy.
3. Connected Cantonese data from 20 utterance sample following the break from articulation therapy and following the break from phonological therapy.

8.2.5 DISCUSSION OF JASON

The treatment case study presented shows clear evidence concerning two important issues: the difference between articulation and phonological disorders, and the generalisation effect of different types of therapy. Articulation therapy, targeting /s/, conducted in English and only with English target words, generalised into the correct production of /s/ in Cantonese. Phonological therapy, targeting a shared phonological process across Cantonese and English (cluster reduction), did not generalise from English to Cantonese. Phonological therapy in English did not have any effect on consonant accuracy in Cantonese.

Over the last 15 years the distinction between phonology and articulation and the relationship between them has been widely discussed. Dodd (1995) clearly differentiates

between articulation and phonological disorders. Phonology is the cognitive, rule-based system that organises sounds within language, while articulation is the motor skill required to produce the sounds. Fey (1992) agrees with this distinction between articulation and phonology and views them as “highly interdependent constructs” (p.228). Elbert (1992) prefers the terms 'phonemic' and 'phonetic' but essentially also agrees with Dodd. One of the concerns raised by Elbert is that people will adopt an either/or dichotomy and fail to “acknowledge that an individual with a phonological disorder may have both phonetic [articulation] and phonemic [phonological] problems occurring within the same disordered system” (p.242). The errors Jason produced are a good example of such an individual.

Dodd (1995) defined articulation disorders as an inability to produce a perceptually acceptable version of particular phones, either in isolation or in any phonetic context. Jason was unable to produce an accurate /s/ in either Cantonese or English. His distortion of the sound was the same in both languages. He appeared to have learned the wrong motor program, in that he used a labiodental lip position with palatalisation of the tongue for both /s/, /z/ and /ʃ/. Articulation disorders in bilingual children are easily identifiable for phonemes shared by the two languages - by definition the child must produce the same phoneme in the same way in both languages or it is not simply a motoric error but governed by phonological constraints.

Therapy that corrected Jason's motor program, through feedback about tongue and lip position, resulted in a generalised remediation in both his languages. However, a similar pattern to Jason's, of generalisation across bilingual children's languages, has been previously reported. McNutt (1994) reported evidence from seven bilingual French-English children. A motor based articulation therapy program provided in English, generalised into French for all the children. The children in the study had phonetic errors that were identical across their languages. Intervention successfully resolved the motoric

errors - indicating that the errors were peripheral and not embedded in language-bound constraints.

Phonological disorders, however, are not the result of motor program errors. Consistent non-developmental errors might be due to an impaired ability to abstract knowledge about the nature of the phonological system to be acquired (Dodd, 1995). Jason's phonological systems were not identical, and the processes he used in each language were different. The errors he was making were not normal for bilingual Cantonese-English children either, so it cannot be suggested that his errors were due to normal interference between the languages - he was having trouble abstracting knowledge about both of the systems. The data clearly shows that Jason had a combination of articulation and phonological errors, and that these errors had different underlying causes.

There are two pieces of evidence that suggest that Jason had two separate phonological systems. The first is that the phonological error patterns were different in each language. The example, previously cited, of Jason's backing /t/ to [k] in Cantonese but not in English is a clear illustration of a phoneme that had been acquired and was used appropriately in one language and yet in the other language an incorrect process was evident. The second piece of evidence is the lack of generalisation across languages following phonological therapy.

The basic goal of phonological therapy is to "facilitate cognitive reorganisation of the child's phonological system and his phonologically-oriented processing strategies" (Grunwell, 1985, p.99). The phonological therapy given was successful in re-organising Jason's system, but only in one of his languages. Phonological therapy did not generalise from English to Cantonese. In fact, phonological therapy had no effect on Jason's Cantonese. Jason must have had separate phonological systems otherwise you would

expect the error patterns to be identical in each language and you would expect that intervention would resolve errors in both languages not just one. The lack of generalisation clearly shows that Jason's phonological systems were separate: he was not using the one phonological system for both languages.

The effect of the phonological therapy on Jason's speech suggests that the phonological contrast therapy was not actually targeting the underlying deficit (an inability to abstract the correct phonological rules). It was simply teaching the correct contrasts for the phonology of that language.

The data presented bears on another minor theoretical point regarding specific patterns of generalisation. It was hypothesised that similar patterns would be evident in both monolingual and bilingual children although the generalisation would only occur within-language. The different types of generalisation were presented in Section 6.7.2. The data from Jason's treatment effects suggest that generalisation occurred:

- across lexical items: changes in the untaught generalisation probes were evident;
- across phonetic contexts: Jason was able to master final and medial position /s/ more rapidly than initial-position;
- across levels of linguistic complexity: although most of the therapy targeted single word or set phrase level targets, there was generalisation evident in conversational speech;
- across sound categories: treating /s/ generalised to the other within-class sounds -/z/, /ʃ/, /ts/, /ts^h/;
- across error patterns: teaching a limited number of words with meaning contrasts targeting the pattern of cluster reduction and gliding, generalised to other words affected by those patterns.

8.3 TREATMENT CASE STUDY - HAFIS

The second case study reported in this chapter also investigates the effect of phonological therapy with a bilingual child. However, Hafis made inconsistent errors in both languages.

It was hypothesised that:

- a *core vocabulary* approach would effectively increase consistency of production in the language that was targeted in intervention; and
- that generalisation to the other language would occur. Generalisation across language would indicate that the core vocabulary approach was effectively targeting the underlying deficit (difficulty generating phonological output plans). Previous research regarding core vocabulary therapy has documented generalisation from treated to untreated words (Dodd & Iacono, 1989; Bradford-Heit, 1996). This generalisation suggests that the intervention successfully changes the underlying phonological planning system, not just lexical items. In Chapter 6 it was argued that bilingual children use the same “phonological planner” to process the phonology of each language. Therefore, generalisation from one language to the other would occur.

8.3.1 PRE-INTERVENTION ASSESSMENT

A detailed description of Hafis’s speech production was presented in Chapter 6. Hafis was a 4;6 year old Punjabi-English successive bilingual child. He was assessed by an English-speaking speech-language pathologist. Hafis’s mother elicited speech in Punjabi during the assessment. The following communication skills were assessed:

- Receptive Language - Results of the British Picture Vocabulary Scales (Dunn, Dunn, Whetton & Pintillie, 1982) and the Test for Reception of Grammar (Bishop, 1983) indicated age-appropriate English receptive language skills. Hafis’s Punjabi language comprehension was not formally assessed.

- Oro-motor Skills - Performance on an informal oro-motor assessment suggested age-appropriate oro-motor skills.
- Speech Production - The Goldman Fristoe Test of Articulation (Goldman & Fristoe, 1986), the 25 Word Test for Inconsistency (Dodd, 1995), and the Rochdale Assessment of Mirpuri Phonology (RAMP; Punjabi Version: Stow & Pert, 1998) were administered. Twenty words from the RAMP were elicited three times to determine the consistency of Hafis's production in Punjabi. Connected speech samples were not elicited in either language.

Hafis's assessment results were discussed in Chapter 6 in comparison to other normally developing monolingual English children as well as normally developing bilingual (Punjabi-English) children. Table 8.2 summarises the results of Hafis's initial assessment and the conclusions are outlined below.

- Hafis's speech indicated that his phonetic development was age-appropriate. The few English phonemes he was missing are later developing phonemes in monolingual English children and are phonemes not used in Punjabi (Prather, Hendrick & Kern, 1975; Holm, Dodd, Stow & Pert, in press).
- His speech accuracy was poor in both languages, although he was more accurate in Punjabi than English.
- Hafis's speech was inconsistent in both languages. Inconsistency is indicative of disorder in both Punjabi and English monolingual and bilingual children (Holm, Dodd, Stow & Pert, in press).
- There was no clear pattern to Hafis's substitution patterns in English. His substitutions were equally as variable in Punjabi.
- His degree of inconsistency was consistent and overall consonant accuracy was relatively stable.

- Some phonological processes were identified in each language, however few of these processes were always applied (processes used are outlined in Table 8.2). The phonological processes identified were primarily processes evident in normally developing bilingual Punjabi (Holm, Dodd, Stow & Pert, in press). However there were also some error patterns that were atypical (e.g., medial consonant deletion in English).

Table 8.2 Summary of Error Data - Hafis

	Punjabi	English
<i>Consonants Correct</i>	57.7%	44.9%
<i>Inconsistency</i>	45%	56%
<i>Phones missing</i>		/θ, ð, ʒ/
<i>Phonological Processes</i>	Cluster reduction Stopping Affrication Backing Nasalisation De-/voicing/aspiration Initial consonant deletion	Cluster reduction Stopping De-/affrication Backing/Fronting Gliding Medial consonant deletion Final consonant deletion/non-release De-/voicing/aspiration Consonant addition

Notes:

1. Quantitative data is based on the Goldman Fristoe Test of Articulation and Rochdale Assessment of Mirpuri Phonology speech samples. Qualitative data is based on the entire speech corpus collected.
2. Processes were determined to be present if there were at least five examples of the process in different lexical items.
3. A word was considered inconsistent if it was not produced in the same way on the three trials.

8.3.2 BASELINE DATA

Before the first intervention session and two weeks following the initial assessment, Hafis was reassessed on the Goldman Fristoe Test of Articulation and the RAMP to establish the stability of his phonological system. Comparison of Hafis's pattern of substitutions and percent consonants correct (PCC) from the two assessment sessions revealed no noticeable differences in either language. The results of these assessments are presented in Figure 8.7.

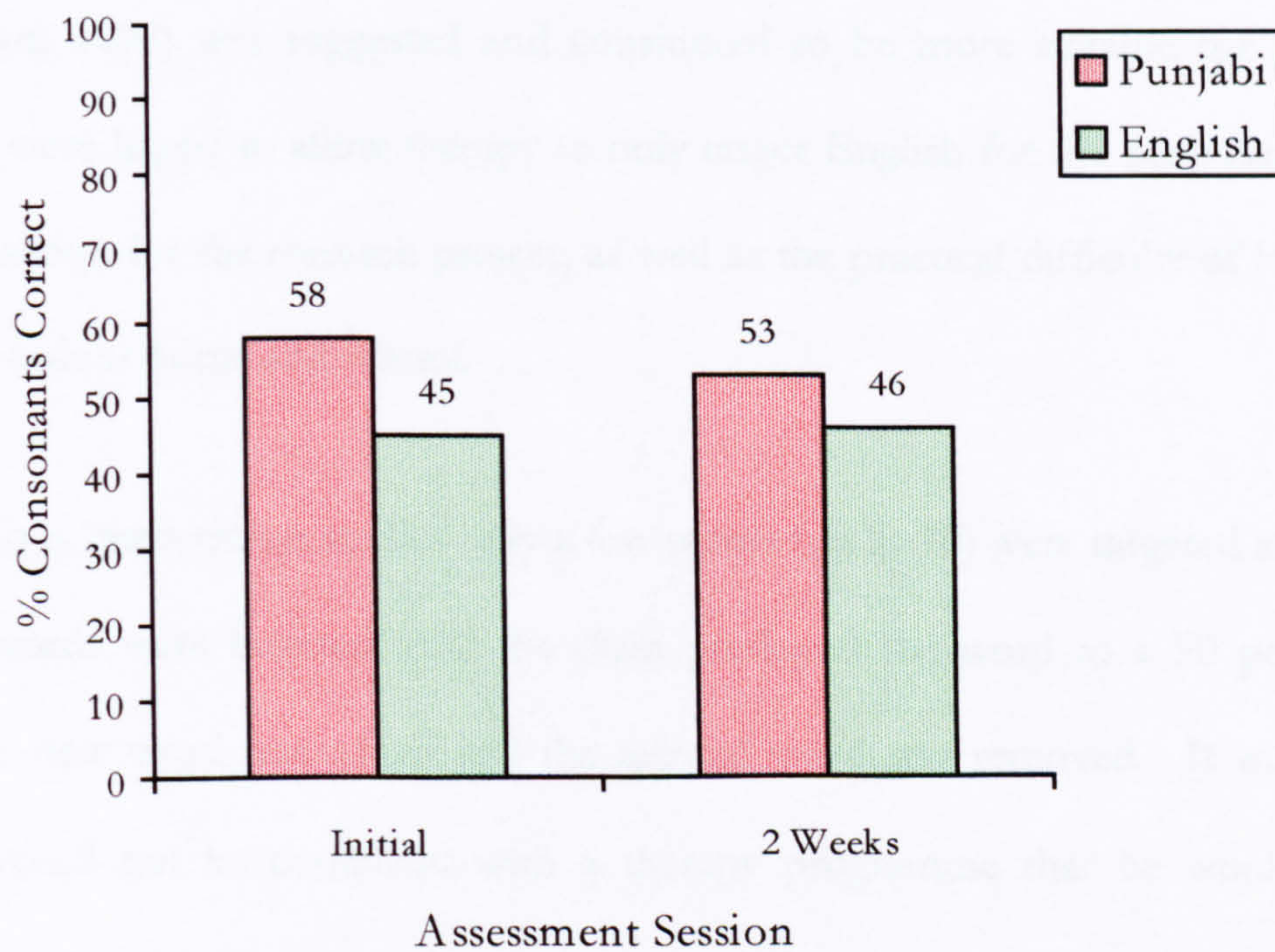


Figure 8.7 Baseline data

8.3.3 CORE VOCABULARY THERAPY

A core vocabulary therapy approach was used to target increasing the consistency of Hafis's phonology. Therapy was provided on an individual basis with the clinician twice weekly. Therapy was provided only in English. Therapy sessions were

alternately conducted in Hafis's home and school to allow liaison with both his teacher and parents. There were 16 thirty minute sessions over an eight week period.

Before starting the intervention, the clinician met with Hafis, his parents and his teacher, to determine a list of words that were functionally 'powerful' for him (categories of people, food, school activities, places, TV shows etc. were used to prompt suggestions). A list of 50 words was established. The clinician explained the principles of core vocabulary therapy to Hafis's parents and teacher. A modified approach to that described previously in the literature (Bradford & Dodd, in press; Dodd & Iacono, 1989; Dodd, McCormack & Woodyatt, 1994) was suggested and considered to be more suitable for Hafis. Hafis's parents were happy to allow therapy to only target English for the purpose of monitoring generalisation for the research project, as well as the practical difficulty of having different target words at home and school.

In previous intervention studies only a few words (up to 10) were targeted at any one time. These words were targeted until the child produced the word to a 90 percent criterion before a new word was added and the learned word was removed. It was decided that Hafis would not be compliant with a therapy programme that he would find boring. Therefore, a motivating reward system was established with a chart of all the target words listed.

Each week 10 words were drawn randomly from the set of 50 target words. Hafis was taught the 10 words by the clinician, and then those words were targeted consistently by his parents and teacher throughout the week and revised in the second session with the clinician. Some of the words were able to be taught correctly, and for others developmental errors were accepted (e.g., Hafis had great difficulty with his clinician's name so [æwəsə] was accepted as the target for "Alison" - which was significantly better

than his initial attempts of [ædə] and [salə]). It was emphasised that the primary target of the program was making sure Hafis produced the word exactly the same way each time he said it, not achieving an error-free production.

Production was drilled sound-by-sound by linking sounds to letters because Hafis's sound segmentation skills and letter awareness were good. After the initial session where Hafis learned the target words, his parents and teacher consistently required him to produce those 10 words in the same way throughout the week. Hafis went through the 10 words on average five times each day, as well as being reinforced on his productions of those words in everyday communication situations. His parents and teacher used the same teaching strategies as the clinician. Hafis's parents did not target any words in Punjabi. The same 10 words were revised in games (e.g., Memory, Snakes and Ladders) during the second weekly session with the clinician.

At the end of the second weekly session Hafis had a "test" where he had to produce the 10 words three times. Untreated probes (a set of 10 untreated words matched to the target words were used each week) were also elicited three times to monitor generalisation. Hafis's progress was drawn on to his chart and his parents implemented a reward scheme linked to his progress on the weekly words. Any words that Hafis could produce consistently were then removed from the list of 50 words. The other words remained on the list from which the next week's 10 words were randomly chosen.

Hafis found the intervention program rewarding and was motivated to continually try to produce the target words consistently. His parents and teacher were also extremely committed to the intervention program and ensured that Hafis was consistently reinforced to use the specified production of each word. It was also important to decide a set period

(for Hafis this was eight weeks) for the intervention to occur, so that everyone involved was able to commit to it knowing when it was going to end.

8.3.3.1 PROGRESS DURING INTERVENTION

Over the eight weeks Hafis learned 52 words consistently (some additional words were chosen for the final week as he had gone through the list of 50). Following the eighth therapy session, Hafis was reassessed on the consistency tasks used in the initial assessment. In addition, 10 of the words from the treated and matched untreated probe word lists were selected randomly and elicited three times. After a two week break from therapy (Hafis's parents and teacher also stopped reinforcing Hafis's consistency), he was reassessed in the same way to monitor the stability of the changes observed.

8.3.3.2 GENERALISATION TO UNTREATED WORDS

Figure 8.8 shows Hafis's consistency of production improved over the eight weeks of therapy (e.g., in the first week of therapy Hafis produced 4 of the 10 words targeted consistently; in the final assessment he produced 9 of the 10 randomly selected treated words consistently). His consistency increased not only on the words specifically targeted in therapy but also on the untreated probe words. Hafis was able to maintain this increased consistency following a two week break from therapy.

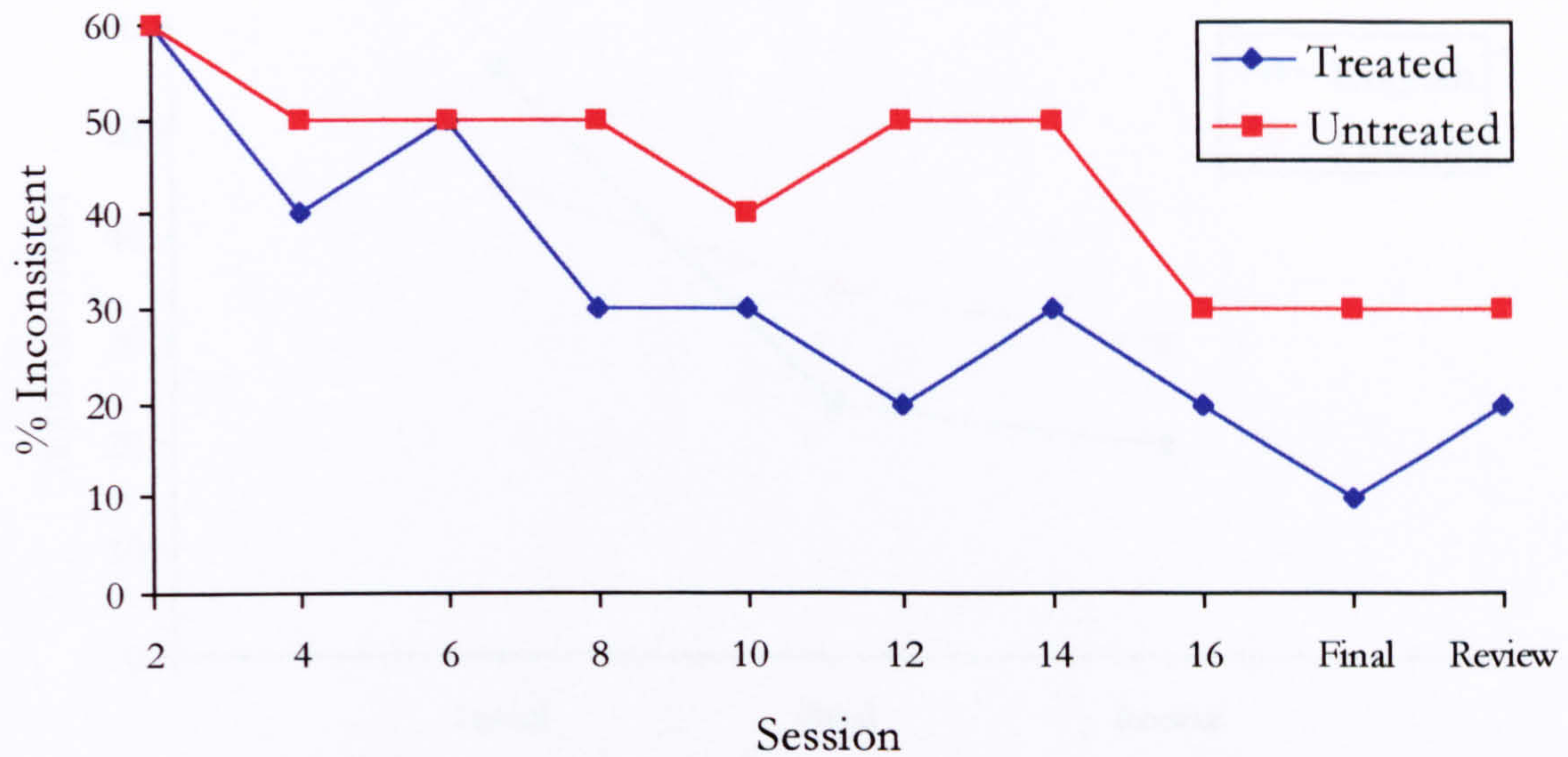


Figure 8.8 Hafis’s consistency on treated and untreated probes during intervention.

8.3.3.3 GENERALISATION ACROSS LANGUAGES

Although the intervention strategy only targeted the consistency of Hafis’s English phonological system, there was also an increase in the consistency of Hafis’s Punjabi productions. Figure 8.9 shows the generalisation in consistency across languages evident from the 25 Word Test and 20 words from the RAMP elicited three times. The change in the consistency of Hafis’s English was greater than in Punjabi. However, both languages were below the 40 percent inconsistency criterion used for classification of speech as “inconsistent” (Dodd, 1995) in the final and review assessments.

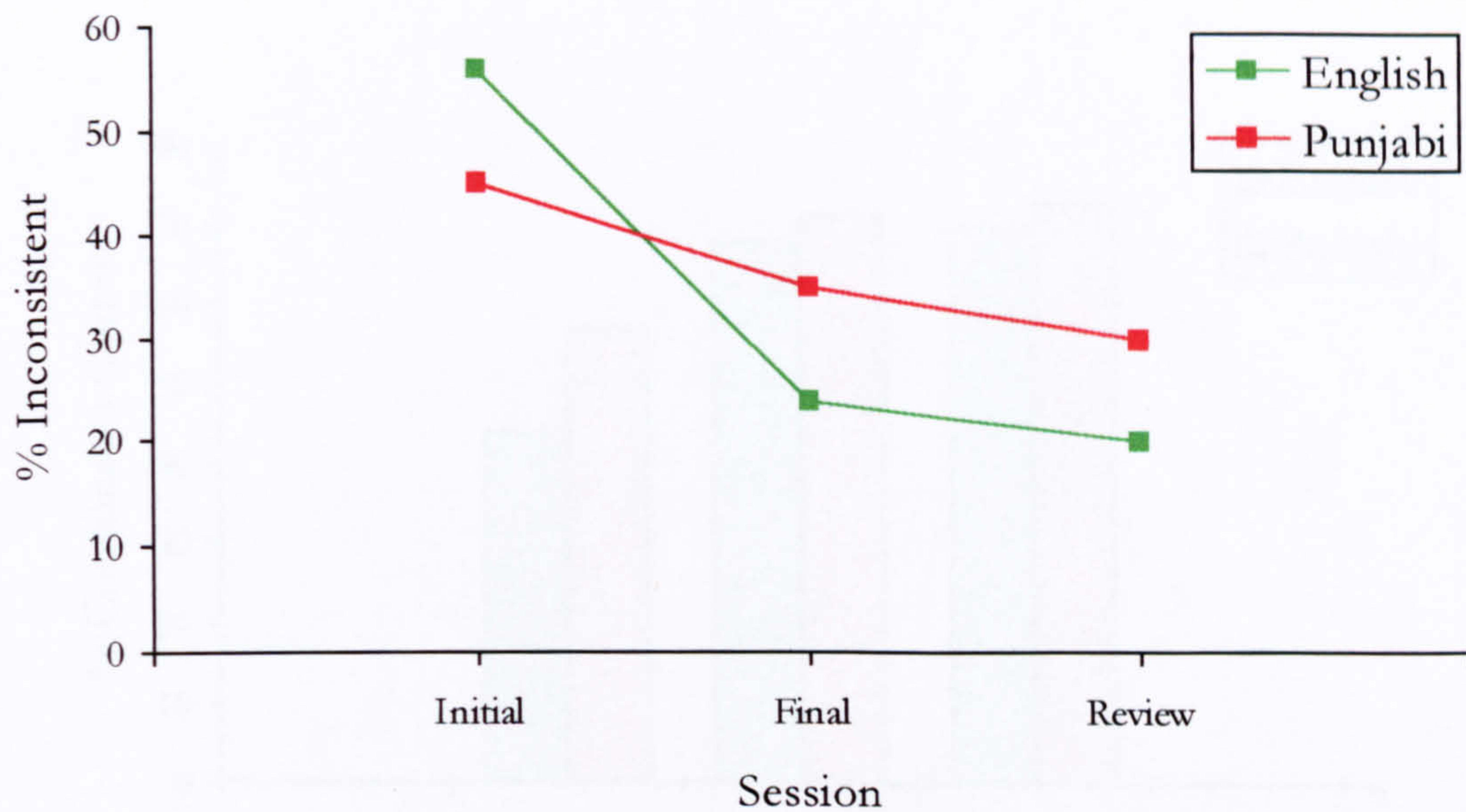


Figure 8.9 Generalisation of consistency across languages following intervention

8.3.3.4 CHANGES IN CONSONANT ACCURACY FOLLOWING INTERVENTION

Hafis's consonant accuracy increased significantly in both Punjabi and English (Punjabi: increase of 16 percent; English: increase of 26 percent). The changes in consonant accuracy are shown in Figure 8.10. Hafis was not only more consistent in his production of the same word on different occasions, he was also more consistent in his substitution patterns following intervention (see Figure 8.11, cf. Figure 7.3). For example, he generally only used either the correct phoneme or one other phoneme instead of the almost free variation between up to six phonemes evident in his earlier assessments. His speech was still affected by developmental phonological processes but there was no evidence of atypical processes in his speech at the review assessment.

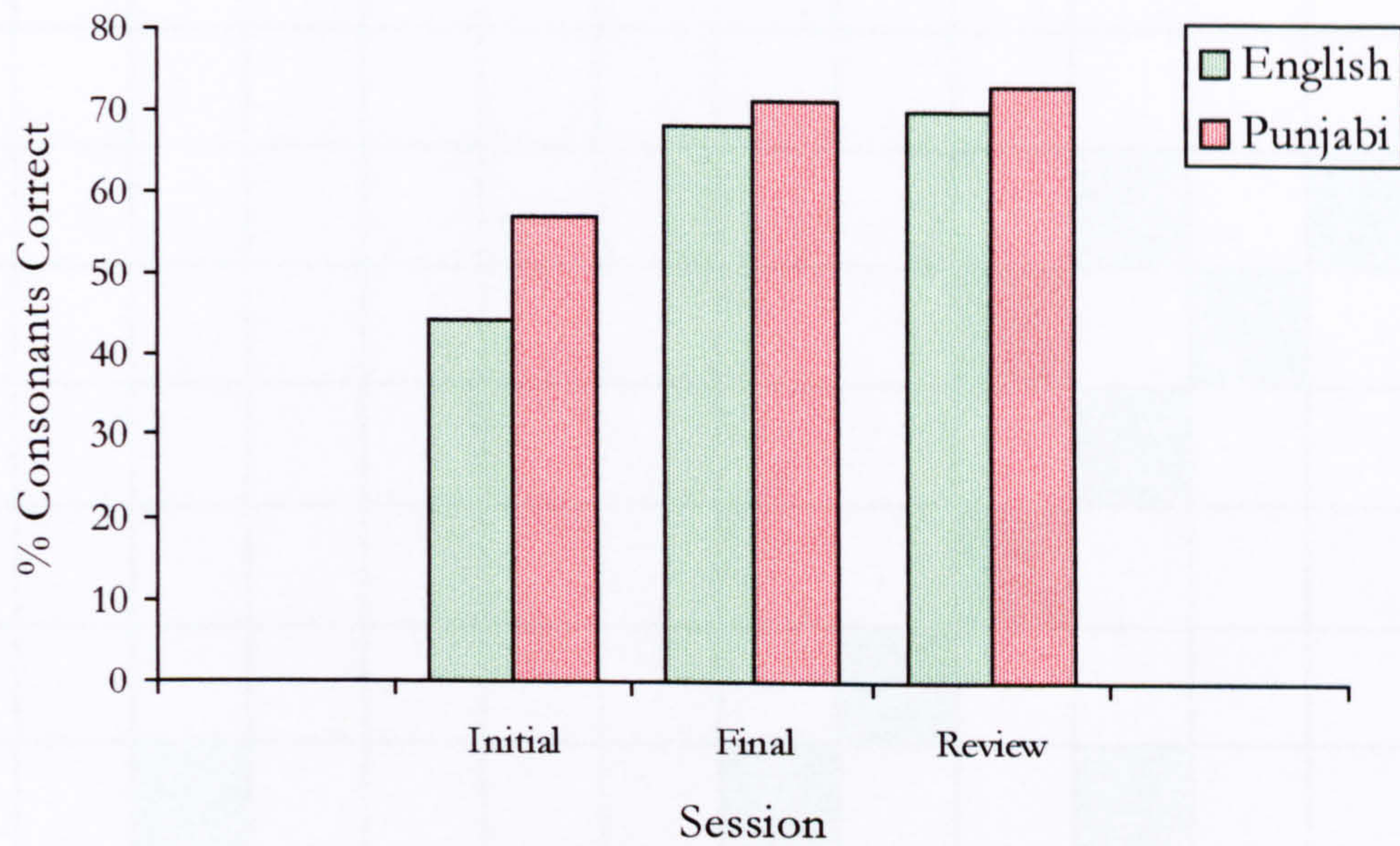


Figure 8.10 Changes in consonant accuracy in Punjabi and English following intervention.

8.3.4 DISCUSSION OF HAFIS

Hafis presented with inconsistent lexical productions in both Punjabi and English at the start of the intervention study. As a deficit in phonological planning was hypothesised to underlie inconsistent deviant speech disorder (Bradford & Dodd, 1994; 1996), it was predicted that he would benefit from a core vocabulary intervention method that focused on establishing consistent production of a limited number of words.

learned for a set of treated words to untreated words. The variation in his substitution patterns was greatly reduced over the eight weeks of intervention. The results of the intervention study support previous research showing that children with inconsistent speech errors can benefit from a core vocabulary therapy approach (Bradford & Dodd, in press; Dodd & Iacono, 1989; Dodd, McCormack & Woodyatt, 1994).

The generalisation of consistency within and across languages evident in Hafis's results indicates that the core vocabulary therapy did not simply target surface speech errors. Hafis did not just learn how to say the words targeted in therapy. Learning to say the set of 52 words changed the underlying "phonological planner" that serves the two phonological systems for the generalisation to occur. Core vocabulary therapy effectively targeted the deficit in phonological planning skill evident in Hafis's speech. Hafis's ability to create phonological output plans was improved by providing him with detailed, specific information about a limited number of words and drilling the use of that information with continued systematic practice.

Hafis had developed two separate phonological systems in the same way as normally developing bilingual Punjabi-English children. He was able to extract information about the two phonological systems (evident by his good phonological awareness and developing literacy skills). Therefore, he did not appear to have a cognitive-linguistic deficit (indicative of consistent deviant speech disordered children). He had acquired most of the phonemes of his two languages and did not have any difficulty with oro-motor or articulation skills (indicative of children with developmental verbal dyspraxia or articulation disorders). He had developed good receptive language skills (indicating that he did not have generally delayed language development). Hafis's speech disorder was specific and isolated to difficulty in storing or retrieving phonological plans for words.

At the end of the intervention period Hafis's speech in both languages remained difficult to understand in connected speech. However, the *type* of disorder had changed from "inconsistent deviant" to "delayed": he used several developmental processes consistently that were appropriate for normally developing bilingual children of a younger age. Hafis was referred back to his initial speech-language pathologist following his involvement in the study. It was recommended that his speech be reviewed after a six month break to check that Hafis had maintained his increased consistency and that the developmental processes were being suppressed. It was not considered appropriate to target the delayed processes immediately following the core vocabulary intervention. It was hypothesised that Hafis would spontaneously suppress the developmental processes once his phonological planning problem had been remediated.

8.4 COMPARISON OF TWO CASE STUDIES

There is a difference between the results of the two intervention studies reported in this chapter. The effects of phonological contrast therapy did not generalise to Jason's other language, whereas the effects of core vocabulary therapy did generalise to Hafis's other language. These differences support the hypotheses generated in Chapter 5 regarding the nature of phonological disorder and the effectiveness of treatment. The hypothesis was that intervention would generalise across languages when the deficit in the speech processing chain was targeted directly. Intervention treating language-specific surface errors was not hypothesised to generalise across languages.

Phonological contrast therapy is language-specific in that it teaches the phonotactic constraints and patterns of a particular phonological system. It does not appear to remediate the underlying deficit giving rise to the impaired ability to abstract those constraints and patterns. Consequently the metaphonological approach to intervention

used with Jason resulted in changes only in the surface phonology of the language targeted in therapy.

In contrast, core vocabulary therapy appears to target the ability to construct phonological plans for output, and consequently remediates inconsistency across languages. Although core vocabulary therapy appears to be appropriate for children with inconsistent phonology, it is not necessarily suitable for all children with speech disorders. Therefore, current intervention used for children with consistent deviant phonological errors needs further research.

8.5 SUMMARY AND CLINICAL IMPLICATIONS

Any conclusions drawn from limited case data must be extremely tentative. However, the treatment case studies presented suggest important clinical implications for speech-language pathologists:

- Bilingual children's speech needs to be assessed in both of their languages for a clear profile of the nature of their errors.
- Articulation errors, common to both languages due to incorrect motor planning, can be remediated in both languages by providing therapy in only one language.
- Bilingual children have two separate phonological systems for their two languages.
- The deficits underlying phonological disorder are not language specific; consistent errors are the product of a general inability to abstract the phonological rules specific to that language accurately. This inability results in different error pattern profiles across the two languages. Phonological assessment in only one language is not sufficient.
- In contrast to articulation therapy, although consistent phonological errors can be remediated in the language that therapy is provided in, this therapy will probably not affect the child's other phonological system. Phonological contrast therapy does not

generalise across languages indicating that therapy will need to be carried out in each language separately.

- Therapy targeting a specific deficit in the speech processing chain will result in change in both of the output phonologies. For example, core vocabulary therapy which targets the use of phonological plans, will remediate the inconsistency evident in both languages.

SECTION III:
DISCUSSION AND
CONCLUSIONS

CHAPTER 9:
GENERAL DISCUSSION
AND CONCLUSIONS

9.1 INTRODUCTION

This chapter summarises the major findings of the studies reported in this thesis that relate to the aims and hypotheses of the study. In addition, the findings are linked to different theoretical issues about the nature of bilingual processing and models of speech processing. Finally, methodological considerations in the interpretation of the results are discussed and areas for future research are proposed.

9.2 REVIEW OF THE MAJOR QUESTIONS AND FINDINGS

When we look at children growing up with more than one language, we observe that their production of the ambient language may show certain patterns that are erroneous with reference to monolingual speakers of that language. In these circumstances, we would like to find out whether these nonconforming patterns are due to the influence of the child's other language(s), or if this is an indication of some kind of language disorder.

(Yavas, 1998, pp.215-216).

This thesis has addressed several theoretical and clinical questions highlighted by Yavas. The first step in differentiating normal from disordered development is to describe normal development. Section I of this thesis described the normal bilingual phonological development of children from two different language combination backgrounds: Cantonese-English and Punjabi-English.

The study was limited to children acquiring their two languages successively rather than simultaneously. These successive bilingual children had achieved minimal competence in one language before the introduction of the second language within the primary language learning period. The phonological development of successive bilingual children was

investigated because this group has been ignored in the research literature although they form a significant demographic group within immigrant communities around the world.

Phonological development, rather than other aspects of language development, was investigated due to the small amount of previous linguistic or psychological research. In addition, speech-language pathologists have a significant clinical need for information because they have no clear guidelines on how to assess, diagnose or treat bilingual children with speech disorders.

9.2.1 NORMAL BILINGUAL PHONOLOGICAL DEVELOPMENT

Chapter 2 reported the phonological development of 40 Cantonese-English bilingual children. Chapter 3 described the phonological development of two Cantonese-English bilingual children over the year they were first exposed to English. Chapter 4 described the phonological development of 35 Punjabi-English bilingual children. The specific questions addressed in Section I of this thesis were:

- ◆ Do bilingual children have a single phonological system that serves both languages or do they have differentiated systems? and
- ◆ Do bilingual children develop their phonological system/s in the same way (in terms of developmental sequences, patterns and errors) as monolingual children?

The cross-sectional Cantonese-English group study showed that there were qualitative differences between monolingual and bilingual development. However, it was difficult to determine whether there was a developmental pattern in these qualitative differences because of the other variables that may have been affecting the children's development. The group of bilingual children included children with significantly different language backgrounds (e.g., a 4;0 year old child, first exposed to English at age 3;6 years through

full-time attendance at childcare; compared to a 3;0 year old child in full-time childcare from age 1;6 years).

To investigate the phonological *development* of Cantonese-English children two longitudinal studies were reported. Two children were assessed at monthly intervals during their first year of exposure to English. This allowed changes in the children's phonological systems to be monitored and patterns of development to be described.

The phonological development of the Punjabi-English children was investigated so that a comparison of a bilingual group from a completely different language combination to the Cantonese-English children could be made. This study was designed to determine whether all bilingual children produce error patterns that differ from those of monolingual children. The study was also designed to investigate the specific role of the ambient phonologies of the two languages - could the error patterns observed be traced to individual characteristics of the two phonologies? If so, the error patterns observed in the Punjabi-English children should differ to the patterns observed in the Cantonese-English children.

9.2.1.1 ONE SYSTEM OR TWO?

The Cantonese-English bilingual children used language-specific phonological systems. The phonological processes evident in each language were different. The children simplified the same sounds differently in the two languages, using a process in only one of the two languages, using language-specific phonemes in only one language, obeying the phonotactic constraints of each language, and/or using contradictory processes across the two languages. All these patterns provided evidence of differentiation of the two phonological systems. In addition to this evidence, there were often similarities across the systems (e.g., phonological processes evident in both languages).

The articulatory development of the bilingual children was language-independent. Generally, phonemes that were common to the two languages were evident in both languages (or could be elicited in both languages). The longitudinal data collected from two Cantonese-English bilingual children confirmed that the children used language-specific phonological systems although they used language-independent articulatory systems. For example, Catherine used the same distortion of a sound in both languages. When she self-corrected her production of the sound, the change was evident in both languages.

The Punjabi-English children's data showed similar patterns of system differentiation to the Cantonese-English children's. The children used language-specific phonological systems (based on the same criteria for identifying differentiation outlined for the Cantonese-English children). Articulatory development was also language-independent. Like the Cantonese-English children, the Punjabi-English children used some phonological processes in both languages and some processes that were language-specific.

9.2.1.2 COMPARISON OF BILINGUAL AND MONOLINGUAL DEVELOPMENT

The Cantonese-English bilingual children's phonological development differed to monolingual children's development of each language. There were many phonological processes evident in the bilingual children's speech that would be considered atypical for a monolingual child to use. The use of these processes was argued to be a characteristic of normal development of Cantonese-English bilingual children because of the number of children in the group using the processes (e.g., backing evident in the speech of 27 of 56 children).

The longitudinal data showed that the presence of atypical error patterns was transient and directly related to the introduction of the second language: the children did not use any atypical processes before the introduction of the second language. The atypical processes were also less consistently applied than the processes common in monolingual development. Some 'atypical' (for monolingual) error patterns could be plausibly explained by referring to the nature of the two phonological systems interacting (e.g., difficulty marking contrasts on the basis of aspiration when aspiration is only contrastive in Cantonese). Other atypical processes could be explained by differences in normal developmental or adult variation patterns specific to only one language (e.g., in Cantonese some initial consonants may be deleted, so the bilingual children deleted a range of initial consonants in both languages).

The Punjabi-English children also used error patterns that would be considered atypical for monolingual English children. The lack of normative developmental data for Punjabi did not allow detailed analysis of the two languages in the same way that was possible for Cantonese-English. However, there was evidence that some of the error patterns could be plausibly explained by referring to the two phonological systems. For example, the children had difficulty marking voicing and aspiration contrasts in both languages. This difficulty may result from differences between the contrastive use of aspiration and voicing in the two languages.

9.2.1.3 MODEL OF BILINGUAL SPEECH PRODUCTION

Cross-linguistic studies have shown that there are many similarities in the phonological processes used by children who acquire dramatically different languages. Some processes commonly used in some languages are not evident in other languages due to the specific nature of the phonological system (e.g., weak syllable deletion not evident in Cantonese

which is primarily monosyllabic). Yavas (1998) attempted to predict the types of errors evident in bilinguals with specific language combinations based on the nature of the two phonological systems interacting. The data presented in this thesis suggests that it is possible to explain some of the unusual aspects of phonological production of bilingual children by referring to the two systems interacting. However, not all errors could be explained by differences between the two systems. *Contrastive Analysis* methods have been criticised in the second language acquisition literature for failing to account for error patterns not determined by comparisons of the two systems.

Other researchers have attempted to explain bilingual acquisition patterns strictly in terms of *markedness*. It has been suggested that second language learners will transfer unmarked forms from their first language to their second language but will not transfer marked forms (Hyltenstam, 1984). For example, the Cantonese-English bilingual children's difficulty with final consonant voicing is not due to differences in the two phonological systems. It is due to the natural process of 'final consonant devoicing' evident in most languages that have voiced final consonants (devoicing is unmarked, while voicing is marked). Much second language acquisition research has supported the markedness hypothesis, however, there are also error patterns that do not follow the predictable patterns.

Ellis (1994) suggests that bilingual error patterns may be 'doubly determined' to reflect both the influence of the first language and 'naturalness' factors (universal patterns). The data in this thesis support this suggestion. The children used many common developmental patterns that are also used by monolingual children of each language. However, there was also evidence of an interaction between the two systems that resulted in differences to monolinguals.

The literature has not discussed how bilingual children in the primary language learning stage acquire phonology. Much of the research on phonological patterns has focused on adults or older children learning a second language, or on simultaneous bilinguals. However, successive bilingual children who are in the process of acquiring one phonological system when the second system is introduced, would presumably use different processes to these other groups. This presumption is based on the research investigating the 'critical age' hypothesis that shows there is a different outcome for children exposed to their second language in the pre-school years.

This thesis has argued that the differences evident in the bilingual children's phonological patterns are due to hypothesis testing (e.g., Macken, 1992). One theory addressing the process of phonological acquisition in children is based on hypothesis testing (see review in Chapter 1). This model can plausibly explain the bilingual children's data. Hypothesis testing allows children to generate hypotheses regarding the realisation rules that govern their phonological output. Leonard (1985) suggested that children with phonological disorders might have an impaired ability to abstract knowledge about the phonological system - and this impairment results in atypical error patterns. While the bilingual children do not have an impaired phonological system (shown in the longitudinal studies by normal monolingual development up to the introduction of the second language), it is possible that the burden of processing the two languages resulted in the unusual error patterns.

When their second language was introduced the bilingual children investigated were still in the developmental stage of analysing their first language phonological input to derive hypotheses that governed their phonological output. They still made normal developmental errors in their first language when their second language was introduced. It is possible that there was some interaction between the two phonological systems due to the process of analysing and generalising the input they were receiving.

The fact that there was an effect of the introduction of the second language on the child's first language (e.g., unusual error patterns evident in Cantonese only following exposure to English) shows that the child continually updated the hypotheses about both languages. Unlike older second language learners whose first phonological system is stable, the pre-school bilingual children were still in the process of consolidating the information they had abstracted about how the phonological system worked. Therefore, older second language learners do not experience any effect on the phonological patterns of their first language, just interference of the first language on their second language. The pre-school bilingual children's intralingual effect was evident in both languages not just the second language.

Many unusual error patterns evident in the bilingual children's speech could be interpreted as 'over-generalisations' of language-specific patterns. This over-generalisation occurred both across languages and within. This suggests that the bilingual children constructed underspecified realisation rules. For example, the children noticed that initial /ŋ/ and initial /h/ could be deleted in Cantonese. Instead of limiting this rule to these specific phonemes in this specific language, they formed a more general rule that said that sometimes initial consonants can be deleted and that this could happen in either language. (This is not to suggest that children *consciously* think about phonology in this way.)

Other studies have reported this pattern of over-generalisation of rules for other aspects of bilingual children's language development. Ellis (1994) reports an example of English-German difficulty with negation, "when confronted with evidence that L2 negation worked in the same way as L1 negation, they assumed that the two languages were completely identical in this structure" [the negative particle can follow the verb 'be' or an auxiliary/modal verb but not a main verb as in German] (p.332).

The bilingual children's use of atypical error patterns suggests an *intralingual* effect (a general pattern of bilingual development) due to faulty generalisations, incomplete applications, or underspecified rules. The individual error patterns were *interference* effects that were specific to the two systems interacting (a differentiation of effects suggested by Ellis, 1994). That both bilingual groups used error patterns unusual for monolingual children, but which were specifically determined by the nature of the ambient phonological systems supports this conclusion.

It is important to emphasise that the developmental data reported in this thesis do not suggest that the bilingual children's development was *disordered* in any way. Their use of error patterns atypical for monolingual children simply suggests that their path to developing error-free adult-like speech was different from the path that monolingual children take. However, the fact that the older Cantonese-English bilingual children's speech accuracy was not significantly different to older monolingual children's indicates that they do achieve the target phonology of each language appropriately.

The bilingual children's speech data are difficult to explain in terms of connectionist models of speech processing (e.g., Stemberger, 1992). These models are based on the premise that connections are solely learned through practise (frequency of activation). If this were the case the bilingual children should not have started making errors in the phonological system of their first language as soon as the second language was introduced. Within a connectionist framework you would also expect the interaction effect between the two languages to be much more uni-directional (due to the greater exposure to one language) rather than the bi-directional effects seen in the bilingual children's speech.

In terms of current psycholinguistic models of speech processing (e.g., Dodd & McCormack, 1995; Stackhouse & Wells, 1997), there was no indication that bilingual children process phonological input and output differently to monolingual children. However, they differentiate the cognitive-linguistic information they abstract from the two languages, and they use separate phonological realisation rules for each language. This thesis has argued that bilingual children use the same phonological processing mechanism for both languages, however they are able to filter each language through the appropriate language-specific phonological information. The investigation of bilingual children with disordered speech reported in Section II of this thesis provides further evidence that bilingual children process their phonology in this way.

9.2.2 SPEECH DISORDER IN BILINGUAL CHILDREN

Chapters 6 and 7 presented case studies of 21 children with disordered speech. Chapter 8 presented treatment case studies of two children with different types of speech disorder. Speech disorder in bilingual children is interesting and important for theoretical and clinical reasons. This thesis has argued that the validity of current psycholinguistic models can be tested by their ability to explain error patterns of bilingual children. The effect of treatment on these error patterns would further investigate the applicability of these speech-processing models. Clinically, it is important to investigate the nature of speech disorder in bilingual children to determine 'best practice' methods. Speech-language pathologists do not have a research-driven basis for their clinical decisions about assessment, diagnosis or treatment of bilingual children. The data presented in Section II were analysed to answer partially the following theoretical and clinical questions:

- ◆ Is it important to assess both languages?
- ◆ Do bilingual children have the same *type* of speech disorder in both languages?
- ◆ Are the error patterns the same in both languages?

- ◆ Is therapy required in both languages or will the effects of therapy generalise across languages?

9.2.2.1 ERROR PATTERNS ACROSS LANGUAGES

All the bilingual children with disordered speech made errors indicative of the same *type* of speech disorder in both languages (using Dodd's (1995) classification system). For example, a child who made inconsistent errors in one language also made inconsistent errors in their other language. Error pattern profiles depended on the level of deficit in the speech processing chain:

- ◆ articulation - deficit in motor plan for specific phoneme: phonemes used in both languages were distorted in the same way in each language because motor plans are language-independent
- ◆ delayed - generalised language-learning deficit: evidence of lower speech accuracy and greater use of normal bilingual phonological processes in both languages; some processes used in both languages, some processes language-specific; clear differentiation of language-specific phonological systems
- ◆ consistent deviant - cognitive-linguistic deficit resulting in difficulty abstracting appropriate realisation rules: some processes used in both languages, some language-specific atypical bilingual error patterns evident in both languages; phonological systems were differentiated but error processes were not identical because phonological systems were language-specific
- ◆ inconsistent - deficit in using phonological word plans: inconsistent productions of words evident in both languages; phonological systems were differentiated but consistent error patterns were not used because the phonological planning mechanism is language-independent.

The disordered speech data support current psycholinguistic models of speech processing: the hypothesised levels of breakdown fit with the error profiles evident in the bilingual children's phonological patterns. Further, the bilingual children with speech disorder validate Dodd's (1995) classification system: all four types of disorder were evident in the bilingual population. There was also clear evidence to show that speech disorder in bilingual children does not result from an inability to differentiate the two phonologies: the disordered children all showed evidence of separation of their systems.

9.2.2.2 INTERVENTION FOR BILINGUAL CHILDREN WITH SPEECH DISORDER

The two treatment case studies presented in Chapter 8 have important theoretical and clinical implications. The results suggest that unless intervention targets the underlying deficit the effect of intervention will be language-specific. Phonological contrast therapy targeting language-specific phonological realisation rules did not effectively target the deficit underlying children making consistent deviant errors. Core vocabulary therapy targeting language-independent phonological planning skills targeted the underlying deficit and the effect of the intervention was evident in both languages. Articulation therapy targeting the language-independent motor plan for specific shared phonemes was effective in both languages.

These findings provide further support for the argument that bilingual children have a single phonological processing mechanism that processes language-specific phonological systems. The findings also support the hypothesised levels of breakdown in psycholinguistic models of speech processing.

9.3 CLINICAL IMPLICATIONS

The results of the investigation into bilingual children with disordered speech indicates that speech-language pathologists need to assess both languages of a bilingual child to determine the language-specific patterns and the type of disorder. However, there will continue to be practical difficulties for speech-language pathologists due to the lack of information about the phonological development and structure of many languages, and the lack of clinical tools to use in assessment. The findings of Section I of this thesis indicate that it is also important to compare bilingual children to their bilingual normally developing peers, not to monolingual developmental data.

The results of the intervention studies suggest that depending on the type of speech disorder, intervention may be effective when provided in only one of the child's languages. However, the intervention must target the underlying speech processing deficit, not language-specific surface errors. It is possible that intervention methods other than the phonological contrast method used in this study will be effective in targeting the deficit underlying consistent deviant children's errors. Further research is needed to investigate this possibility. Until then, speech-language pathologists need to be aware that intervention targeting consistent deviant error patterns may not generalise across languages and the disorder will remain evident in the child's other language.

The findings indicate that it is imperative for speech-language pathologists working with bilingual children to assess both of the child's languages and monitor the effect of their intervention across both languages. The therapy provided to the two children in the study reported in Chapter 8 was conducted entirely in English. It is possible that intervention conducted through the child's first (and often stronger) language would be more effective. However, again there is the practical difficulty of the lack of bilingual speech-language

pathologists (or well-trained assistants) who would be able to provide intervention in the child's first language.

9.4 LIMITATIONS OF THE STUDY

Several factors limit the findings reported in this thesis.

The Cantonese-English bilingual cross-sectional group differed on several variables that may have affected the results (e.g., age of first exposure to English). Although, the regression analyses suggested that the children's chronological age was the only variable that could account for any variation between the children, it is possible that the strength of this variable masked the possible impact of other factors.

The lack of monolingual normative data for Punjabi children limited the comparison between the two bilingual groups. It was not possible to analyse the results of the Punjabi-English group in the same amount of detail as the Cantonese-English group. Therefore, language-specific interference patterns could not be as clearly identified in this second bilingual group.

The age of the children in the Punjabi-English group also limited comparisons between the two bilingual groups. The Punjabi-English children were older than the Cantonese-English children were and it is possible that their process of development was not directly comparable to the Cantonese-English children because they were older when first exposed to English.

It would have been interesting to follow the two longitudinal studies for longer. However, the longitudinal study could not continue because the investigating clinician moved from

Australia to the United Kingdom. Follow-up assessments every six months would allow the pattern of development to be monitored until the child's speech has matured.

Investigation into another language combination would have allowed more firm conclusions to be drawn about the role of ambient phonology. For example, this thesis investigated language combinations that were quite different. Research into children with similar phonological systems would show whether some bilingual groups use just one phonological system for both languages, with some very specific language rules that differentiate the two.

Conclusions drawn from limited case data need to be tentative. However, the 21 children with speech disorder reported in this thesis had quite strong patterns. Again, a range of language combination backgrounds is required to confirm the findings reported. Further intervention studies are also required to confirm the results of cross-linguistic generalisation reported in this thesis.

9.5 SUGGESTIONS FOR FUTURE RESEARCH

The findings reported in this thesis indicate many issues that require further investigation.

1. Further cross-linguistic bilingual normative studies are required to investigate the respective roles of universal tendencies and interference between the two languages. To do this systematically, normal monolingual development of each language is required. This suggests that normative monolingual developmental data (including normal phonological process use, not just phonetic acquisition studies) for many languages are also needed. The bilingual normative studies should minimise the variables (e.g., age of first exposure to second language, amount of exposure) that made the Cantonese-English data somewhat difficult to interpret (e.g., in an ideal world the

group would consist of children that all had closely matched language backgrounds - monolingual until a certain age and then exposed to the second language in identical circumstances).

2. Ideally, further bilingual group studies should minimise the effect of variables that may have affected the children's development of the two phonological systems. However, it would also be interesting to examine the specific roles of some of these variables. For example, it would be interesting to compare children exposed to the same two languages but in a different order (e.g., Cantonese followed by English vs. English followed by Cantonese). Another factor that would be interesting to investigate is the role of the dominant community language on acquisition: Do children who acquire Cantonese and then English in a predominantly English-speaking country differ from children acquiring Cantonese-English in a Cantonese-speaking country?
3. Further longitudinal studies of bilingual children with a range of language-combinations are also required. Studies that follow children for longer periods would also be beneficial.
4. Experimental investigation into bilingual children's implicit knowledge about the phonological structure of each language would also be interesting. The fact that bilingual children appear to be able to keep the phonological information about each language separate (e.g., they do not break the phonotactic constraints of each language) could be investigated using a 'legality awareness' task.
5. The development of language-independent assessment methods is another area that requires investigation. For example, Lahey's (1992) suggestion that a language *learning* task might be a valid way of assessing bilingual children's speech and language (e.g.,

how efficiently can the child abstract phonological information from a set of nonwords?).

6. One treatment case study highlighted the nature of inconsistent speech disorder. It is not clear what is involved in phonological planning (the hypothesised area of deficit). For example, what information is included in phonological word plans? Do inconsistent children have difficulty in storing, retrieving or constructing the phonological plan? Why does core vocabulary therapy work?
7. Further investigation into intervention techniques for children with consistent deviant speech disorder is also required. Intervention is required that effectively targets the underlying deficit not just surface errors. The need for this research is emphasised by the finding that children with consistent deviant speech disorder re-emerge with literacy difficulties when they start school. The same underlying deficit that was remediated in their spoken phonology underlies their difficulty learning to read and spell.

9.6 GENERAL SUMMARY AND CONCLUSIONS

The most significant findings reported in this thesis are:

- ◆ bilingual children develop language-specific phonological systems
- ◆ the two phonological systems are served by a language-independent speech processing mechanism;
- ◆ the phonological development of successive bilingual children is qualitatively and quantitatively different to monolingual development of each language;
- ◆ evidence of error patterns atypical for monolingual children is not indicative of disorder in bilingual children;

- ◆ although there are some qualitative differences between monolingual and bilingual development, most developmental processes evident are similar;
- ◆ the phonological development of bilingual children is governed by both universal tendencies and interaction between the two phonologies;
- ◆ the unusual error patterns evident in the bilingual children's speech are due to underspecified realisation rules for each language;
- ◆ although bilingual children acquire their two phonological systems in a different way to monolingual children they are able to develop the appropriate phonological systems effectively;
- ◆ bilingual children with speech disorder show the same type of error patterns in both languages, but the specific processes used may be either language specific or evident in both language;
- ◆ there is a clear difference between articulatory (motor) and phonological (linguistic) errors;
- ◆ the same patterns of speech disorder evident in monolingual children are evident in bilingual children;
- ◆ current psycholinguistic models of speech processing can be applied to bilingual children, however, the bilingual children have language-specific phonological representations and realisation rules;
- ◆ speech-language pathologists need to assess the speech production in both languages of a bilingual child;
- ◆ intervention for bilingual children with speech disorder will generalise across languages when the underlying deficit is targeted, however, intervention approaches that target surface speech errors will only be effective in the language targeted in therapy.

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APPENDIX I

BILINGUAL SPEECH DEVELOPMENT QUESTIONNAIRE

Thankyou for completing the following details about your child. The questionnaire should only take a few minutes to complete and will provide us with essential information about your child's development.

Child's Name: _____
Date of Birth: _____ / _____ / _____
Sex: Male Female
Childcare Centre: _____

Family History

Occupations: Mother _____
Father _____

Please rate your level of English acquisition:

Mother:	Spoken	Excellent <input type="checkbox"/>	Good <input type="checkbox"/>	Poor <input type="checkbox"/>	None <input type="checkbox"/>
	Written	Excellent <input type="checkbox"/>	Good <input type="checkbox"/>	Poor <input type="checkbox"/>	None <input type="checkbox"/>
Father:	Spoken	Excellent <input type="checkbox"/>	Good <input type="checkbox"/>	Poor <input type="checkbox"/>	None <input type="checkbox"/>
	Written	Excellent <input type="checkbox"/>	Good <input type="checkbox"/>	Poor <input type="checkbox"/>	None <input type="checkbox"/>

Other children in family:	Name	Age	Sex
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____

Languages spoken at home: Cantonese only
Mostly Cantonese, some English
Some Cantonese, some English
Mostly English, some Cantonese
English only

Are any other language spoken at home? Yes No

If Yes, please give details: _____

Medical History

Is your child generally in good health? Yes No

Has your child had any medical problems, illnesses or operations? Yes No

If Yes, please describe: _____

Has your child's hearing been tested? Yes No
If Yes, was their hearing normal? Yes No
Does your child have frequent ear infections? Yes No

General Developmental History

Have you had any concerns about your child's motor development (e.g., learning to crawl, walk, eat, draw)? Yes No If Yes, please describe: _____

Language Development

Do you have any concerns about your child's Cantonese? Yes No

If Yes, please describe: _____

Do you have any concerns about your child's English? Yes No

If Yes, please describe: _____

Have you noticed any changes in your child's Cantonese since they started learning English? Yes No

If Yes, please describe: _____

At what age did your child first start learning English? ____ years ____ months

How did they first learn English?

At Childcare

At home From: Parents Brothers/Sisters Friends

Other Explain: _____

Where does your child speak English now?

At Childcare

At home With: Parents Brothers/Sisters Friends

Other Explain: _____

Does your child watch English television? Yes No

If Yes, how many hours per day? Up to 1 hour
1-2 hours
More than 2 hours

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APPENDIX II

Examples of Cantonese and English normal monolingual developmental and non-developmental processes.

Process	Cantonese		English	
	<i>Example</i>	<i>Status</i>	<i>Example</i>	<i>Status</i>
Cluster reduction	/kwa/ [ka]	Dev	/step/ [tɛp]	Dev
Final consonant deletion*	/suk/ [tsu]	Atyp	/kʌp/ [kʌ]	Dev
Stopping	/si/ [ti]	Dev	/ʃu/ [du]	Dev
Fronting	/kam/ [tam]	Dev	/kʌp/ [tʌp]	Dev
Gliding/continuant variation*	/leɟ/ [wɛɟ]	Atyp	/rɪŋ/ [wɪŋ]	Dev
Deaffrication	/tʃi/ [si]	Dev	/tʃɪp/ [ʃɪp]	Dev
Affrication*	/sy/ [tsy]	Dev	/ʃak/ [tʃak]	Atyp
Deaspiration*	/p ^h ɪŋ/ [pɪŋ]	Dev	/p ^h ɪn/ [pɪn]	Atyp
Aspiration*	/tɛŋ/ [t ^h ɛŋ]	Atyp		
Voicing*	/pɛŋ/ [bɛŋ]		/tɪp/ [dɪp]	Dev
Weak syllable deletion*			/bənaɪnə/ [nana]	Dev
Assimilation	/ŋan/ [ŋaŋ]	Dev	/bɛd/ [bɛb]	Dev
Reduplication	/ji/ [jiji]	Dev	/bʌtʌ/ [bʌbʌ]	Dev
Backing	/tin/ [kin]	Atyp	/fut/ [kut]	Atyp
Initial consonant deletion	/mat/ [at]	Atyp	/tɔɪ/ [ɔɪ]	Atyp
Tone errors*	/fa ₁ / [fa ₂]	Atyp		
Addition	/ap/ [tap]	Atyp	/bæk/ [bæŋk]	Atyp
Nasalisation	/leɟ/ [nɛɟ]	Atyp	/tɪp/ [mɪp]	Atyp
Transposition	/pa si/ [sa pi]	Atyp	bʌtən/ [tʌbən]	Atyp

APPENDIX III

Rochdale Assessment of Mirpuri Phonology - Word Lists

English	Mirpuri/ Punjabi	Urdu	English	Mirpuri/ Punjabi	Urdu
cat	'bɪl:i	'bɪl:i	chair	kur'si:	'kursi
milk	ɖuɖ	ɖu:ɖ	doll	'guɖi	'guriɖ
tongue	zba:n	zu'ba:n	monkey	'bandəɾ	'bandəɾ
grapes	ʔaŋ'gu:ɾ	ʔaŋ'gu:ɾ	snake	sa ^h p	sa:mp
basket	'dɔkri	'duɖri	apple	se:b'	se:b
cow	ga:	gai	ear	kaŋ	ka:n
swing	biŋ:g	biŋɖ	nose	na ^h k	na ^h :k
flag	'dʒenda	'dʒenda	car	'gɒdi:	'gari
spoon	'dʒʌmɒɖʒ	'dʒəməɖʒ	water	'pāŋi	'paŋi
watch	'kaɽi	ŋ'k ^h ɒri	clean	sa:f	sa:f
chicken	'murgɪ	'murgɪ	soap	'sa:brɪn	'sabən
fan	'baɽ ^h :a	'baŋk ^h a	flower	p ^h ul	p ^h u:l
letter	haɽ	ha ^h ɽ	bed	'bɪstɾ	'bɪstɾ
envelope	lə'fafa	lɪ'fafa	chapatti	'ɽoɽi:	'ɽoɽi
hat	'tɔpi:	'topi	fire	ʔag	ʔa:g
book	'kɪɽab	'kɪt ^h a:b	hot	garm	'gərəm
page	'vrka	'vərək	star	'stara	sɪ'tara
picture	tas'vi:ɾ	tas'vi:ɾ	moon	dʒʌn	dʒa:nd
tree	draxɽ	'drahəɖ	lips	hōnt	hōnt
goat	'bakri	'bak:əri	lion	ʃer	ʃer
bridge	pul	pul	spider	'maɽ ^h i	'maɽ:i
fish	'matʃi:	'matʃli	mother	'ʌm:i	'ʔʌm:i
aeroplane	dʒʌz	dʒə' ^h a:z	ball	gē:ŋɖ	gend
balloon	p ^h ə'ka:nɔ	wu'bara	sun	'surɪɖʒ	'surɪɖʒ
key	'dʒabi	'dʒabi	umbrella	'tʃʌtri:	'tʃətəri
kite	p ^h ə'tāŋɖ	pə'taŋɖ	shoes	'dʒuɽi	'dʒuɽe
leg	la ^h t	tā:ŋɖ	bear	ɾɪtʃ	ɾi:tʃ
hat	'tɔpi:	'topi	banana	'kela	'ke:la
happy	huʃ	huʃ	bird	'dʒɪri	'dʒɪɾɾa
rain	'baɾɪʃ	'baɾɪʃ	light	'paɽi	'baɽi