PHONOLOGICAL DEVELOPMENT IN KOREAN-ENGLISH BILINGUAL CHILDREN

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A THESIS SUBMITTED IN FULFILMENT OF THE REQUIREMENTS
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ABSTRACT

Speech-language therapists are encountering an increasing number of bilingual children with suspected speech sound disorder of unknown origin (SSD). Accurate identification of bilingual children with SSD is a significant challenge because there is a lack of information about the characteristics that constitute typical phonological development in bilingual children. This doctoral thesis aims to provide clinically relevant information about phonological development in Korean-English bilingual (KEB) children.

Using a cross-sectional design, single word speech samples were collected from 52 KEB children aged between 3;0 and 7;11 and analysed for phonetic inventories, segmental accuracy and the type of errors produced. The phonetic inventories, segmental accuracy and error productions in KEB children were compared to the available studies in monolingual English-speaking (ME) and monolingual Korean-speaking (MK) children. Twenty-three KEB children of these KEB children were followed up to supplement the findings of the cross-sectional study. Using a correlation study design, this doctoral thesis also examined the potential use of parental report as a tool for a universal speech screen to identify KEB children who require a full clinical assessment by a speech-language therapist.

Phonological development in KEB children was qualitatively different from their monolingual counterparts. KEB children produced the type of errors that would be indicative of SSD in monolingual children. The qualitative differences in KEB children could be attributed to cross-linguistic interactions between two phonological systems. Cross-linguistic interactions reflect reorganisation of the two phonological systems wherein a dynamic process of re-specifying learned phonemes and their realisation rules for each language takes place. One manifestation of reorganisation was suggested to be prominent regressions during the course of phonological development. Clinically relevant information could not be obtained by comparing phonological skills and error productions of bilingual children to their monolingual counterparts. The findings in the correlational study mirrored the studies in phonological development in KEB children. A parent-rated measure based on monolingual children identified over 40% of the KEB children as needing a comprehensive clinical assessment by a speech-language therapist. What is considered the appropriate approach for monolingual children may not be applicable for bilingual children. This doctoral thesis suggests specific future research directions to build further evidence for how a universal speech screen may be implemented.

This doctoral thesis presents a strong case against the use of available monolingual normative data to identify KEB children with SSD in clinical practice. Bilingual children should be considered fundamentally different from monolingual children in the use and development of their languages. Clinical implications for speech-language therapists working with KEB children with suspected SSD and directions for future research are further discussed.

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NOTES ON STYLE

1. This doctoral thesis is presented as a thesis with publications, which includes published or unpublished research papers conducted under supervision for the degree of Doctor of Philosophy. Each manuscript, which is published, submitted or in preparation for submission to a journal, has been edited to provide links between chapters and a coherent structure of the thesis.
2. This doctoral thesis adopts the International Phonetic Alphabet (IPA), a notional standard for the phonetic representation of speech. Slanted brackets (/ /) are used to represent the underlying representation for segments of words and square brackets ([ ]) to represent the child's realisation of the target words.
3. A child's age is noted as years;months. For example, 4;5 denotes four years and five months.
4. Double quotation marks (“ ”) are used for a quotation with reference to its original source. Single quotation marks (‘ ’) are used for scare quotes to imply that a word or phrase enclosed with single quotation marks may not signify its apparent meaning.
5. Italics are used for emphasis and to indicate the target words. In Chapter 6, italics are also used for the items in the parent-rated measures.
6. In keeping with common usage in New Zealand, speech-language therapy and speech-language therapist are used rather than speech-language pathology and speech-language pathologist in this thesis.
7. This doctoral thesis uses the term, error pattern, to mean a clinically relevant descriptive device to represent the consistent and systematic discrepancies between an adult's target and the child's erroneous production. The term, phonological process, is used to mean a formal way of expressing sound-related operations associated with a systematic phonological or morphophonological process.
8. This doctoral thesis uses expressions such as “production of error patterns”, “children produced age-appropriate error patterns” or “children deleted word-final consonants”, when describing the consistent and systematic difference between the adult's targets and child's erroneous realisations. This is for efficiency of presentation of the data concerning erroneous productions. This thesis, however, does not assume that children's production of speech errors is a conscious or goal-oriented mental process.

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CO-AUTHORS

Name	Nature of Contribution
Elaine Ballard	Supervision, Editing of manuscript, Discussion of argumentation
Clare McCann	Supervision, Editing of manuscript, Discussion of argumentation

Certification by Co-Authors

The undersigned hereby certify that:

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Extent of contribution by PhD candidate (%)	90

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Clare McCann	Supervision, Editing of manuscript, Discussion of argumentation

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Name	Nature of Contribution
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Clare McCann	Supervision, Co-writing and editing of manuscript

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1 INTRODUCTION

This doctoral thesis aims to provide clinically relevant information about phonological development in Korean-English bilingual (KEB) children. Phonological development refers to the processes acquiring and using the sound patterns of the language(s) they are learning (Snowling & Hulme, 1994). Thus, phonological development goes beyond simply learning how to produce individual speech sounds but it is learning the pattern and use of speech sounds in the language(s). In the field of phonological development, monolingual English-speaking (ME) children are the most studied population. Reflecting the increasing number of bilingual children in English-speaking countries around the world (e.g. Australian Bureau of Statistics, 2014; Statistics New Zealand, 2014a; United States Census Bureau, 2012), the study of bilingual phonological development has gained considerable interest. A recently published systematic literature review on bilingual phonological development (Hambly, Wren, McLeod, & Roulstone, 2013) and the position paper by the International Expert Panel on Multilingual Children's Speech (2012) reflect the emphasis currently given to bilingual phonological development. The majority of researchers who have contributed to the recent literature on bilingual phonological development are not those in linguistics or child development but those in speech-language therapy. Researchers and clinicians in speech-language therapy have been clinically motivated to obtain information about the characteristics that constitute typical phonological development in bilingual children, so that they can utilise the information to identify and provide appropriate clinical interventions for bilingual children whose phonological development is clinically delayed or disordered. This doctoral thesis is also motivated by the need for clinically relevant information about phonological development in KEB children. This introductory chapter describes the contextual framework, states the overall aims of the doctoral research and outlines the structure of this doctoral thesis.

1.1 MEASURING PHONOLOGICAL DEVELOPMENT

This doctoral thesis focuses on phonological development in KEB children aged between 3;0 and 7;11. This age range signifies the period during which children's speech becomes more complex and refined. There are three common ways in which children's acquisition of phonology have been measured; phonetic inventories, segmental accuracy and error patterns (McLeod, 2013). These three 'measurements' of phonological development are used in the doctoral thesis. They form the basis of clinical analysis used to identify children

whose phonological development is delayed or disordered by means of independent and relational phonological analyses (Bernthal, Bankson, & Flipsen, 2013; Bowen, 2014; Skahan, Watson, & Lof, 2007). In an independent phonological analysis, a child's speech sound productions are analysed independent of the target productions (Goldstein, 2001). By analysing the speech sounds produced by the child, phonetic inventories are established. The child's inventories are then compared to normative data to determine whether the speech sounds produced by the child in question are comparable to those produced by children of the same age group. Relational phonological analyses compare a child's productions with the target productions (Goldstein, 2001). By doing so, segmental accuracy and error patterns can be obtained. Segmental accuracy is calculated by using the percentage of consonants correct (PCC) and the percentage of vowels correct (PVC) and they have been used widely in clinical practice and research (Shriberg, Austin, Lewis, McSweeny, & Wilson, 1997a; Shriberg & Kwiatkowski, 1982). The PCC and PVC scores of the child in question are then compared to available normative data. Another example of relational phonological analysis is error pattern analysis. Also known as phonological process analysis or phonological pattern analysis, the erroneous productions, rather than the correct productions, are analysed for the type of surface-level speech errors. The type of errors the child in question produce are then compared to normative data to determine whether the errors produced by the child are typical and age-appropriate.

Despite the wide usage of these phonological analyses in clinical practice, there are considerable variations in the criteria used to obtain these measurements across different studies and they have been summarised and discussed at length in Zhu (2006) and more recently in McLeod (2013). As an example, inclusion of a speech sound in a child's inventory depends on whether imitated productions are included or whether the speech sound is produced in any word position or has to be produced in both word initial and word final positions. Although error analysis is the most widely used analysis procedure in clinical practice (McLeod & Baker, 2014; Skahan et al., 2007), there is no single universally accepted method of analysing speech samples for error patterns (Miccio & Scarpino, 2008). The criteria used in data collection and analyses have been described comprehensively in this doctoral thesis, so that speech-language therapists utilising the information presented here can make a valid comparison. The approach taken to define the criteria for analysing speech samples took into consideration the current trend in the field of bilingual phonological development, in which the majority of the studies have focused on how the rates and patterns of phonological development in bilingual children differ

from those in monolingual children (Hambly et al., 2013; Unsworth, 2013). Although this approach has been criticised for being biased toward monolingualism as it assumes that monolingualism is the norm (Meisel, 2006), it has allowed us to examine how phonological development is influenced by specific language exposure and to contribute to theoretical discussions concerning developmental universals (Zhu & Dodd, 2006). In addition, there could be clinical implications, if systematic differences can be revealed in the rates and patterns of phonological development between bilingual and monolingual children and if clinically relevant information about bilingual phonological development could be derived from already widely available normative data in monolingual children. This possibility will be critically examined in this doctoral thesis. In order to do so, the criteria used in data collection and analyses needed to be comparable to the available English and Korean monolingual studies. The normative studies associated with the Diagnostic Evaluation of Articulation and Phonology (Dodd, Zhu, Crosbie, Holm, & Ozanne, 2002) and the Assessment of Phonology and Articulation for Children (M. J. Kim, Pae, & Park, 2007) were used as the basis for comparison with the KEB children included in this doctoral thesis. These assessment tools are widely used in clinical practice in New Zealand for ME children and in South Korea for monolingual Korean-speaking (MK) children, respectively. The data collection and analysis procedures closely mirrored the studies associated with these two assessment tools for their respective languages (Dodd, Holm, Zhu, & Crosbie, 2003 for English; M. J. Kim, 2006; M. J. Kim & Pae, 2005 for Korean).

1.2 SPEECH SOUND DISORDER

Most children acquire and use the sound patterns of the language(s) to which they are exposed in their own natural environments (Goldstein & McLeod, 2012; Hambly et al., 2013). However, a small but significant proportion of children experience difficulties in phonological development (J. Law, Boyle, Harris, Harkness, & Nye, 2000b). Speech-language therapists frequently receive new referrals for children whose speech is unintelligible or delayed (American Speech-Language-Hearing Association, 2012; Broomfield & Dodd, 2004a). For many years, there has not been a universal agreement on the diagnostic label for children who presented with ‘speech difficulties’. In clinical practice and the literature, ‘(functional) articulation disorder’, ‘(developmental) phonological disorder’, ‘speech delay’, ‘speech system disorder’ and ‘speech sound disorder’ are among the diagnostic labels that have been used to describe these children (see Bowen, 2014). Various terms used to refer to children with speech difficulties,

especially in the 1980s and early 1990s, reflect the paradigm shift within speech-language therapy regarding the separation between phonetically based speech difficulties and phonemically or phonologically based speech difficulties (Fey, 1985, 1992; Ingram, 1976; Stoel-Gammon & Dunn, 1985). Even when Fey (1992) suggested the distinction between phonetically based articulation disorder and phonemically based phonological disorder, Kamhi (1992, p. 262) argued "the disagreement among child phonologists about the use of the term *phonological* is to me an unequivocal indication that the term never will receive widespread acceptance".

The standpoint of this doctoral thesis is consistent with the position paper put forward by the International Expert Panel on Multilingual Children's Speech (2012). The term, speech sound disorder, is used as an umbrella term covering speech sound difficulties of both known and unknown origin (International Expert Panel on Multilingual Children's Speech, 2012). The clinically relevant information provided in this doctoral thesis is concerned with the latter, speech sound disorder of unknown origin (henceforth SSD). SSD is a clinically significant deviation from typical phonological development that is not explained by an impairment in sensory, motor or structural functions (Flipsen, Bankson, & Bernthal, 2013; Shriberg, 1980). It is widely accepted that children with SSD are not a homogeneous group (Dodd, 2005; Dodd, Leahy, & Hambly, 1989; Lewis et al., 2006; Shriberg, Austin, Lewis, McSweeny, & Wilson, 1997b; Shriberg et al., 2010; Stackhouse & Wells, 1997; Tyler, 2010). Different classification systems have been proposed to explicate the heterogeneity within SSD. These include the Speech Disorders Classification System (Shriberg et al., 2010), the Psycholinguistic Framework (Stackhouse & Wells, 1997) and the Differential Diagnosis System (Dodd, 1995, 2005) and they have been extensively reviewed in Waring and Knight (2013). The classification system adopted in this doctoral thesis is the Differential Diagnosis System because of its clinical feasibility and cross-linguistic applicability (Dodd, 2005, 2014; Waring & Knight, 2013). According to the Differential Diagnosis System, the best criterion to determine whether a child's phonological development is typical or disordered is the error patterns produced by the child. Error patterns are considered to be a clinically relevant descriptive device to represent the consistent and systematic discrepancies between a child's erroneous productions and an adult's targets (Peña-Brooks & Hegde, 2000; Zhu & Dodd, 2006). The subgroups of SSD classified using error patterns in the Differential Diagnosis System (illustrated in Figure 1.1) reflect distinct underlying processing deficits (Crosbie, Holm, & Dodd, 2009; Dodd, 2011; Dodd et al., 1989; Holm, Farrier, & Dodd, 2008). The

Differential Diagnosis System has now been applied to children who speak languages other than English, including Cantonese (So & Dodd, 1994), Mandarin (Zhu & Dodd, 2000b) and German (Fox & Dodd, 2001), supporting its applicability across different languages.

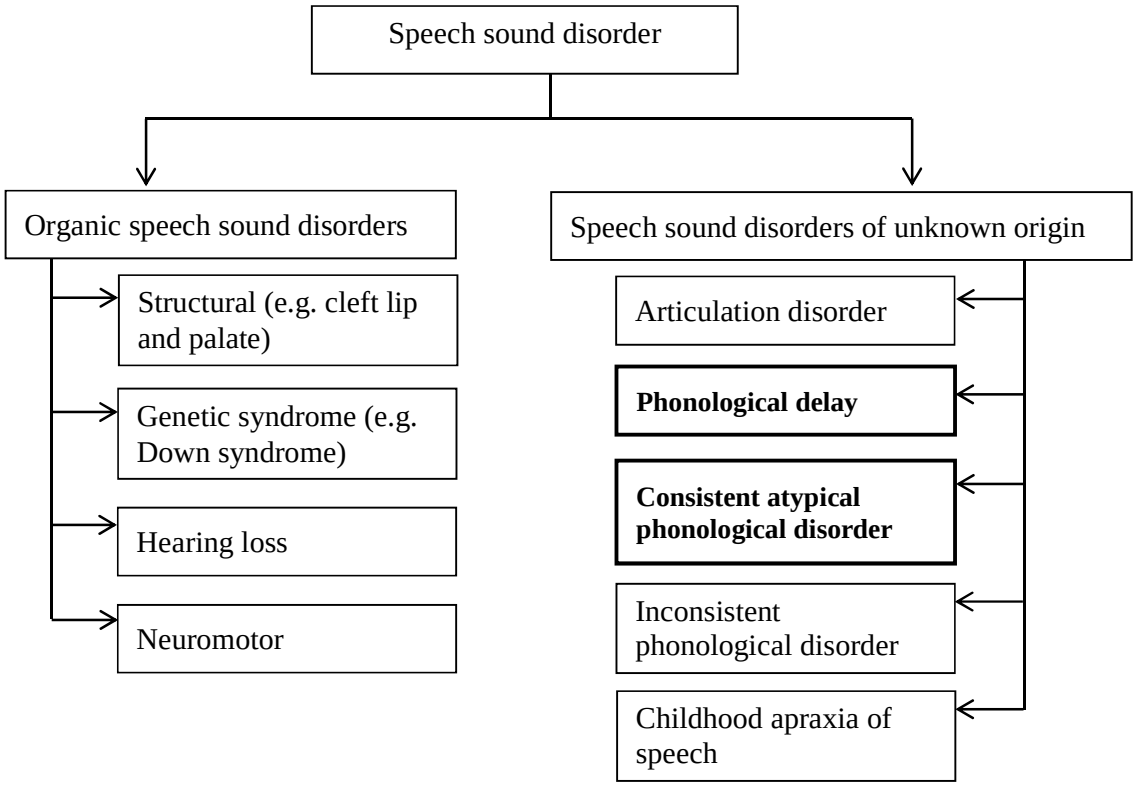

Figure 1.1. The classification of speech sound disorder adopted in the doctoral thesis

Figure 1.1 illustrates how this doctoral thesis approaches the classification of SSD. This thesis is particularly relevant to assessment of KEB children with phonological delay and consistent atypical phonological disorder (henceforth simply phonological disorder). Children with phonological delay produce typical, developmental error patterns but the error patterns they produce are typical of a younger age group (Dodd, 2005). For example, stopping of fricatives (e.g. [paɪb] for /faɪv/) is typical until 3;5 in ME children (Dodd et al., 2003). ME children who produce stopping of fricatives beyond this age would be diagnosed as having a phonological delay. Children with phonological disorder produce atypical, non-developmental error patterns (Dodd, 2005). For example, producing backing of alveolar consonants (e.g. [ki] for /ti/) or word initial consonant deletion (e.g. [eb] for /web/) would be clinical signs of a phonological disorder in ME children. In an incidence study involving 320 English-speaking children with SSD, Broomfield and Dodd (2004b) found that children with phonological delay made up the largest proportion of children

with SSD (57.5%), followed by those with phonological disorder (20.6%). A similar pattern has been found in Cantonese-speaking children (So & Dodd, 1994), German-speaking children (Fox & Dodd, 2001) and Mandarin-speaking children (Zhu & Dodd, 2000b), in which children with phonological delay and phonological disorder reflected approximately 80% of children with SSD. Hence, the focus in this doctoral thesis is given to these two subgroups of SSD.

1.3 BILINGUALISM

Bilingualism is not just a linguistic concept but also a social and psychological phenomenon framed within a multidimensional context of a society (Butler, 2013). Depending on the sociolinguistic and historical context, there can be a wide range of definitions of bilingualism. The purpose of this section is to describe and explain the approach taken in this doctoral thesis to define bilingual children. A brief description of the Korean community in New Zealand, where this doctoral research was conducted, is provided.

1.3.1 KOREANS IN NEW ZEALAND

The Ministry of Social Development (2010) forecasts New Zealand will become more ethnically and linguistically diverse in the coming decades. Recently, the influx of Asian migrants has been a major factor in its increased ethnic diversity. The Asian population, currently making up 11.8% of the total population (Statistics New Zealand, 2014a), is projected to have the greatest relative growth (The Ministry of Social Development, 2010).

Koreans are a relatively recent migrant group in New Zealand. In 1991, there were 930 Koreans in New Zealand (Statistics New Zealand, 1991). Today, Koreans are the fourth largest Asian group in New Zealand, with 30,717 registered residents (Statistics New Zealand, 2014a). The majority of Koreans came to New Zealand under the Immigration Amendment Act 1991, which prioritised education and health for migrants. Koreans in New Zealand are relatively young, highly qualified and affluent (Friesen, 2008; Ho, Au, Bedford, & Cooper, 2003; H.-J. Park & Anglem, 2012). Reflecting the recent status of migration, only about 10% of Koreans currently living in New Zealand were born in New Zealand. Statistics New Zealand (2004) reported that Koreans were most likely to be able to speak Korean but, among all ethnic minority groups, Koreans were least likely to be able to carry out everyday conversations in English. Subsequent research has also discussed issues regarding poor English language proficiency in the majority of Korean

adults living in New Zealand (e.g. J. Y. Lee, Kearns, & Friesen, 2010; Morris, Vokes, & Chang, 2007; H.-J. Park & Anglem, 2012). As observed in many recently established migrant groups, Koreans rely on other Koreans for economic, social and emotional support, building their own Korean community within the greater New Zealand society (Morris et al., 2007). Socio-cultural transnational activities are widely and frequently observed in Koreans living in New Zealand, maintaining strong cultural and emotional ties to Korea (Koo, 2013; H.-J. Park & Anglem, 2012). Considered a 'model minority' (Shin, 2005), rarely are Koreans considered problematic in education and health at a population level in New Zealand (J. Y. Lee et al., 2010). Therefore, the research needs for them have never been emphasised. Although some research on the Korean community in New Zealand has been done, it tended to focus on migration, transnationalism and identity. There has never been a study specifically focused on Korean children growing up in New Zealand.

1.3.2 PARTICIPATION CRITERIA

For the research reported in this doctoral thesis, two criteria were used to define bilingual children. Children were considered bilingual if (1) they were exposed to both English and Korean language environments regularly and consistently and (2) their parents considered them to be bilingual. The first criterion reflects the suggestion made by Goldstein and Gildersleeve-Neumann (2007, p. 12) that "the *exposure* to two languages can result in a phonological system that has subtle differences from either of the monolingual language environments" and with the approach taken in Hambly et al.'s (2013) systematic literature review in which they focused on "children who are *exposed* to bilingual or multilingual environments" [emphasis added] (Hambly et al., 2013, p. 3). The second criterion took into consideration both this trend in the literature and the clinical nature of this doctoral thesis. Parental report is commonly used in the field of bilingual phonological development to describe children's language use and background and to determine their bilingual status (e.g. Fabiano-Smith & Barlow, 2010). Speech-language therapists also rely on parental report to determine whether the child is monolingual or bilingual. Given the general characteristics of the Korean community in New Zealand (e.g. recent migrant group, Korean language-dominant) and the descriptive nature of this doctoral thesis, strict criteria, which might exclude some bilingual children, were not imposed.

1.3.3 SIMULTANEOUS AND SEQUENTIAL BILINGUALISM

Bilingual children are often categorised into one of two groups based on the age of acquisition of their languages. Some studies have investigated phonological skills in

simultaneous bilingual children who had been exposed to both languages since the onset of language acquisition or from very early in childhood (e.g. Brice, Carson, & Dennis O'Brien, 2009; Goldstein & Washington, 2001; N. C. W. Law & So, 2006). Others reported on sequential bilingual children who were exposed to one language after the other (e.g. Gildersleeve-Neumann, Peña, Davis, & Kester, 2009; Holm & Dodd, 2006; Lin & Johnson, 2010; Prezas, Hodson, & Schommer-Aikins, 2014). Although such categorisation is common, different criteria have been used in the literature to group children into simultaneous and sequential bilinguals. For example, Meisel (2006) stated that simultaneous bilinguals refer to children who acquire two languages during the first three or four years of life and sequential bilinguals to acquisition of the second language between the ages of five and ten years. In McLaughlin (1978), sequential bilingual children were those who acquired their second language after the age of three years. Zhu and Dodd (2006, p. 9) argued that "a normally developing child's phonological system is definitely well established by 30 months of age, therefore exposure to another language at 30 months will presumably yield quite different results than that of a child exposed to two languages from birth". They seem to suggest that the criterion to categorise children into simultaneous and sequential bilinguals should be the age of 30 months. Take, for example, a Korean-speaking child who began learning English at the age of 3;6. Following Meisel (2006), this child could be considered a simultaneous bilingual. McLaughlin (1978) and Zhu and Dodd (2006) suggest that this child should be considered a sequential bilingual.

Categorisation of bilingual children into simultaneous and sequential bilinguals has potentially significant theoretical and practical implications. Wode (1980) and Watson (1991) suggested that sequential bilingual children learn the second language phonology by initially superimposing it on to the first language phonology before they are differentiated. Goldstein and Gildersleeve-Neumann (2007) also suggested that sequential bilingual children use the knowledge of the first language phonology to learn the phonology of their second language and therefore cross-linguistic effects may be more pronounced in sequential than simultaneous bilingual children. Despite its potentially theoretical and clinical importance, only a limited number of studies have directly addressed the difference in phonological skills between simultaneous and sequential bilingual children. Those that have addressed this issue found no remarkable, clinically significant differences between the two groups of bilingual children (e.g. Arnold, Curran, Miccio, & Hammer, 2004). In addition, Gildersleeve-Neumann et al. (2009) noted that the phonological skills of their sequential Spanish-English bilingual children were comparable

to the phonological skills of simultaneous bilingual children reported in Goldstein and Washington (2001). Comparing the error patterns produced by simultaneous Spanish-English bilingual children in Brice et al. (2009) and sequential Spanish-English bilingual children of the same age group in Prezas et al. (2014), no differences can be found.

Because the age of language exposure was not part of the participation criteria in the doctoral research, the proportion of simultaneous and sequential bilingual children in the sample could not be controlled, which has implications for statistical analyses. Given the apparent arbitrariness of the criterion used to group bilingual children into simultaneous and sequential bilinguals and the lack of evidence in the literature regarding the differences between these two bilingual groups, a detailed comparison of phonological skills and error productions between these two groups of bilingual children will not be one of the major aims of this doctoral thesis. However, age of language exposure is closely examined. Reflecting the characteristics of the Korean community in New Zealand, all KEB children who participated in the doctoral research were exposed to the Korean language from birth. The age of acquisition of English was used as a continuous variable rather than a categorical variable to determine whether it is a potential factor influencing phonological development in KEB children.

1.3.4 HOW MANY SYSTEMS?

Whether bilingual children had a single underlying system or separate systems supporting each language was a prominent topic of debate in the past. Initially, this debate concerned simultaneous bilingual children. In a single case study of a two-year-old Romanian-English bilingual child, Vogel (1975) reported that similar error patterns were used in both of the child's languages and argued for a single underlying system supporting both languages. Volterra and Taeschner (1978) also argued for a single underlying system during the initial stage of language development but that the system is differentiated into two separate systems after the age of two years. Schnitzer and Krasinski (1994) also supported beginning with a single system, which is at least partially separated after the age of two years. Shortly after the publication of their single case study, the same authors reported another single case study, which argued for separate phonological systems from the age of 1;6, the earliest point of their data collection (Schnitzer & Krasinski, 1996). The majority of subsequent research provided evidence for separate underlying systems for bilingual children and that the separate systems interact with each other. The evidence for this has come from language-specific patterns in syllable truncations in nonword repetition

(Paradis, 2001) and early acquisition of language-specific stress patterns (Keshavarz & Ingram, 2002), as well as from language-specific patterns of phoneme acquisition (e.g. Goldstein & Washington, 2001; N. C. W. Law & So, 2006). This theoretical stance, now known as the Interactional Dual Systems Model, has been discussed in morphosyntactic development, as well as phonological development (see Genesee, Nicoladis, & Paradis, 1995; Hulk & Müller, 2000; Müller, 1998; Paradis & Genesee, 1996).

Underlying systems in sequential bilingual children received less attention in the literature. Some suggested that the second language phonology is initially superimposed onto the first language phonology before they are differentiated in sequential bilingual children (Watson, 1991; Wode, 1980). This argument was subsequently challenged by Holm and Dodd (1999b). In a longitudinal study of two Cantonese-English bilingual children which began three months after exposure to English (second language), they found language-specific patterns of phoneme acquisition. Shared phonemes were not mastered at the same time but in one language before the other. Errors in the shared phonemes were also language-specific. For example, a phoneme shared between English and Cantonese /s/, was erroneously realised as [d] in English but as [ts] in Cantonese. Holm and Dodd (1999b) therefore suggested that the two phonological systems were differentiated. The same authors provided further evidence for their argument with a cross-sectional study with a much larger sample (Holm & Dodd, 2006). More recently, Prezas et al. (2014) also supported the application of the Interactional Dual Systems Model for sequential bilingual children, based on their findings which were similar to those reported in Holm and Dodd (1999b, 2006).

On the discussion on phonological systems, Hambly et al. (2013, p. 7) put forward; “More recently researchers have moved away from questioning whether there are one or two phonological systems and accept that there are two systems that interact. Investigations are more focused on finding evidence of positive and negative transfer and cross linguistic effects”. This doctoral thesis takes the same approach. Even for those who supported a single underlying system for simultaneous bilinguals, it is argued to be differentiated at around the age of two years (but also see Keshavarz & Ingram, 2002; Paradis, 2001; Schnitzer & Krasinski, 1996). This doctoral thesis focuses on KEB children between the ages of 3;0 and 7;11. The youngest bilingual children in the doctoral research can be said to have gone through the differentiation of their underlying phonological system (thus now possessing separate phonological systems). Phonological skills and surface-level speech errors will be considered in the context of age of English language acquisition to determine

whether cross-linguistic effects are more pronounced in KEB children who were exposed to English after Korean, as suggested in Goldstein and Gildersleeve-Neumann (2007).

1.4 STATEMENT OF THE PROBLEM

The clinical diagnosis of SSD is made by comparing the phonological skills and error patterns of a child with suspected SSD to the available normative data that reflect the biographical and linguistic backgrounds of the child in question. Accurate differential diagnosis is necessary because children in the different subgroups of SSD respond differentially to different types of treatment (Broomfield & Dodd, 2011; Crosbie, Holm, & Dodd, 2005; Dodd & Bradford, 2000). Speech-language therapists are able to access information about typical phonological development in ME children from a range of published studies (e.g. Dodd et al., 2003; James, 2001a; Roberts, Burchinal, & Footo, 1990; Smit, Hand, Freilinger, Bernthal, & Bird, 1990) to determine whether their phonological development is typical, delayed or disordered.

Speech-language therapists are encountering an increasing number of bilingual children with suspected SSD in their clinical practice (American Speech-Language-Hearing Association, 2012; Roseberry-McKibbin, Brice, & O'Hanlon, 2005; Speech Pathology Australia, 2002; Winter, 1999). The Differential Diagnosis System is a classification system of SSD based on linguistic symptomatology (Dodd, 2005). As there is no evidence to suggest that the nature of SSD in bilingual children is fundamentally different from that in monolingual children, the Differential Diagnosis System should be clinically applicable to bilingual populations. To identify bilingual children with a phonological disorder, speech-language therapists require information about their typical, development error patterns. To identify bilingual children with a phonological delay, speech-language therapists require information about the age at which each typical, developmental error pattern is expected to be resolved. For the majority of bilingual populations, such information is unavailable. Surveys of speech-language therapists have consistently identified a lack of bilingual-specific developmental norms as a significant clinical challenge (Guiberson & Atkins, 2012; Kritikos, 2003; Roseberry-McKibbin et al., 2005; Williams & McLeod, 2012). The recent systematic literature review concluded that phonological development in bilingual children is qualitatively different from that in monolingual children (Hambly et al., 2013). Therefore, the clinical use of the available monolingual norms for bilingual children with suspected SSD is likely to lead to erroneous clinical decisions (Goldstein & Gildersleeve-Neumann, 2007). Nevertheless, Prezas et al.

(2014) noted that bilingual children are still being compared to their monolingual peers. Such practice is understandable, as there is a significant lack of information about the characteristics that constitute typical phonological development in bilingual children. However, it puts bilingual children at risk of being misdiagnosed. If a speech-language therapist misattributes the qualitative differences in a typically developing bilingual child to characteristics of SSD and provides treatment, then time and resources are inappropriately spent. If a speech-language therapist misattributes the clinical signs of SSD in a bilingual child to the qualitative differences arising from bilingualism, then the child who does have an SSD is not provided with treatment (Kohnert, 2008; Yavaş & Goldstein, 1998). The latter case is especially concerning, because there is evidence for long-term adverse consequences of SSD, including academic and literacy difficulties throughout school years (Bird, Bishop, & Freeman, 1995; Felsenfeld, Broen, & McGue, 1994; Leitão & Fletcher, 2004; Lewis, Freebairn, & Taylor, 2000, 2002; McCormack, McLeod, McAllister, & Harrison, 2009). Given the positive evidence for speech-language therapy interventions for SSD (e.g. Almost & Rosenbaum, 1998; Broomfield & Dodd, 2005, 2011; Crosbie et al., 2005; Gierut, 1998; J. Law, Garrett, & Nye, 2010), accurate identification of SSD is likely to lead to appropriate clinical interventions thereby minimising its psychosocial consequences. A lack of bilingual-specific information about the characteristics that constitute typical phonological development is a pressing issue that cannot be addressed soon enough.

Once children with SSD are identified, speech-language therapists can provide effective clinical interventions. However, McLeod, Harrison, McAllister, and McCormack (2013) recently reported that a significant number of preschool children with SSD in the community are not being identified by service providers. Such children are at risk of experiencing significant education or academic challenges, especially as the demand on literacy increases throughout the school years. The situation may be much worse for bilingual children. There is no research evidence to suggest that the prevalence of SSD is any higher or lower in bilingual children (Goldstein & McLeod, 2012; Hambly et al., 2013; Winter, 2001). Nevertheless, Stow and Dodd (2005) reported that bilingual children are much less likely to be referred to clinical services with concerns regarding their phonological development than monolingual children. The issue of under-representation of bilingual children in speech-language therapy services has gained more attention in recent years (International Expert Panel on Multilingual Children's Speech, 2012; Stow & Dodd, 2003; Winter, 2001). In particular, it has been pointed out that the public awareness

of SSD may be lower in the bilingual community in English-speaking countries (Stow & Dodd, 2005). While there have been major publicity campaigns to raise public awareness of communication disorders in children, for example, the Identify the Signs campaign (American Speech-Language-Hearing Association, 2014) and the Raise Awareness of Language Learning Impairments (RALLI) campaign (Bishop, Clark, Conti-Ramsden, Norbury, & Snowling, 2012), such campaigns tend to be conducted in English and may fail to reach bilingual communities. Given the under-identification of monolingual children with SSD (McLeod et al., 2013), the number of bilingual children with SSD unidentified by service providers may be higher. Proactive actions need to be taken by the speech-language therapy community.

1.5 AIMS OF THE THESIS

This doctoral thesis aims to provide preliminary and clinically relevant information about phonological development in KEB children for speech-language therapists. Speech-language therapists collect speech samples from children with suspected SSD and analyse the speech samples for inventories, segmental accuracy and error production. This doctoral thesis describes phonetic inventories, segmental accuracy and types of errors produced by KEB children, so that speech-language therapists can utilise these information in assessment with KEB children with suspected SSD. Currently, the approach to studying bilingual phonological development in the literature has been to compare it against monolingual phonological development (Hambly et al., 2013; Unsworth, 2013). It is an appealing idea to derive clinically relevant information about bilingual phonological development from monolingual phonological development, since monolingual norms are widely available. This doctoral thesis will evaluate this approach to determine whether diagnostically reliable information for KEB children with suspected SSD can be derived from the available monolingual norms. The Differential Diagnosis System (Dodd, 1995, 2005) has been widely adopted in the assessment procedure with ME children. Although the clinical applicability of the Differential Diagnosis System has been extensively studied with ME children, there has been comparatively and significantly less discussion for bilingual populations. This doctoral thesis serves to fill this gap in the literature. It should be noted that this doctoral thesis is not an in-depth study of phonological development in KEB children but it is applying clinical tools to this population in order to provide useful reference points for an applied setting. This thesis will be a useful first step in helping speech-language therapists to identify KEB children with SSD.

This doctoral thesis also explores a potential solution to the under-identification of bilingual children with SSD. Parents are one of the major referral sources to speech-language therapy (Broomfield & Dodd, 2004a) and already play a significant role in assessment of bilingual children with suspected SSD (e.g. McLeod & Baker, 2014; Williams & McLeod, 2012). The doctoral thesis aims to explore how parental report could be used in identifying KEB children with SSD in the community. Furthermore, whether parent-rated measures of bilingual children's speech can be used as a tool for a universal speech screen will also be explored. A universal speech screen tests all children in a population and identifies those who require further clinical assessment. The justifications for implementation of a universal speech screen already exist, including the prevalence of SSD and positive evidence for effectiveness of speech-language therapy interventions. The speech-language therapy community has been engaged in discussions about implementation of a universal speech/language screen (e.g. J. Law, Boyle, Harris, Harkness, & Nye, 2000a; Nelson, Nygren, Walker, & Panoscha, 2006). The preliminary study examining the use of parent-rated measures as a potential tool for a universal speech screen aims to reignite clinical discussions and research activities.

1.6 STRUCTURE OF THE THESIS

In accordance with the University of Auckland Statute for the Degree of Doctor of Philosophy, this thesis is presented as a series of published or unpublished research papers (Clause 1). This introductory chapter has served to provide a contextual framework and the final chapter will provide a concluding discussion. There is no separate chapter presenting the review of the literature. Bilingual phonological development has been reviewed in various recent publications (Goldstein & McLeod, 2012; Hambly et al., 2013; Hammer et al., 2014; Unsworth, 2013), all of which were published when this doctoral research was being carried out. Relevant literature is reviewed in the Introduction sections of Chapters 3, 4, 5 and 6.

Chapter 2 serves two purposes. Firstly, it serves as a reference chapter for Korean and English phonologies for the remaining chapters in the doctoral thesis. Secondly, it provides information about phonological assessment specifically in KEB children, which serves as rationale for the methodology employed in the doctoral research.

The remaining chapters are presented as a series of 'papers' that have been edited to form a coherent content. In particular, the Introduction and Summary sections have been edited to provide a link between the chapters. Chapter 3 outlines a cross-sectional study

reporting on phonological skills in 52 KEB children aged between 3;0 and 7;11. Phonetic inventories and segmental accuracy (PCC and PVC) in KEB children are profiled in this chapter. The phonological skills of the bilingual children are compared to the available monolingual normative data. We critique the current approach of making a group comparison of phonological skills between bilingual and monolingual children. Findings are used to investigate cross-linguistic effects at points of structural overlap between the two languages.

Chapter 4 reanalyses the data presented in Chapter 3 for errors. The Introduction section of this chapter provides a review of the literature on error production in bilingual children. The Methodology section details a three-stage analysis used in this doctoral thesis to obtain error patterns (referred to as common error types in the chapter) in KEB children.

Chapter 5 is a follow-up study of 23 of 52 KEB presented in Chapters 3 and 4. The main purpose of this chapter is to supplement the findings and discussions presented in the previous chapters. In both Chapters 4 and 5, clinical application of the Differential Diagnosis System (Dodd, 1995, 2005) for KEB children is discussed.

Chapter 6 is a correlational study aimed to investigate the potential use of parent-rated measures as a universal speech screen. In particular, the use of two scales, Intelligibility in Context Scale (McLeod, Harrison, & McCormack, 2012a) and Gildersleeve-Neumann Scale (Stertzbach & Gildersleeve-Neumann, 2006), is investigated. All studies outlined in this doctoral thesis were approved by the University of Auckland Human Participants Ethics Committee (UAHPEC).

The final chapter summarises the research findings and the clinical implications of the doctoral research. Recommendations for speech-language therapists assessing KEB children with suspected SSD and future research directions in SSD in bilingual children are suggested.

2 ASSESSING PHONOLOGICAL SKILLS IN KOREAN

2.1 INTRODUCTION

Speech-language therapists are encountering an increasing number of bilingual children with SSD in their clinical practice (American Speech-Language-Hearing Association, 2012; Roseberry-McKibbin et al., 2005; Speech Pathology Australia, 2002; Winter, 1999). While there is no shortage of information about assessing phonological skills in English (e.g. Bankson, Bernthal, & Flipsen, 2013; Bauman-Waengler, 2008; Bowen, 2014; Ingram, 1976, 1981; Peña-Brooks & Hegde, 2000; Stoel-Gammon & Dunn, 1985), there is a lack of specific information about assessing phonological skills in bilingual children, which necessarily involves assessing phonological skills in languages other than English (as well as English). Survey studies have revealed a lack of information about assessing phonological skills and the availability of assessment tools in languages other than English to be among the significant challenges faced by speech-language therapists (e.g. Guiberson & Atkins, 2012; Roseberry-McKibbin et al., 2005; Roseberry-McKibbin & Eicholtz, 1994).

The purpose of this chapter is two-fold. The first is to describe the phonological features of Korean and English. The second is to provide information specifically relating to assessing Korean phonology in KEB children. In particular, the use of monolingual Korean speech assessment tools for KEB children is discussed. There is a focus on Korean in this chapter because assessing ME children has already been discussed widely (e.g. Bankson et al., 2013; Bauman-Waengler, 2008; Bowen, 2014; Ingram, 1976, 1981; Peña-Brooks & Hegde, 2000; Stoel-Gammon & Dunn, 1985). This chapter concludes with a discussion about the methodology employed in the doctoral research.

2.2 SEGMENTAL FEATURES

This section describes the features of contemporary Korean phonology as it is spoken in South Korea today. The Korean language is relatively homogenous, with only minor dialectal variations (Sohn, 1999). In the speech-language therapy literature, there are two publications describing the phonology of Korean with the purpose of informing speech-language therapists about its distinct features (Ha, Johnson, & Keuhn, 2009; M. J. Kim & Pae, 2007). No description of a language is without contention. Our description of Korean phonology differs slightly, yet significantly, from previous publications. Where there are differences, we will provide explanations.

2.2.1 CONSONANTS

Table 2.1 illustrates the Korean consonants by place and manner of articulation. Korean stops and affricates have a three-way distinction by the degree of tenseness and aspiration (Ahn, 2009). The lax segments are weak and breathy, while the aspirated segments are strongly aspirated. Tense segments are characterised by greater glottal tension compared to the other segments (Cho, Jun, & Ladefoged, 2002; I. Lee & Ramsey, 2000). This three-way distinction is phonemic, such that /tal/, /t*al/ and /t^hal/ mean *moon*, *daughter* and *mask*, respectively. Korean has bilabial, alveolar and velar stops (Ahn, 2009; I. Lee & Ramsey, 2000). The International Phonetic Alphabet (IPA) symbols for the Korean affricates vary depending on the source. Ha et al. (2009), for example, used /c, c*, c^h/ for the Korean affricates, even though /c/ is a symbol designated for a voiceless palatal *stop* in the IPA chart (International Phonetic Association, 2005). M. J. Kim and Pae (2007) used /ʨ, ʨ*, $ʨ^h$/. The Korean affricates are illustrated with yet another different set of IPA symbols, /tʃ, tʃ*, $tʃ^h$/, in Cho et al. (2002) and S. Lee, Davis, and MacNeilage (2008). H. Kim (1999, 2001) conducted a series of articulatory and acoustic studies and suggested that the Korean affricates are alveolar. More specifically, the researcher suggested that the IPA symbol, /ts/, should be used for the Korean affricates, reflecting the alveolar placement of articulation. The suggested place of articulation for the Korean affricates has also been supported by a later Magnetic Resonance Imaging (MRI) study investigating the displacement of the tongue and vertical larynx movement (H. Kim, Honda, & Maeda, 2005). Describing Korean affricates as alveolar (/ts, ts*, ts^h/) has also been adopted in the description of Korean phonology in more recent publications in the field of theoretical phonology (e.g. Y. Kang, 2010). This doctoral thesis adopts the view that the Korean affricates are alveolar.

Table 2.1. Korean consonants

		Place			
Manner		Bilabial	Alveolar	Velar	Glottal
Stop	Lax	p	t	k	
	Tense	p*	t*	k*	
	Aspirated	p^h	t^h	k^h	
Affricate	Lax		ts		
	Tense		ts*		
	Aspirated		ts^h		
Fricative	Lax		s		h
	Tense		s*		
Nasal		m	n	ŋ	
Liquid			l		

Between voiced segments, the lax series can be realised as their voiced allophones (I. Lee & Ramsey, 2000). That is, the Korean word for *wave* is represented phonemically as /p^ha.to/ but it is phonetically realised as [p^ha.do]. Korean alveolar fricatives have a two-way phonemic distinction classified by the degree of tenseness. For example, /sal/ means *flesh* but /s*al/ means *rice*. The lax fricative, /s/, is never voiced but can be palatalised before high front vowel and slackened intervocalically (Ahn, 2009). The other fricative, /h/, is the only glottal sound in Korean and it is often dropped between voiced segments in natural speech (I. Lee & Ramsey, 2000). The remaining consonants are three nasals and one liquid. Korean nasals are distinguished by place of articulation. The liquid is realised as [l] in word final position and in a sequence of two liquids at a syllable boundary (e.g. [ol.la.ga.da]), but as [ɾ] in word initial position or intervocalically. Only English loanwords begin with the liquid but no native Korean words do (Ahn, 2009; I. Lee & Ramsey, 2000).

2.2.2 VOWELS

Figure 2.1 shows the seven monophthongs. Other researchers, including Ha et al. (2009) and J. J. Song (2005), have presented a vowel system with ten monophthongs, which includes /y, ø, ɛ/, as well as the seven vowels shown in Figure 2.1. In contemporary Korean, the front rounded vowels, /y/ and /ø/, have been diphthongised to [wi] and [we], respectively (C.-W. Kim, 1968; D.-Y. Lee, 1998; I. Lee & Ramsey, 2000). According to D.-Y. Lee (1998, p. 28), “there is no evidence which supports [their] monophthongal status”. In addition, previously observed /ɛ/ has now been merged with /e/ (Ahn, 2009; H.-S. Kang, 1997) in contemporary Korean.

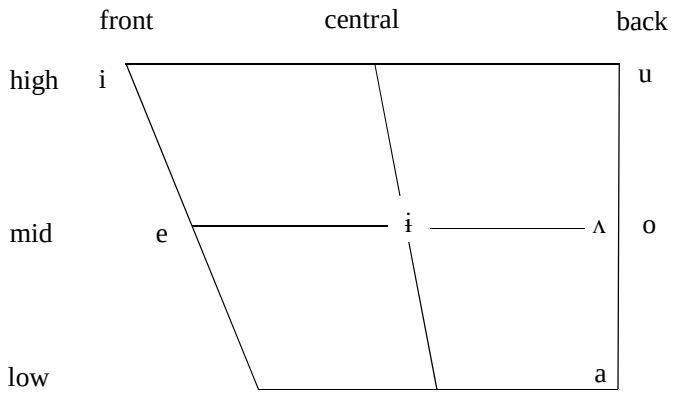

Figure 2.1. Korean vowels

The diphthongs are phonetically realised as a sequence of glide and vowel (Table 2.2). The glides in Korean phonology are not independent phonemes (C.-W. Kim, 1968). The off-glide can be realised as [ɨ] and [i] in word initial and word final positions, respectively (Ahn, 2009; J. J. Song, 2005). The post-consonantal glide can also be deleted in natural speech (Silva, 1991), so that *toilet* can be pronounced either [hwa.dzaŋ.sil] or [ha.dzaŋ.sil]. The latter phonological process is particularly interesting to discuss for KEB children, because in English glides are consonants and are not deleted. Ha et al. (2009) suggested four triphthongs in their description of Korean phonology; [jaj], [jej], [waj] and [wej]. The majority of linguists agree that such triphthongs are not features of Contemporary Korean phonology (Ahn, 2009; I. Lee & Ramsey, 2000; Sohn, 1999; J. J. Song, 2005).

Table 2.2. Korean diphthongs

w on-glides		*j* on-glides			*j* off-glide
wi				ju	ɨj
we	wʌ	je	jʌ	jo	
	wa		ja		

2.2.3 SYLLABLES

The Korean syllabic structure can be represented as consonant-vowel-consonant or $(C_1)V(C_1)$, in which the only obligatory segment is the vowel (Ahn, 2009). There are no consonant clusters within a syllable. A sequence of two consonants can occur at syllable boundary (e.g. /ts^{h}im.te/). A sequence of the same consonants is also permitted in the case of /m/, /n/ or /l/ at syllable boundary, for example, in *mum* (/ʌm.ma/). All consonants, except for /ŋ/, are permitted as onset. Only seven consonants are allowed in coda position

(/p, t, k, m, n, ŋ, l/). Stops in word final position are always unreleased and unaspirated. The slight puff of air released in word final stops in English is not observed in Korean word final stops (Ahn, 2009; I. Lee & Ramsey, 2000).

2.3 COMPARISON WITH ENGLISH PHONOLOGY

Table 2.3 compares the phonological features of Korean and English. Several distinct features of New Zealand English will also be briefly discussed, because the KEB children who participated in the doctoral research were recruited in New Zealand.

In English, voicing results in a phonemic contrast for obstruents, such that the change in voicing is associated with a change in meaning (e.g. *pie* vs. *bye*). The degree of aspiration in English stops is associated with allophonic variants of the same segments in English and thus can vary depending on the distribution (e.g. /t/ in ***t****ime*, *eigh****t***, *s****t****op*) (Ladefoged & Johnson, 2011). It is worth reiterating the differences between English and Korean in terms of voicing and aspiration and the conventions used to express the distinctive features of each language. In Korean, /p/ is a phoneme (note the *slanted* brackets) and it can be realised as its allophonic variants, [b] (note the *square* brackets). In English, both /p/ and /b/ are phonemes. Similarly, in Korean /p/ and /p^h/ are phonemes (slanted brackets), while in English [p^h] (square brackets) is an allophonic variant of /p/ (slanted brackets).

Table 2.3. Comparison of Korean and English phonologies

	Korean	English
CONSONANTS		
Stops	/p, p*, pʰ, t, t*, tʰ, k, k*, kʰ/	/p, b, t, d, k, g/
	voiced stops are allophones of lax stops	aspirated stops are allophones
Affricates	/ts, ts*, tsʰ/	/ʧ, ʤ/
	voiced affricates are allophones of lax affricates	
Fricatives	/s, s*, h/	/f, v, θ, ð, s, z, ʃ, ʒ, h/
	no voiced fricatives	
	/s/ is palatalised before high front vowel	
Nasals	/n, m, ŋ/	/n, m, ŋ/
Liquids	/l/	/l, ɹ/
Glides	No phonemic glides	/j, w/
VOWELS		
Monophthongs	/i, e, ɨ, ʌ, a, u, o/	/i, ɪ, e, æ, u, ʊ, ɒ, ɜ, ɔ, ʌ, a, ə/
	no lax-tense vowel distinction	
Diphthongs	/ui, ie, ue, ɨi, iʌ, uʌ, ia, ua, iu, io/	/eɪ, ɔɪ, ai, aʊ, oʊ, iə, eə, uə/
	phonetic glides are variants of high vowels	
SYLLABLES		
Clusters	No consonant clusters within a syllable	Up to three consonants as onset and four consonants in coda position
Onset	All consonants permitted except for /ŋ/	All consonants permitted except for /ŋ/
Coda	Only lax stops, nasals and liquid permitted	All consonants permitted except for /ɹ , j, w, h/

The English fricative consonants are more complex than Korean in terms of their place of articulation. Unlike other varieties of English, in which the speakers often drop /h/ in natural speech, New Zealand English is a /h/-full variety in which /h/ in natural speech is pronounced. Similar to New Zealand English, Korean /h/ in onset position is always pronounced, although intervocalic /h/ in natural speech can be dropped in Korean.

The contrasts and phonotactic constraints on nasals are similar between the two languages. The flap in Korean, which is an allophonic variation of the liquid, can be heard in speakers of North American English as an allophone of /t/, for example, in *butterfly* ([bʌɾə-flaɪ]) but it is heard less often in New Zealand English speakers. In New Zealand English, /l/ tends to be velarised and can even be vocalised in coda position (e.g. [bɔʊ] for

ball) (Allan & Starks, 1998). The rhotic consonant is specific to English. New Zealand English is non-rhotic. Thus, /ɹ/ following a vowel is not produced. As noted in Table 2.3, complex onset and coda are permitted only in English but not in Korean.

The English vowel system has the phonemic lax-tense distinction (e.g. *live* vs. *leave*), which is not found in Korean. New Zealand English has a standard non-rhotic vowel system, with minor exceptions, including high /e/ and rounding of /ɜ/ (Allan & Starks, 1998; Hay, Maclagan, & Gordon, 2008). Emphasis should be given to the fact that the glides, /w/ and /j/, are consonants in English, while they are allophonic variants of high vowels in Korean.

So far, this chapter has summarised the segmental features of Korean and English phonologies. This thesis is mainly concerned with segmental, rather than suprasegmental, acquisition of phonology in KEB children. Nevertheless, prosodic features of both languages may be worth discussing and comparing, as research suggests that rhythmic or prosodic cues of each language play an important role in differentiation between the languages from an early age (Sebastián-Gallés & Bosch, 2005 for a review). However, neither Korean nor New Zealand English has been clearly defined in terms of their rhythmic structure. Generally speaking, English is classified as a prototypical stress-timed language, in which stressed syllables are distributed at approximately equal time intervals. New Zealand English speakers tend to use a full vowel in unstressed syllables and equalise the stress between stressed and unstressed syllables. This gives New Zealand English characteristics that are more 'syllable-timed' than other varieties of English (Bauer & Warren, 2008; Hay et al., 2008; Warren & Britain, 1998). Korean is perhaps one of the most controversial languages in rhythm typology. Virtually all possible rhythmic categories, including syllable-timed, stressed-timed, phoneme-based and mixed-pattern, have been suggested for Korean (Arvaniti, 2012; J. Kim, Davis, & Cutler, 2008 for reviews). At least a part of this equivocality can be attributed to the lack of lexical stress in contemporary Korean (S.-A. Jun, 1995, 2005). Such characteristics of both languages complicate the discussion of the role of prosodic features (such as lexical stress) on segmental acquisition of phonology in KEB children. In addition, the analysis of single words in the studies reviewed in the doctoral thesis also makes it difficult to discuss prosody in depth. While prosodic features of the two languages are taken into consideration, it is beyond the scope of this thesis to investigate the role of prosodic features in phonological development.

2.4 PHONOLOGICAL ASSESSMENT IN KOREAN

The objectives of phonological assessment are (1) to determine whether a child's phonological development has significantly deviated from typical phonological development to warrant treatment, (2) to identify potential factors contributing to atypical phonological development, (3) to determine treatment directions, (4) to consider prognosis with or without treatment and (5) to monitor change over time (Bankson et al., 2013). These objectives should be achieved for both bilingual and monolingual children. The phonological assessment procedure for ME children has been discussed extensively (e.g. Bankson et al., 2013; Bauman-Waengler, 2008; Ingram, 1981; Peña-Brooks & Hegde, 2000). The general guidelines are applicable for KEB children, but speech-language therapists may require additional information from bilingual children. For example, the case history should include bilingual-specific information, including the age of language acquisition, language exposure and parents' language proficiency, in addition to the case history information typically obtained from monolingual children. Information about KEB children's language environments that may be relevant to their phonological development are discussed throughout this doctoral thesis and summarised in the concluding chapter.

Phonological analyses widely performed with ME children, including phonetic inventory, segmental accuracy and error pattern analysis, should be completed with speech samples in Korean (Korean Academy of Speech-Language Pathology & Audiology, 1994). The procedure for obtaining a speech sample for phonological analysis in KEB children, however, requires more in-depth discussion. The following sections consider the distinct features of the Korean language that have implications for obtaining speech samples from KEB children. We also discuss the available standardised speech assessment tools designed for MK children in South Korea.

2.4.1 CONNECTED SPEECH SAMPLING

Connected speech sampling allows speech-language therapists to assess production of speech sounds in a child's natural environment and, therefore, may be suggested to be more ecologically valid than single word sampling (Morrison & Shriberg, 1992; Stoel-Gammon & Dunn, 1985). Connected speech samples are typically collected with conversational or story-retell procedures. In Korean, however, connected speech samples can be difficult to interpret because of case and honorific markers. Korean postpositional case markers (delimiting particles) assign syntactic elements their roles, such as subject, object, complement or topic (I. Lee & Ramsey, 2000; Sohn, 1999). Generally, if the

syntactic element to be marked ends with a vowel, then the case marker begins with a consonant. If it ends with a consonant, then the case marker begins with a vowel. The majority of case markers end with a vowel. With the suffixation of a case marker, various morphophonological processes take place. One such process is resyllabification in which the word final consonant is carried over to the following syllable as its onset (Ahn, 2009). For example, if *book* (/ts^{h}ek/) is marked with a nominative case marker, /-i/, it is realised as [ts^{h}e.gi]. The lax stop, /k/, in word final position is carried over to the following syllable as its onset, as a result of the resyllabification process. It is also realised as its voiced allophone due to the intervocalic positioning following the resyllabification process. Consequently, a comprehensive analysis of the production of word final consonants can be difficult with a connected speech sample.

Honorific markers can also make the interpretation of connected speech samples difficult. The Korean language has systematic and elaborate honorific markers (Sohn, 1999; Strauss & Eun, 2005). Six speech levels are observed depending on age, gender, profession, and status of the interlocutors (Strauss & Eun, 2005). Polite speech is most commonly used. It is expected, for example, between customers and waiters at a restaurant, and from children to their parents (I. Lee & Ramsey, 2000). Children are often explicitly taught by their parents to use polite speech with any adults. Korean children will also be expected to use polite speech with a speech-language therapist and, therefore, the connected speech samples obtained in conversations with Korean children will typically be at the polite speech level. In polite speech, a suffix, [-jo] is required if the word ends with a vowel and [-i.jo] if the word ends with a consonant. The suffixation of the politeness marker will also trigger the resyllabification process, which makes interpreting the production of word final consonants difficult.

Being unable to conduct a thorough analysis on word final consonants with connected speech samples in Korean has clinical implications. Error patterns are considered to be the best criterion to determine whether a child's speech sound development is typical or atypical (Dodd, 2005). Speech-language therapists should be aware that error patterns such as word final consonant deletion or voicing errors, as observed in ME children, cannot be examined comprehensively if connected speech samples are collected with Korean children. Assessment procedures based solely on connected speech sampling with Korean children may be incomplete and mislead speech-language therapists to make inaccurate clinical decisions regarding diagnosis and treatment.

2.4.2 SINGLE WORD SAMPLING

Single word sampling is the most commonly used when obtaining a speech sample in clinical practice (Skahan et al., 2007). It is typically completed by asking a child to name pictured items. Single word sampling has several advantages, including allowing speech-language therapists to be time-efficient and target a range of speech sounds in different word positions (Bankson et al., 2013). In Korean, it is particularly advantageous in investigating word final consonants.

Standardised speech assessment tools designed for MK children in South Korea include the Urimal Test of Articulation and Phonology (UTAP) (Y. Kim & Shin, 2004) and the Assessment of Phonology and Articulation for Children (APAC) (M. J. Kim et al., 2007). The target *words* included in each assessment tool are used for relational phonological analyses (segmental accuracy and error patterns). Within the list of words, both assessment tools specify the speech sounds for analysing the phonetic inventory. For the purpose of our discussion, the specified speech sounds for analysing phonetic inventory will be referred to as the articulation subtest and the whole list as the phonology subtest. It is stressed that these are clinical assessment tools but are not necessarily designed to describe normal phonological development.

Table 2.4 summarises the content of these two assessment tools (i.e. phonology subtest). Overall the APAC includes more words and segments than the UTAP. The APAC contains both nouns and verbs, while the UTAP does not contain any verbs. As Korean syntactic order is verb-final, verbs can be elicited with sentence completion.

Table 2.4. Comparison of the Urimal Test of Articulation and Phonology (UTAP) and the Assessment of Phonology and Articulation for Children (APAC)

	UTAP	APAC
Words		
Nouns	29	32
Verbs	0	5
Onomatopoeic	1	0
Total	30	37
Syllable types		
Monosyllabic	2	5
Disyllabic	22	24
Trisyllabic	6	8
Consonants		
Articulation subtest	43	70
Phonology subtest	87	91
Vowels		
Monophthongs	60	70
Diphthongs	4	7

Table 2.5 shows the consonants targeted in each word position. Conventionally, four word positions are provided; word initial, word medial syllable initial, word medial syllable final and word final position. This is because research on MK children found that the rate of speech sound acquisition differs depending on word position (Hong & Pae, 2002; M. J. Kim & Pae, 2005; Y. Kim, 1996), although it does not mean that the same finding should be applicable to KEB children. For each word position, the left column corresponds to the frequency of consonants targeted in the phonology subtest and the right column the articulation subtest. The cells coloured grey indicate that the consonants are not permitted in those word positions in Korean.

Table 2.5. Frequency of consonants targeted in the Urimal Test of Articulation and Phonology (UTAP) and the Assessment of Phonology and Articulation for Children (APAC)

	UTAP								APAC							
	WI		WMSI		WMSF		WF		WI		WMSI		WMSF		WF	
p	1	1	2	1	0	0	1	1	4	2	2	1	1	1	2	1
p*	1	1	1	1					1	1	1	1				
p^h	1	1	1	1					1	1	1	1				
t	2	1	1	1	0	0	2	1	1	1	2	2	0	0	2	2
t*	1	1	1	1					1	1	1	1				
t^h	1	1	1	1					1	1	1	1				
k	5	1	1	1	2	1	1	1	3	2	6	2	2	1	1	1
k*	1	1	2	1					1	1	1	1				
k^h	1	1	1	1					1	1	1	1				
m	2	1	5	1	2	0	2	1	2	2	2	1	2	2	2	2
n	2	1	1	1	4	1	2	0	2	2	1	1	3	2	2	2
ts	2	1	1	1					1	1	3	1				
ts*	1	1	1	1					1	1	1	1				
ts^h	2	1	2	1					2	1	1	1				
l	1	1	6	1	0	0	2	1	0	0	5	4	4	1	3	2
s	2	1	2	1					3	2	4	3				
s*	1	1	2	1					1	1	3	2				
h	1	1	1	1					3	2	0	0				
ŋ					5	0	4	1					6	3	2	2
Total	28	18	32	18	8	2	10	5	29	23	36	25	12	7	12	10

* WI = word initial; WMSI = word medial syllable initial; WMSF = word medial syllable final; WF = word final

For both assessment tools, there are certain word positions in which no consonants are targeted. Word medial syllable initial /h/ and word medial syllable final /t/ are not targeted in the APAC, as they are often dropped. The UTAP does not differentiate word medial syllable final and word final positions, so that some consonants are entirely missing from either position. There is a potentially problematic target word in the UTAP, *telephone* (/tsʌn.hua/). Between voiced segments, /h/ can be dropped so that either [tsʌn.hwa] or [tsʌ.nwa] is acceptable. In the latter case, dropping of /h/ leads to the resyllabification process, shifting /n/ in coda position to the onset of the following syllable. Then the UTAP articulation subtest would no longer target /n/ in word medial syllable final position.

Some modifications may need to be considered, as these two assessment tools have been developed primarily for MK children in South Korea. For example, the UTAP

contains an onomatopoeic word, which is associated with vocalisation of a bird. Onomatopoeic words for KEB children in New Zealand may be inappropriate, because such words are highly culture- and language-specific (Veldi, 1994). Both assessment tools also include English loanwords. Erroneous production of English loanwords can be difficult to interpret in KEB children. English word final stops can be produced with an audible, slight release of air, while Korean word final stops are always unreleased and unaspirated. If a KEB child aspirates the word final stop of a native Korean word, then we can be reasonably certain that the word final stop aspiration is due to cross-linguistic influence. If it occurs on an English loanword, then speech-language therapists will need to consider whether it is because the bilingual child has not been exposed to the Korean pronunciation of that word. Further complications may arise because one of the rules of English loanword adaptation is word final vowel epenthesis (Y. Kang, 2003). This rule applies to, for example, *robot*, so that either [ɾo.bot] or [ɾo.bo.tʰɨ] is acceptable. However, for *cup*, only [kʌp] is acceptable but not [kʌpʰɨ]. Therefore, inclusion of English loanwords could mislead speech-language therapists to over-estimate the extent of cross-linguistic effects.

2.4.3 OTHER CONSIDERATIONS

Regardless of how speech samples are obtained, ME speech-language therapists should consider asking a Korean interpreter or a native Korean speaker to obtain Korean speech samples from KEB children. With ME speech-language therapists, KEB children are likely to perceive the communicative context as an English-speaking environment and may choose to speak only English (Shin, 2005). For KEB speech-language therapists assessing both English and Korean in the same session, a short play activity should be carried out in the language to be assessed in order to separate the two language environments.

Language dominance of KEB children should be carefully considered in both sampling conditions. In connected speech sampling, especially using the conversational approach, it can be difficult to elicit a sufficient number of utterances for adequate phonological analyses with bilingual children who are particularly dominant in one language. In single word sampling, using a picture-naming task, bilingual children may not be able to name some of the target words if they have a relatively small expressive vocabulary. In this case, imitated responses can be elicited. Phonological analyses that exclude imitated responses may provide an incomplete clinical picture of the bilingual child's phonological skills.

It is also noteworthy for ME speech language therapists to be aware that Korean speech-language therapists in South Korea do not generally use IPA symbols. They typically use Hangul (the Korean writing system) to phonetically transcribe speech, owing to its phonological transparency. Relational phonological analyses require the target responses against which the child's erroneous productions are analysed. ME speech-language therapists, using a standardised monolingual Korean speech assessment tool, may need to obtain the Korean target responses in IPA in order to carry out relational phonological analyses.

2.5 METHODOLOGY FOR THE DOCTORAL RESEARCH

This section describes the data collection procedure employed in this doctoral thesis. It is important to reiterate that this doctoral thesis is clinical in nature but not an in-depth study of phonological development in KEB children. The content of this thesis should be relevant to speech-language therapists working with bilingual children. It is also important to remind the readers that one of the secondary aims of this doctoral thesis is to compare KEB children's phonological skills to their monolingual counterparts. The methodology employed in this doctoral thesis had to take these aims into consideration.

The doctoral research employed a single word sampling procedure with KEB children. This is the mostly commonly utilised clinical speech sampling procedure (McLeod & Baker, 2014; Skahan et al., 2007). In addition, it was deemed important to take a sampling approach that allows targeting speech sounds in all permissible word positions. This can be difficult with connected speech sampling (Bankson et al., 2013). Clinical assessment tools were chosen to facilitate the single word sampling procedure in both languages, reflecting the clinical nature of this doctoral thesis.

In Korean, the APAC was chosen because it allows sampling of representative Korean speech sounds in all permissible word positions, is used widely in South Korea and has associated normative data (M. J. Kim, 2006; M. J. Kim & Pae, 2005). The English loanwords included in the APAC were replaced with phonetically balanced native Korean words. In English, the Diagnostic Evaluation of Articulation and Phonology (DEAP) was used (Dodd et al., 2002). It is commonly and widely used in New Zealand and Australia and is based on the Differential Diagnosis System (Dodd, 1995, 2005). It is also accompanied by one of the most comprehensive normative data in ME children (Dodd et al., 2003). It is highlighted that these are clinical assessment tools and therefore are not designed to provide an in-depth description of phonological development in children.

However, they can provide clinically relevant information about phonological development, which can contribute significantly to clinical decision making in speech-language therapy.

Analytic procedures also reflect the aims of this doctoral thesis. Analysing speech samples for phonetic inventory, segmental accuracy and error production is the most commonly used clinical procedure, as they are adequate in facilitating the clinical decision as to a child's phonological development is typical or not (McLeod & Baker, 2014; Skahan et al., 2007). To date, there are no universally accepted analytic methods to obtain phonetic inventory, segmental accuracy and error patterns. The analytic methods employed in the doctoral thesis were consistent with the monolingual studies in Korean (M. J. Kim et al., 2007) and in English (Dodd et al., 2003).

To establish phonetic inventory, speech sounds produced at least once, in either word initial or word final position; and produced either spontaneously or in imitation are identified (Dodd et al., 2003; Zhu, 2006). These speech sounds are considered to be present in the child's phonetic inventory, which is analysed separately for each language.

Segmental accuracy is obtained by means of percentage of consonants correct (PCC) and percentage of vowels correct (PVC) scores, in which the child's speech sound productions are analysed against the target responses. PCC is calculated as:

$$= \frac{\text{Number of correctly produced consonants}}{\text{Number of all consonants}} \times 100$$

Similarly, PVC can be calculated using the same method. PVC is used to a lesser extent in older children because children master all vowels by the age of three years, at least in the case of ME children (Dodd et al., 2003; James, van Doorn, & McLeod, 2001; McIntosh & Dodd, 2008; Pollock & Berni, 2003).

Error production was analysed by means of phonological pattern based on Ingram (1976, 1981) in both monolingual ME and MK studies (Dodd et al., 2003). The same analytic method was used in bilingual phonological development (Brice et al., 2009; Dodd, So, & Li, 1996; Gildersleeve-Neumann, Kester, Davis, & Peña, 2008; Gildersleeve-Neumann et al., 2009; Gildersleeve-Neumann & Wright, 2010; Goldstein & Bunta, 2012; Goldstein, Fabiano, & Washington, 2005; Goldstein & Washington, 2001; Grech & Dodd, 2008; Holm & Dodd, 1999b, 2006; N. C. W. Law & So, 2006; Lin & Johnson, 2010; Prezas et al., 2014; Salameh, Nettelbladt, & Norlin, 2003; So & Leung, 2006). In monolingual studies, distinctive feature analysis has been used as a way of analysing speech samples for errors, in which the surface-level speech errors are analysed for presence or absence of

particular feature (Bankson, Bernthal, & Flipsen, 2009). It can provide clinically relevant information because the errors can be analysed to determine whether the target speech sounds and their erroneous realisations share common features. If they do, then these features can be come intervention targets rather than individual speech sounds. However, Bankson et al. (2009) suggest that distinctive feature analysis may not be the most suitable analytic method, because it was originally developed to classify the speech sounds of languages. Therefore, the binary nature of distinctive feature analysis is not adequate in capturing the speech sound distortions that are sometimes observed in children with SSD. Analysing deleted speech sounds is also problematic in distinctive feature analysis because deletion is treated as errors in features, even though those features were never attempted. Reflecting the clinical nature of this doctoral thesis, error analysis method based on Ingram (1976, 1981) was employed (McLeod & Baker, 2014; Skahan et al., 2007). A more detailed description of speech sampling and analysis procedure is outlined in the Methodology sections of Chapters 3 and 4.

3 PHONOLOGICAL SKILLS

3.1 INTRODUCTION

SSD is one of the most common developmental disorders in childhood (Broomfield & Dodd, 2004a; Jessup, Ward, Cahill, & Keating, 2008; J. Law et al., 2000b). Children with SSD display a clinically significant deviation from typical phonological development that is not accounted for by an impairment in sensory, motor or structural functions (Flipsen et al., 2013; Shriberg, 1980). Many children with SSD have long-term adverse consequences, including literacy and spelling difficulties and these can have a negative effect on education and academic performance (Bird et al., 1995; Felsenfeld et al., 1994; Larrivee & Catts, 1999; Lewis et al., 2000, 2002; McCormack et al., 2009). Speech-language therapy interventions can be effective in managing children with SSD (Almost & Rosenbaum, 1998; Broomfield & Dodd, 2005, 2011; Crosbie et al., 2005; Gierut, 1998; J. Law et al., 2010), thereby minimising the long-term consequences. However, provision of effective speech-language therapy intervention is contingent on accurate diagnosis of SSD. Because children with SSD do not have an identifiable aetiology, knowledge of typical phonological development is essential in diagnosing SSD. Speech-language therapists can access such information for ME children from a wide range of published studies (e.g. Dodd et al., 2003; James, 2001a; Smit et al., 1990).

Speech-language therapists have been encountering an increasing number of bilingual children with suspected SSD in their clinical practice (American Speech-Language-Hearing Association, 2012; Roseberry-McKibbin et al., 2005; Speech Pathology Australia, 2002; Winter, 1999). The clinical use of monolingual norms for bilingual children with suspected SSD is discouraged (Goldstein & Gildersleeve-Neumann, 2007), because bilingual phonological development is qualitatively different from monolingual phonological development (Hambly et al., 2013). A lack of information about the characteristics that constitute typical bilingual phonological development is a significant challenge experienced by speech-language therapists (Guiberson & Atkins, 2012; Kritikos, 2003; Roseberry-McKibbin et al., 2005; Williams & McLeod, 2012). If a speech-language therapist misattributes the qualitative differences in a typically developing bilingual child to characteristics of SSD and provides treatment, then time and resources are inappropriately spent. If a speech-language therapist misattributes the clinical signs of SSD in a bilingual child to the qualitative differences arising from bilingualism, then the child is not provided with treatment (Kohnert, 2008; Yavaş & Goldstein, 1998). The latter case

is especially concerning, given the potential adverse long-term consequences of SSD. Nevertheless, Prezas et al. (2014) recently observed that bilingual children are still being compared against their monolingual peers; an approach that puts bilingual children at risk of being misdiagnosed.

3.1.1 COMPARISON WITH MONOLINGUAL CHILDREN

One way to address the lack of bilingual-specific information may be to explicate how bilingual phonological development is different from monolingual phonological development, thereby predicting, or at least describing with reasonable accuracy, the rates and patterns of bilingual phonological development based on the widely available monolingual normative data. The Interactional Dual Systems (IDS) model (e.g. Fabiano-Smith & Goldstein, 2010; Keshavarz & Ingram, 2002; Prezas et al., 2014) suggests bilingual children have two separate phonological systems that are interdependent of each other in development. Interdependence is defined as "the systematic influence of grammar of one language on the grammar of the other language during acquisition, causing differences in a bilingual's patterns and rates of development in comparison with a monolingual's" (Paradis & Genesee, 1996, p. 3). The interdependence between the two phonological systems was suggested to manifest in three different ways; acceleration, deceleration and transfer (Fabiano-Smith & Goldstein, 2010; Keshavarz & Ingram, 2002; Paradis & Genesee, 1996).

Acceleration "means that a certain property emerges in the grammar earlier than would be the norm in monolingual acquisition" (Paradis & Genesee, 1996, p. 3). With regard to deceleration, Paradis and Genesee (1996, p. 4) proposed that having to master two languages "slow[s] down the acquisition process in bilinguals, causing them to be behind monolinguals in their overall progress…". These two hypothesised manifestations have received equivocal support. For example, So and Leung (2006) suggested that deceleration in bilingual children's phonological development should be expected because bilingual children receive proportionately less exposure to each of their languages, compared to monolingual children. Goldstein and Gildersleeve-Neumann (2007, p. 13) added that bilingual children likely "practice later-developing sounds and syllable shapes less often" compared to monolingual children, which leads to slower mastery of the production rules governing the phonological systems. Bunta, Fabiano-Smith, Goldstein, and Ingram (2009) and Gildersleeve-Neumann et al. (2008) found that bilingual children obtain lower PCC scores than their monolingual counterparts, supporting deceleration. On the other hand, in

a study that compared the phonetic inventories of monolingual and bilingual children, Fabiano-Smith and Barlow (2010) found no evidence of deceleration and the bilingual children acquired the phonetic inventories at the same rate as monolingual children in both of their languages. Other studies also reported that bilingual phonological development is commensurate or shows an accelerated rate of development compared to monolingual children (Goldstein et al., 2005; Grech & Dodd, 2008; N. C. W. Law & So, 2006; Lin & Johnson, 2010). As Hambly et al. (2013, p. 14) concluded "the evidence is inconclusive with regard to whether being bilingual results in acceleration or deceleration of acquisition of speech sounds".

Revisiting the acceleration and deceleration framed within the IDS model (Paradis & Genesee, 1996), the definitions seem to imply that acceleration should be measured in qualitative terms ("a certain property"), whereas deceleration should be measured quantitatively ("their overall progress"). As a result, there have been some discrepancies in the methodology concerning acceleration and deceleration in the literature. For example, in Fabiano-Smith and Barlow (2010), phonetic inventories were used to investigate which speech sounds were mastered earlier or later than monolingual children, while others used the PCC scores (e.g. Bunta et al., 2009; Gildersleeve-Neumann et al., 2008). The former provided evidence against deceleration, while the latter group provided evidence for deceleration, which suggests the methodological differences in the literature may have contributed to the equivocality in the evidence regarding the IDS model. In addition, inferential statistical tests were often used to determine whether bilingual phonological development was accelerated or decelerated. Some previous studies suggested that bilingual children may obtain slightly lower PCC scores than monolingual children but still within what would be expected of typically developing monolingual children (e.g. Fabiano-Smith & Goldstein, 2010; Goldstein & Washington, 2001). It is difficult to determine whether the statistically significantly lower mean PCC score in bilingual children should be taken as evidence for deceleration when the individual PCC scores of at least some bilingual children still fall within the range of PCC scores expected for typically developing monolingual children.

Regarding the third hypothesised manifestation, transfer, the IDS model states that "consonants and/or vowels that are specific to one language will transfer to productions of the other language" (Fabiano-Smith & Goldstein, 2010, p. 161). Note that transfer framed within the IDS model specifically relates to language-specific speech sounds, as this is different to how transfer is discussed in the literature of second language acquisition (e.g.

MacWhinney, 2005; Major, 2008). The evidence for segmental transfer, as described in the IDS model, is also equivocal. Previous studies found that such segmental transfer in bilingual children is uncommon or does not occur systematically (e.g. Anderson, 2004; Brice et al., 2009; Fabiano-Smith & Goldstein, 2010; Goldstein et al., 2005; Holm & Dodd, 1999b, 2006). Specifically, Holm and Dodd (1999b) found that shared phonemes between English and Cantonese were simplified differently for each of their languages and that they were simplified in a way that was different from monolingual children, suggesting qualitative differences in phonological development between monolingual and bilingual children. However, transfer of a language-specific phoneme to the other language was not found (Holm & Dodd, 2006). One of the few exceptions is Gildersleeve-Neumann and Wright (2010) who reported that transfer occurred frequently in Russian-English bilingual children and attributed this finding to language dominance and perceptual saliency of the transferred segments.

3.1.2 CROSS-LINGUISTIC EFFECTS

It is a reasonable and appealing idea to utilise the findings from much studied monolingual phonological development to further our understanding of bilingual phonological development. However, the current focus on *whether* there are differences in the rates and patterns of phonological development between bilingual and monolingual children has been criticised for being "strongly biased toward monolingualism in that it implicitly assumes that monolingual acquisition is the norm" (Meisel, 2006, p. 93). In addition, clinically reliable information attempting to describe the systematic differences in phonological development between bilingual and monolingual children has not yet been offered from research. Hence, increasing attention has been given to explicating cross-linguistic effects in bilingual phonological development. The qualitative and quantitative differences in phonological development between bilingual and monolingual children have been attributed to cross-linguistic interactions between the two phonological systems (Fabiano-Smith & Barlow, 2010; Fabiano-Smith & Goldstein, 2010; Keshavarz & Ingram, 2002; Paradis, 2001; Prezas et al., 2014). The assumption held in the current thesis is that the rates and patterns of phonological development in bilingual children that are different from those in monolingual children can be taken as manifestations of cross-linguistic effects. The same approach has also been taken in the literature (e.g. Fabiano-Smith & Goldstein, 2010; Keshavarz & Ingram, 2002; Sorace & Serratrice, 2009).

Different approaches have been taken to describe and explain cross-linguistic effects in bilingual phonological development but the starting point of most approaches is to consider the relative complexity between the two phonological systems (e.g. Dodd et al., 1996; Gildersleeve-Neumann et al., 2009; Holm & Dodd, 1999b, 2006; N. C. W. Law & So, 2006). Empirical evidence so far suggests that cross-linguistic effects in bilingual language development should be manifested at points of structural overlap (e.g. Hulk & Müller, 2000; Nicoladis & Paradis, 2011; Paradis, 2001). Structural overlap has been discussed extensively in syntactic acquisition in bilingual children (Sorace & Serratrice, 2009 for a review) but has not been applied in bilingual phonological development. Structural overlap hypothesises that cross-linguistic effects are manifested (1) at the interface between two modules of grammar and (2) if language A has one pattern for a target structure, but language B has more than one pattern for that structure (Hulk & Müller, 2000). Nicoladis and Paradis (2011, p. 712) posit "the presence of the structural pattern in language A influences the child to more often use the matching pattern in language B, even when the other options in language B might be more appropriate". The current thesis applies structural overlap to phonological development in KEB children. The interface between the two modules of grammar is concerned with the phonetics-phonology interface in the case of phonological development. With regard to the second condition of cross-linguistic effects, previous studies have considered structural overlap in prosodic features (Paradis, 2001) and phonological processes (Nicoladis & Paradis, 2011). Structural overlap in the acquisition of consonants in KEB children may be considered, for example, with /l/ in English and Korean. In English, /l/ is realised as [l], whereas Korean /l/ can be realised as [l] or [ɾ] depending on word position, creating structural overlap between the two languages. We would expect delayed mastery of the allophonic variant, [ɾ], in Korean, because the structural pattern of English influences KEB children to use its matching pattern, [l].

Structural overlap also brings about other important issues regarding cross-linguistic effects; directionality and language dominance. Hulk and Müller (2000, p. 240) put forward that "cross-linguistic influence is due to language internal reasons and not to language external factors such as language dominance". Subsequent research disputed this claim based on the findings that quantitative aspects of language input did affect cross-linguistic effects (e.g. Serratrice, Sorace, Filiaci, & Baldo, 2009; Sorace, Serratrice, Filiaci, & Baldo, 2009), although exactly how is still unclear. Nevertheless, directionality and the role of language dominance in cross-linguistic effects have been recurring themes of

research in bilingual phonological development. Directionality in cross-linguistic effects has been alluded to in Gildersleeve-Neumann et al. (2009), albeit in the opposite direction predicted by structural overlap. In their study, when Spanish-speaking children were introduced to English language environments, vowel errors in their first language (Spanish) increased due to the introduction of a more complex vowel system of the second language (English). Paradis (2001, p. 35) also found evidence for directionality in cross-linguistic effects but added that "these effects could be influenced by between-language asymmetries…, or by the children's language dominance". Paradis (2001) defined language dominance as the language of the greatest exposure, which conflates language dominance and language exposure. This approach has also been taken in the literature on bilingual phonological development. Gildersleeve-Neumann et al. (2008) on Spanish-English bilingual children and N. C. W. Law and So (2006) on Cantonese-Putonghua bilingual children suggested that language dominance is not a significant factor in their phonological development. On the other hand, So and Leung (2006) suggested that the dominant language of bilingual children is less affected by cross-linguistic effects. In contrast, the manifestations of cross-linguistic influence appeared to be more pronounced in the Cantonese language of Cantonese-English bilingual children in Dodd et al. (1996), even though Cantonese was their dominant home language. Evidence for language dominance as a factor influencing cross-linguistic interactions and bilingual phonological development is inconclusive in the literature, and therefore requires further investigation.

3.1.3 THE CURRENT STUDY

The primary aim of the current study is to describe phonological skills in KEB children growing up in New Zealand. Koreans are one of the largest linguistic minority groups in multicultural and multilingual New Zealand (Statistics New Zealand, 2014a). Assessing KEB children with suspected SSD is a significant challenge for speech-language therapists, because there is only very limited information about phonological development in KEB children. To date there are only two published case studies on KEB children, both of which were conducted in North America (Anderson, 2004; Ha et al., 2009). A second aim of the current study is to compare phonological skills in KEB to their respective monolingual populations. The hypothesised manifestations of the IDS model are investigated. The main focus is to critically evaluate whether the current approach of comparing bilingual and monolingual children can provide clinically useful information for speech-language therapists.

This thesis is clinical in nature. It however provides an opportunity to contribute to theoretical discussions regarding phonological development in bilingual children. Manifestations of cross-linguistic effects at points of structural overlap are investigated. Potential factors influencing phonological development and manifestations of cross-linguistic effects are also explored. As the study design necessarily involves a comparison with ME and MK children, we first describe phonological skills in ME and MK children and summarise the previous studies in KEB children.

3.1.4 PHONOLOGICAL SKILLS IN MONOLINGUAL ENGLISH- AND KOREAN-SPEAKING CHILDREN

Phonological skills will be presented as age of acquisition of consonants and segmental accuracy in the current thesis. While these measures of phonological skills have been used widely in clinical practice and research, there are considerable differences in the way they have been defined (McLeod, 2013; Zhu, 2006). In this section, we define these measures as they are utilised in this doctoral thesis.

The age of acquisition of consonants has been used widely in the clinical assessment procedure with children with suspected SSD. To determine the age of acquisition, a phonetic inventory of individual children is first established. Speech sounds produced at least once, in either word position and either spontaneously or in imitation are included in the phonetic inventory (Dodd et al., 2003). Different criteria have been used to determine the age of acquisition of speech sounds (McLeod, 2013; Zhu, 2006). Dodd et al. (2003) used the 90% criterion based on the research findings that approximately 10% of the paediatric population have SSD of unknown origin. That is, a speech sound present in 90% of children in an age group is considered *mastered* for that age group. This criterion is used in the current study and the term *mastery* is used as such throughout this thesis. The age of acquisition of speech sounds is not a phonological skill assessed by speech-language therapists for individual children. Speech-language therapists establish the phonetic inventory for a child and compare it to the age of acquisition of speech sounds from a normative study. Table 3.1 compares the age of acquisition of speech sounds between the normative studies of ME children (Dodd et al., 2003) and MK children (M. J. Kim & Pae, 2005). M. J. Kim and Pae (2005) specified syllable position for the six consonants that are permitted in either syllable initial or syllable final position. For /k*/, /t^h/, syllable initial /m/, syllable initial /n/, syllable final /t/ and syllable final /l/, M. J. Kim and Pae (2005) do not provide the age of mastery (i.e. correctly produced by 90% of the children in the age group) but reported that 75% of the children in the age group of 3;0-3;5 correctly produced

these speech sounds. According to earlier studies, (Hong & Pae, 2002; Pae, 1994; Um, 1994), they are mastered before the age of four years.

Table 3.1. Age of acquisition of speech sounds in monolingual children

	English	Korean
3;0-3;5	p, b, t, d, k, g	p (SI), p*, p^h, t*
	m, n, ŋ	
	f, v, s, z, h	h
	l, w, j	
3;5-3;11	ʧ	p (SF)
4;0-4;5		t (SI), k (SI)
		m (SF), n (SF)
	ʒ	
	ʤ	ts, ts*, ts^h
4;6-4;11		k (SF), k^h
		ŋ
5;0-5;5	ʃ	
5;6-5;11		l (SI)
6;0-6;5	ɹ	
6;6-6;11		
7;0-	θ, ð	s, s*

Generally, stops are mastered earlier than other consonant classes in both languages. MK children tend to acquire speech sounds earlier in syllable initial position than in syllable final position, with the exception of the liquid. The liquid in syllable initial position, which is realised as [ɾ], is mastered only after 5;6. There are noticeable differences in shared speech sounds in terms of the age of acquisition. The most striking difference in segmental acquisition between the two groups of monolingual children is the age of acquisition of /s/. While ME children master /s/ at the of three years, it is mastered after the age of six years in MK children (H. Jun & Lee, 1999; M. J. Kim & Pae, 2005).

Segmental accuracy is obtained by means of a relational analysis in which the child's productions are analysed against the target responses. PCC is calculated as:

$$= \frac{\text{Number of correctly produced consonants}}{\text{Number of all consonants}} \times 100$$

The PCC scores, as a quantitative measure of phonological development, have been used widely in clinical practice and research (Shriberg et al., 1997a; Shriberg & Kwiatkowski, 1982), as a way of estimating the age of normalisation of speech (Gruber, 1999) and as "an

objective means for determining the relative priority of those who may need intervention and a way to monitor progress/change" (Bernthal et al., 2013, p. 218). Similarly, PVC is also used, albeit to a lesser extent in older children. ME children master all vowels by the age of three years (Dodd et al., 2003; James et al., 2001; McIntosh & Dodd, 2008; Pollock & Berni, 2003) with PVC scores above 95% by the age of three years. Table 3.2 compares the age group mean PCC scores between ME children and MK children (Dodd et al., 2003; M. J. Kim & Pae, 2005, respectively). The scores increase and the standard deviations become smaller with age in both studies. There is a general trend for higher scores in MK children, based on these two studies. Detailed information about the mean PVC scores across age groups (and the age of acquisition of vowels) in MK children is not available. The available studies suggest that the age of mastery of vowels in MK children is comparatively late, particularly for diphthongs. MK children still make some vowel errors at the age of four years (S. J. Park, 2010) and diphthongs are not mastered until after the age of five years (S.-H. Park, 2011; Um, 1994). Note, however, that post-consonantal glide deletion is common in natural speech as discussed in Chapter 2.

Table 3.2. Percentage of consonants correct (PCC) in monolingual English-speaking children and monolingual Korean-speaking children (standard deviations in the parentheses)

Age	English	Korean
3;0-3;5	82.11 (13.0)	82.36 (11.03)
3;6-3;11		88.08 (7.37)
4;0-4;5	90.37 (9.05)	92.19 (7.47)
4;6-4;11		93.71 (7.35)
5;0-5;5		94.38 (5.86)
5;6-5;11	95.86 (5.2)	96.76 (3.81)
6;0-6;5		97.29 (3.51)
6;6-6;11		Not included

Hambly et al.'s (2013) recent literature review identified two published papers reporting case studies of KEB children (Anderson, 2004; Ha et al., 2009). In addition, a more recent study, Morrow, Goldstein, Gilhool, and Paradis (2014), investigated English phonological skills in 19 sequential bilingual children, one of whom was a KEB child. They reported that the phonological skills of bilingual children, improved over time with increasing exposure to English. However, no information about the phonetic inventory or segmental accuracy, specific to the KEB child, was reported.

Ha et al. (2009) provided a brief description of three KEB children (aged 3;10, 6;0 and 11 years,), all of whom were exposed to English after Korean. Their segmental accuracy measures were considerably higher in Korean than in English. In particular, the PCC scores of the three year old were 97% and 76% in Korean and English, respectively. The Korean PCC score is even higher than what would be expected of MK children of a similar age. Although specific information about their phonetic inventories was not provided, all three children reportedly produced fricative consonants erroneously in English.

Anderson (2004) investigated the phonological skills of three four-year-old sequential KEB children, who were followed up every one or two months for five sessions. In Korean, the three children appeared to have a complete phonetic inventory, even including the alveolar fricatives which are mastered only after the age of six years in MK children (H. Jun & Lee, 1999; M. J. Kim & Pae, 2005). Anderson (2004) noted that two of the children did not produce /h/ intervocalically. However, /h/ is often dropped in that position in natural speech (see Chapter 2). The phonetic inventory in English was more variable across the three children. Similar to the children in Ha et al. (2009), there were some fricative and affricate consonants absent from their phonetic inventory; /ʒ/ was absent in the inventory

of two children; /ð/ in one child; and /dʒ/ in one child. Interestingly, speech sounds that are mastered by the age of five years or later, such as /ʃ/ and /ɹ/ were present in their phonetic inventory. Their PCC scores were higher in Korean than in English in every session. The PCC scores in Korean were in the 90s for all children, which were comparable with the monolingual normative data (Table 3.2). Two of the three children obtained PCC scores in English that were within the one standard deviation range of the monolingual age group mean and the third child obtained the mean PCC score of 79.9% (the average of PCC scores across the five sessions).

3.2 METHODOLOGY

3.2.1 PARTICIPANTS

The current study set out to recruit typically developing KEB children aged between 3;0 and 7;11. Children were considered bilingual if (1) they were receiving regular and consistent input in both English and Korean and (2) the parents reported that their children were bilingual. Children were considered typically developing, if they did not have any conditions known to impact on speech/language development, such as hearing loss, craniofacial anomaly and autism spectrum disorder. It was not possible to recruit KEB children who did not have SSD, as there was only limited information about what constituted typical phonological development in KEB children at the time of participant recruitment. Thus, 'typical' development may not necessarily mean that the children did not have SSD. A total of 86 primary schools and kindergartens in the Greater Auckland region were contacted about the study to recruit potential participants. Nineteen schools and kindergartens (22.1%) responded to our contact, four of which were unable to assist in identifying potential participants. Information sheets were sent to those 15 schools/kindergartens for them to send to the parents of potential participants. Five Korean language schools operating in the region were also contacted. One of the Korean language schools agreed to help identify potential participants. In total, parents of 244 children were contacted about the study. Of those, parents of 20 children agreed to participate (8.2% of those contacted). An additional 32 children were recruited via chain-referral sampling, making up a total of 52 children. Table 3.3 illustrates age, gender, birth country and language exposure of the 52 KEB children (n.b. children were codified from 3A to 7G according to their chronological age).

All children in the study were exposed to the Korean language from birth, regardless of where they were born. Age of English language exposure (in months) varied greatly (mean

= 19.87 months; SD = 18.76). Of the 52 children in the study, 38 were born in New Zealand. Only 20 of these were exposed to the English language from birth. For those who were born in South Korea, the age of arrival in New Zealand (in months) is given in parentheses in Table 3.3. Following the procedure used in Goldstein, Bunta, Lange, Rodriguez, and Burrows (2010), the proportion of language exposure was calculated by the total hours of Korean language exposure divided by the total hours of English language exposure in a child's typical week. The mean proportion of language exposure of the sample was 2.06 (SD = 2.03), which indicates that the children, on average, were exposed to Korean language environments 2.06 times more than they were to English language environments. The proportion of language exposure shows a decreasing trend with age.

Table 3.3. Characteristics of the participants

Participant	Age	Gender	Birth country (age of arrival)	Age of English exposure	Proportion of language exposure
3A	3;0	M	New Zealand	0	13.00
3B	3;1	M	New Zealand	36	7.17
3C	3;1	M	New Zealand	34	4.06
3D	3;2	F	New Zealand	0	0.69
3E	3;4	M	Korea (35)	36	1.44
3F	3;6	F	New Zealand	0	3.09
3G	3;7	F	Korea (12)	41	4.06
3H	3;9	F	New Zealand	0	0.31
3I	3;9	M	New Zealand	0	2.50
3J	3;11	M	New Zealand	0	2.37
3K	3;11	M	New Zealand	0	2.28
3L	3;11	F	New Zealand	27	2.16
4A	4;0	M	New Zealand	34	1.33
4B	4;3	F	Korea (7)	7	4.83
4C	4;3	F	New Zealand	0	0.66
4D	4;7	M	Korea (9)	9	3.15
4E	4;8	F	Korea (35)	46	5.05
4F	4;8	F	New Zealand	12	1.77
4G	4;11	M	New Zealand	0	1.03
4H	4;11	M	New Zealand	0	2.50
5A	5;0	M	New Zealand	39	2.03
5B	5;1	F	Korea (34)	38	1.19
5C	5;1	F	New Zealand	0	1.80
5D	5;1	F	Korea (3)	24	1.33
5E	5;3	F	New Zealand	0	0.70
5F	5;5	F	New Zealand	34	1.65

Participant	Age	Gender	Birth country (age of arrival)	Age of English exposure	Proportion of language exposure
5G	5;6	M	New Zealand	48	1.11
5H	5;6	F	New Zealand	60	1.28
5I	5;6	F	New Zealand	0	2.38
5J	5;8	M	New Zealand	18	0.37
5K	5;8	F	New Zealand	0	1.28
5L	5;10	F	Korea (45)	36	0.59
5M	5;11	M	New Zealand	27	1.86
6A	6;0	M	Korea (17)	30	2.27
6B	6;0	F	Korea (67)	55	2.72
6C	6;1	M	New Zealand	42	1.88
6D	6;2	M	New Zealand	42	1.67
6E	6;3	M	New Zealand	18	1.33
6F	6;6	F	Korea (14)	36	0.79
6G	6;6	M	New Zealand	36	1.71
6H	6;6	M	New Zealand	36	2.03
6I	6;7	F	New Zealand	24	1.18
6J	6;9	M	New Zealand	0	0.86
6K	6;9	F	New Zealand	5	1.38
6L	6;11	F	Korea (18)	30	1.51
7A	7;4	M	New Zealand	0	0.70
7B	7;4	F	New Zealand	0	1.35
7C	7;6	F	Korea (62)	37	1.23
7D	7;6	M	New Zealand	0	0.07
7E	7;6	F	New Zealand	0	0.64
7F	7;9	F	New Zealand	0	2.27
7G	7;11	F	Korea (70)	36	0.72

Eight of the 52 children had a father who was a monolingual English speaker and a Korean mother (3D, 3H, 4C, 5E, 5J, 7A, 7D, and 7E). These were among 12 children who were receiving greater input in English than in Korean. For all children, the primary source (i.e. the greatest amount of relative exposure) of Korean language exposure was the home environment. Figure 3.1 illustrates the frequency of reported code-switching behaviours of the primary carers with the children at home. Secondary sources of Korean language exposure included weekend Korean language school (n = 25), church (n = 20), regular playgroup (n = 17), private Korean language lessons (n = 9), private maths lessons (n = 3) and other extracurricular activities (n = 16). All children were attending an early education centre/kindergarten or school where English was the language of instruction. For 39 children, the primary source of English language exposure was school or kindergarten with the remaining 13 children exposed to the English language primarily at home. Other than

home and school/kindergarten, bilingual children were exposed to the English language at church (n = 7), regular playgroup (n = 8), private English language lessons (n = 2) and other extracurricular activities (n = 19).

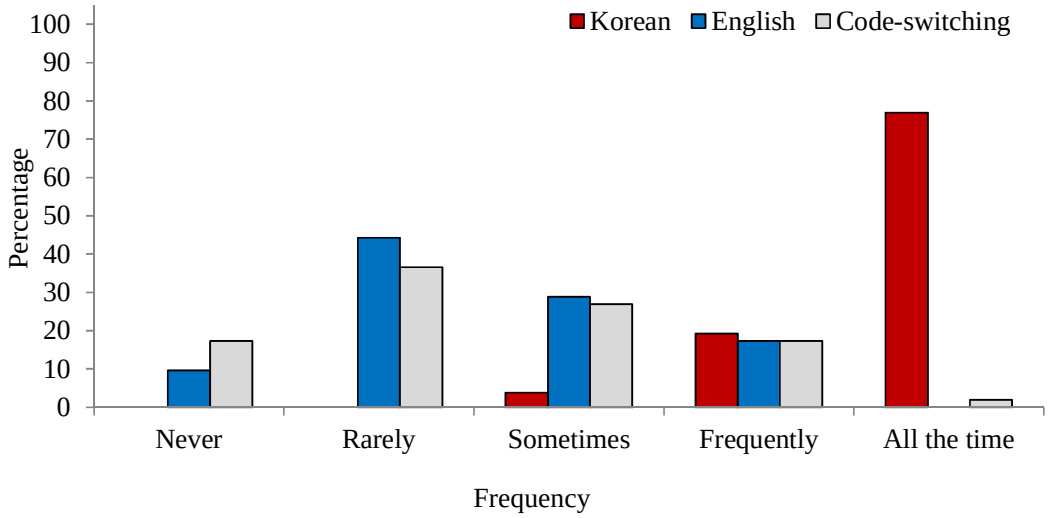

Figure 3.1. Reported code-switching behaviours of the primary carers when speaking to their children

The mean age of mothers at the time the child was born was 32.08 years (SD = 3.76; min = 26; max = 43). On average, the mothers had 16.64 years of formal education (SD = 2.22; min = 12; max = 25) and fathers had 16.93 years of formal education (SD = 2.40; min = 12; max = 25). The mean annual household income, estimated from the recent population census (Statistics New Zealand, 2014a) was $91,631.77 NZD (SD = 22, 416.71; min = 42,400; max = 133,500), which was higher than the national average household income of $85,588 NZD (Statistics New Zealand, 2014b). Consistent with previous reports that concerns regarding language development are common in parents of bilingual children (Bedore, Peña, Joyner, & Macken, 2011; King & Fogle, 2006), the parents of 13 children (25.0%) reported varying degrees of concerns about their children's language development. The majority of the concerns were directly related to bilingualism (e.g. knowing some words in one language but not in the other; limited opportunity to speak English).

3.2.2 MATERIALS

The Diagnostic Evaluation of Articulation and Phonology (DEAP) (Dodd et al., 2002) and the Assessment of Phonology and Articulation for Children (APAC) (M. J. Kim et al., 2007) were used to obtain single word samples for English and Korean, respectively. The DEAP has separate Articulation and Phonology subtests. The APAC has a single list of

words, among which phonemes in various word positions are specified for establishing the phonetic inventory. For the efficiency of presentation, the specified phonemes in the APAC will be referred to as the Articulation subtest and the whole list as the Phonology subtest in the current study.

The APAC included two English loanwords (*cup* and *hamburger*) and these were replaced with phonetically balanced native Korean words to avoid over-estimating the extent of cross-linguistic influence arising from the variable pronunciations and the overgeneralisation of the loanword adaptation rule. English word final stops can be produced with an audible, slight puff of air, while Korean word final stops are unreleased and unaspirated. If a KEB child aspirates the word final stop of an English loanword, the interpretation can be confounded by the possibility that the KEB child may not have been exposed to the Korean pronunciation of the word. In addition, one of the rules of English loanword adaptation is word final vowel epenthesis (Y. Kang, 2003). This rule applies to, for example, *robot* so that either [ɾo.bot] or [ɾo.bo.t^{h}ɨ] is acceptable. However, for *cup*, only [kʌp] is acceptable but not [kʌ.p^{h}ɨ].

3.2.3 DATA COLLECTION

All children completed both assessments (DEAP and APAC) with the doctoral candidate. The order in which the assessments were completed was not counterbalanced. The children chose which language to complete first. The child was shown each picture from the assessments and was asked to name each picture. For the Articulation subtest, imitated responses were elicited for all erroneous productions. For the Phonology subtest, imitated responses were elicited only if (1) the child indicated that he or she did not know the name, (2) no response was given after five seconds had elapsed or (3) the child provided a wrong name and did not self-correct (e.g. lion for *tiger*). Imitated responses were not elicited if the child's production was erroneous in the Phonology subtest. Children's responses were audio-recorded using a digital voice recorder.

3.2.4 PHONETIC TRANSCRIPTION

The doctoral candidate transcribed children's responses on-line and completed the phonetic transcriptions from the audio-recording for all children. Two independent transcribers with experience in phonetic transcription and working with children with SSD re-transcribed 10% of the data. The percentage of agreement with the phonetic transcriptions done by the doctoral candidate was 95.0% for English and 96.4% for Korean. The small number of disagreements in the phonetic transcriptions were discussed with

other independent transcribers (native speakers in each language who were trained in phonetic transcription) to determine the final transcriptions to be used for analysis.

3.2.5 DATA ANALYSIS: PHONETIC INVENTORY

Children's speech samples from the Articulation subtest of each assessment were independently analysed to establish phonetic inventories for each language. Speech sounds were included in the inventory if they were produced at least once, in any word position and either spontaneously or in imitation. For the six Korean consonants permitted in either syllable position, whether children produced them in one syllable position but not in the other was considered for comparison with the MK study.

3.2.6 DATA ANALYSIS: SEGMENTAL ACCURACY

The Phonology subtest was used to obtain segmental accuracy, calculated by the PCC and PVC for each language. In addition, the PCC scores for each consonant class were also calculated from the Phonology subtests. Imitated responses were included in the analysis, as previous research suggests there is no significant difference between spontaneous and imitated productions (e.g. Andrews & Fey, 1986; Goldstein, Fabiano, & Iglesias, 2004). For the APAC, if an imitated response was elicited for erroneous production on the words that belonged to both the Articulation subtest and the Phonology subtest, then the initial erroneous response was analysed for the Phonology subtest and the imitated response was analysed for the Articulation subtest. In calculating PCC, stringent scoring criteria were used. Positional variants or allophones were considered incorrect if they were not produced in a way that followed the realisation rules for each language. Producing [f] for /θ/ in English and post-consonantal glide deletion in Korean were also treated as errors. While the substitution and deletion may not be uncommon in natural speech in the respective monolingual adult speakers (Silva, 1991; Wood, 2003), it is difficult to determine whether these are variations or true errors for KEB children.

3.2.7 DATA ANALYSIS: COMPARISON WITH MONOLINGUAL CHILDREN

For comparison with monolingual children, the following procedure was used. The phonetic inventories of individual children were compared against the age of acquisition of speech sounds from monolingual studies. The child's phonological development was considered decelerated if the speech sounds expected to be mastered by monolingual children of the same age group were not in the child's phonetic inventory. The child's phonological development was considered accelerated if the speech sounds expected to be

mastered in an older age group by the monolingual standard were present in the KEB child's phonetic inventory. To compare the PCC scores, inferential statistical tests were avoided in favour of a descriptive comparison based on standard deviations. This is because previous studies suggested that bilingual children may obtain PCC scores that are slightly, but statistically significantly, lower than monolingual children but still within what would be expected of typically developing monolingual children (e.g. Fabiano-Smith & Goldstein, 2010; Goldstein & Washington, 2001). It is difficult to determine whether the statistically significantly lower mean PCC score in bilingual children should be considered decelerated when the individual PCC scores of at least some bilingual children still fall within the range of PCC scores expected for typically developing monolingual children. KEB children who obtained a PCC score that fell one standard deviation below the normative age group mean were considered to be decelerated and those who scored above one standard deviation were considered to be accelerated in phonological development. Potential factors associated with acceleration and deceleration were also explored, using a descriptive comparison based on standard deviations and inferential statistics using Mann-Whitney U and Chi-square (χ^2) tests. Lastly, transfer is only concerned with production of language-specific speech sounds in the other language, as framed within the IDS model (Fabiano-Smith & Goldstein, 2010).

3.2.8 DATA ANALYSIS: STATISTICAL ANALYSIS

The SPSS Statistics for Windows, Version 22.0 (International Business Machines Corporation, 2013) was used for statistical analyses. The alpha-level was set at 0.05 for statistical significance. Inferential statistical analysis took into consideration the inherent sampling biases in studies of bilinguals in a country where they are a minority population (Hambly et al., 2013). Appropriate data treatments or distribution-free nonparametric statistical tests which do not make stringent assumptions about the underlying populations (Siegel, 1956) were used wherever possible. The logarithmic transformation was performed on the PCC and PVC scores (Keene, 1995) and the transformed scores were entered into a multiple linear regression model to consider the factors influencing phonological development in bilingual children. The following variables were all initially entered into the regression model; age (in months), gender, age of English language exposure (in months), the proportion of language exposure, the number of contexts in which the children were receiving English and Korean language exposures, the estimated annual household income, years of mother's education and mother's age at the time of

child's birth (in years). Using the backward elimination method, the contribution of all variables to the model was considered and, on the basis of F-statistics for testing each partial coefficient, the single variable contributing the least to the model was removed from the model (n.b. probability of F-to-remove ≥ 0.100 as the removal criterion). The model was re-evaluated with the remaining variables. This process was repeated until the regression equation of the best fit could be derived. The backward elimination method was chosen because the current study is interested in the question "What potential factors influence the rates of bilingual phonological development?" rather than "Does X influence the rates of bilingual phonological development?" In addition, the backward elimination method is less likely than the forward method to eliminate the variable which has significant contribution to the model only when another variable is held constant (Field, 2009; Thomas, Hughes, & Zumbo, 1998).

3.3 RESULTS

3.3.1 SEGMENTAL ACCURACY

Table 3.4 summarises the mean PCC and PVC scores for each age group. In both languages, there is a trend for higher segmental accuracy in Korean than English in younger age groups. The mean PCC and PVC scores show fluctuations in both languages rather than a steady increase from 3;0 to 7;11. The PVC scores in Korean are largely comparable with the MK studies (S.-H. Park, 2011; S. J. Park, 2010; Um, 1994). While English vowel production reaches 100% by the age of seven years, the bilingual children were still deleting the post-consonantal glide in Korean, which is not uncommon even for MK children. All KEB children produced all vowels in both languages. Compared to the ME study (Dodd et al., 2003), however, the PVC scores of the younger KEB children are lower.

Table 3.4. Percentage of consonants correct (PPC) and percentage of vowels correct (PVC) (standard deviations in the parentheses)

	PCC		PVC	
Age	English	Korean	English	Korean
3;0-3;5	64.39 (13.76)	77.75 (9.39)	93.81 (5.05)	96.65 (1.30)
3;6-3;11	75.58 (10.89)	85.45 (5.06)	96.15 (3.47)	95.41 (2.74)
4;0-4;5	72.33 (21.09)	79.78 (10.17)	97.00 (1.80)	95.87 (0.73)
4;6-4;11	85.81 (9.86)	94.65 (3.61)	97.69 (2.29)	97.80 (1.02)
5;0-5;5	92.32 (5.33)	96.03 (2.73)	99.36 (0.70)	98.16 (1.85)
5;6-5;11	89.67 (10.96)	92.64 (7.81)	99.63 (0.63)	98.95 (1.79)
6;0-6;5	93.33 (4.93)	93.63 (4.24)	97.44 (2.56)	98.05 (2.81)
6;6-6;11	97.37 (2.19)	96.42 (2.83)	99.63 (0.63)	99.30 (0.96)
7;0-7;5	99.65 (0.50)	98.51 (0.70)	100 (0)	97.56 (1.72)
7;6-7;11	99.01 (1.08)	96.83 (2.56)	100 (0)	98.54 (1.34)

3.3.2 PRODUCTION OF STOPS

English and Korean stops were present in all KEB children. To be consistent with the MK normative study (M. J. Kim & Pae, 2005), syllable positions were considered for Korean stops. For /p/ and /t/, there was no evidence that these stops were mastered at different ages depending on syllable position. On the other hand, four children (3A, 3G, 4B and 4D) produced /k/ in syllable initial position but not in syllable final position. By the age of five years, the children produced all Korean stops in all syllable positions. Figure 3.2 shows the production accuracy of stops in English and Korean. There is a trend for higher accuracy in English than in Korean in older age groups.

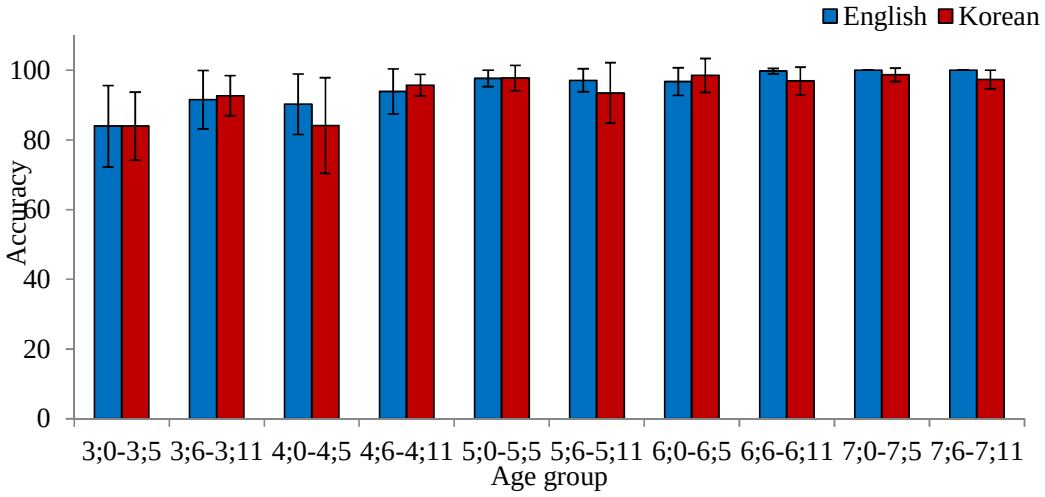

Figure 3.2. Production accuracy of stops (error bars represent standard deviations)

3.3.3 PRODUCTION OF FRICATIVES

Production of fricatives, both in qualitative and quantitative terms, was variable, especially for younger children and for English. In Korean, /s/ was produced by all KEB children expect for two children (3C and 3E) in the youngest age group, which suggests the age of mastery of /s/ in the age band of 3;6-3;11. All KEB children aged five years or older had /s*/ in their phonetic inventory. Only one or two children in each age group did not produce /s*/ in the younger age groups. The children who produced /s*/ also had /s/ in their inventory but not *vice versa*. The remaining Korean fricative, /h/, was present in the phonetic inventory of all children except for one child (4B).

All English fricatives were present in all KEB children aged 6;7 and older, except for one child, 7C, who did not produce /ʒ/. Given the variable nature of production of fricatives in younger children, we present the fricative inventory for individual children younger than 6;7 (Table 3.5). In general, /f, v, s, ʃ, h/ were produced by the majority of three-year-old KEB children, followed by /z, θ/ in older age groups. The last fricatives to be mastered in KEB children appear to be /ð/ and /ʒ/ at the age of seven years.

Table 3.5. English fricative inventory of Korean-English bilingual children

Participant	Inventory	Participant	Inventory
3A	f, v, θ, s, z, ʃ, h	5A	f, v, θ, ð, s, z, ʃ, ʒ, h
3B	f, v, s, z, ʃ, h	5B	f, v, s, z, ʃ, ʒ, h
3C	v, s, z, ʃ, h	5C	f, v, s, z, ʃ, h
3D	f, v, θ, s, z, ʃ, h	5D	f, v, θ, ð, s, z, ʃ, ʒ, h
3E	h	5E	f, v, θ, ð, s, z, ʃ, h
3F	f, v, θ, s, z, ʃ, ʒ, h	5F	f, v, θ, ð, s, z, ʃ, ʒ, h
3G	s, ʃ, h	5G	f, v, s, z, ʃ, h
3H	f, v, θ, s, z, ʃ, ʒ, h	5H	f, v, θ, s, z, ʃ, ʒ, h
3I	f, v, θ, s, z, ʃ, h	5I	f, v, θ, ð, s, z, ʃ, h
3G	f, v, θ, s, ʃ, h	5J	f, v, θ, ð, s, z, ʃ, ʒ, h
3K	f, v, s, ʃ, h	5K	f, v, θ, ð, s, z, ʃ, ʒ, h
3L	f, v, s, ʃ, h	5L	f, v, z, ʃ, ʒ, h
4A	f, θ, v, s, z, ʃ, h	5M	f, v, θ, ð, s, z, ʃ, ʒ, h
4B	θ, h	6A	f, v, θ, ð, s, z, ʃ, ʒ, h
4C	f, v, θ, s, z, ʃ, h	6B	f, v, θ, s, z, ʃ, h
4D	f, v, θ, s, ʃ, h	6C	f, v, θ, s, z, ʃ, h
4E	f, v, s, z, ʃ, h	6D	f, v, θ, s, z, ʃ, ʒ, h
4F	f, v, ð, s, z, ʃ, h	6E	f, v, θ, ð, s, z, ʃ, ʒ, h
4G	f, v, θ, ð, s, z, ʃ, ʒ, h	6F	f, v, θ, ð, s, z, ʃ, h
4H	f, v, s, z, ʃ, h	6G	f, v, θ, ð, s, z, ʃ, h
		6H	f, v, s, z, ʃ, h

Figure 3.3 illustrates production accuracy of fricatives for all children. There is a tendency for higher production accuracy in Korean fricatives compared to English fricatives in the younger age groups. There is an opposite trend in the older age groups.

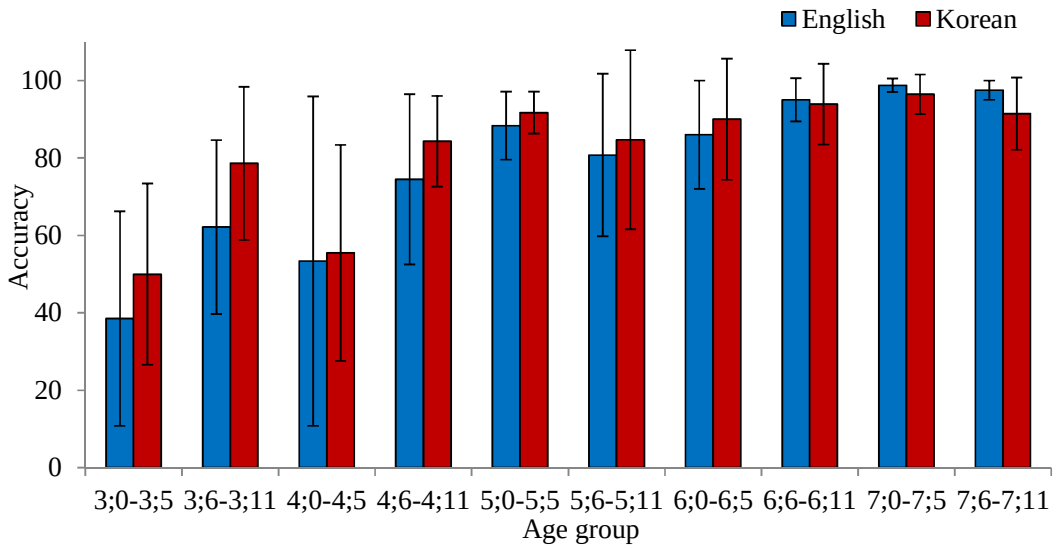

Figure 3.3. Production accuracy of fricatives (error bars represent standard deviations)

3.3.4 PRODUCTION OF AFFRICATES

One child (4B) did not produce any English affricate consonants (but produced all Korean affricates). One child (3C) did not produce /ts*/ (Korean affricate) but produced all other affricates (in both Korean and English). The remaining children produced all affricates in both languages. Younger KEB children were more accurate in producing Korean affricates than English affricates (Figure 3.4). By the age of five years, the gap in production accuracy between English and Korean affricates had narrowed.

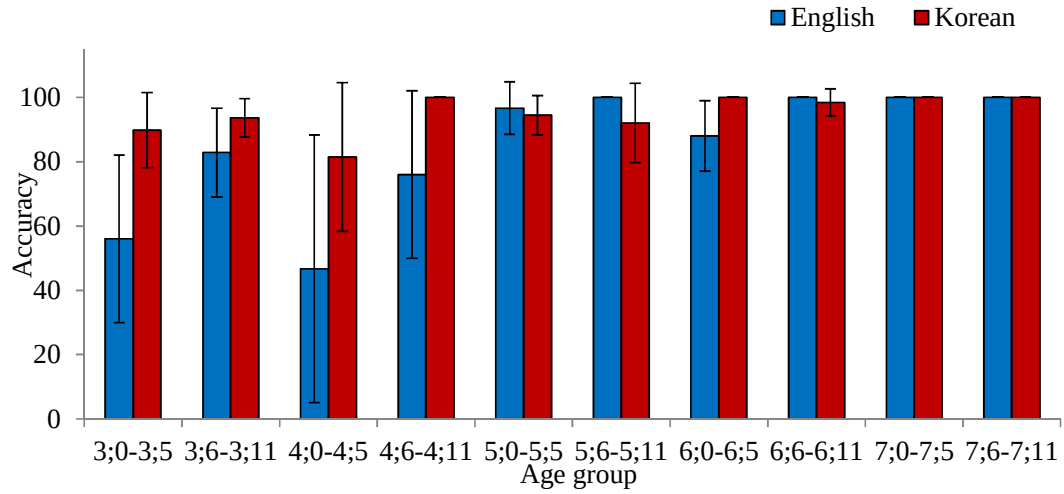

Figure 3.4. Production accuracy of affricates (error bars represent standard deviations)

3.3.5 PRODUCTION OF NASALS

All nasals were present in the phonetic inventories of KEB children except for one child (3E), who did not produce /ŋ/ in Korean but did produce it in English. Contrary to the findings from MK children (M. J. Kim & Pae, 2005), all KEB children produced /m/ and /n/ in both syllable initial and final positions. Nasals were produced with relatively high accuracy from a young age. English nasals were produced more accurately than Korean nasals across the age groups. By the age of five years, the production accuracy of English nasals reached 100% but KEB children produced errors in their production of Korean nasals even at the age of seven years (Figure 3.5).

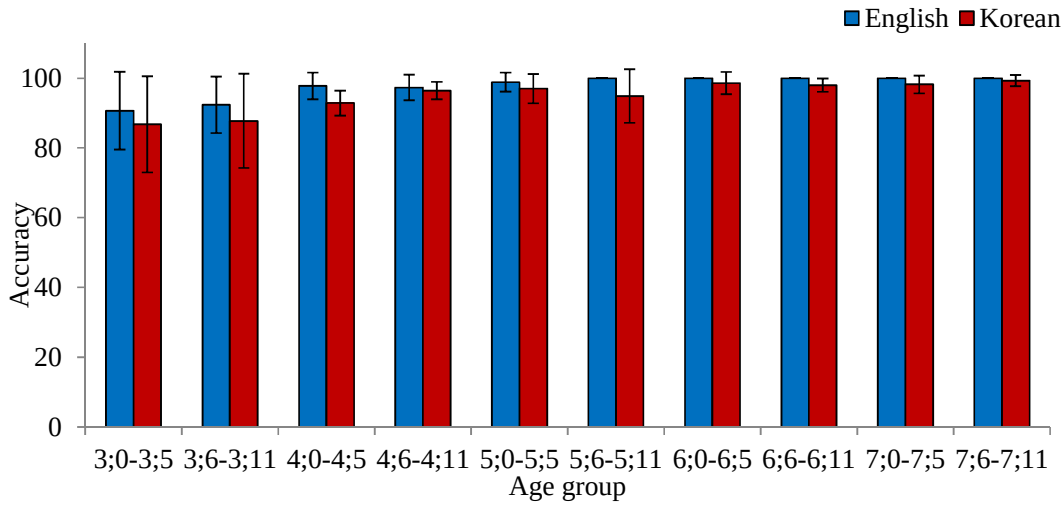

Figure 3.5. Production accuracy of nasals (error bars represent standard deviations)

3.3.6 PRODUCTION OF LIQUIDS

English /l/ was produced by all KEB children except for one child (3L). The English rhotic consonant was produced by some younger children, including some three-year-old KEB children (3C, 3D, 3E and 3K). However, it is not until after 5;6, when the majority of KEB produced /ɹ/ (only 5G, 5I and 6B did not produce /ɹ/ in the age groups older than 5;6).

To be consistent with the MK normative study, we specified syllable positions for the Korean liquid. All KEB children produced /l/ in syllable final position. The majority of the youngest age group did not produce /l/ in syllable initial position (only 3C produced /l/ in syllable initial position). In the older age groups, most children produced /l/ in syllable initial position with the exception of 3H, 4B, 4C and 4H. Three children (4H, 6H and 6L) produced /l/ in syllable initial position but produced it as [l] not as its correct allophonic variant, [ɾ]. Production accuracy of liquids in each language is shown in Figure 3.6. Similar

to fricatives, there is a trend for higher production accuracy of the Korean liquid in younger age groups but higher production accuracy of English liquids in older age groups.

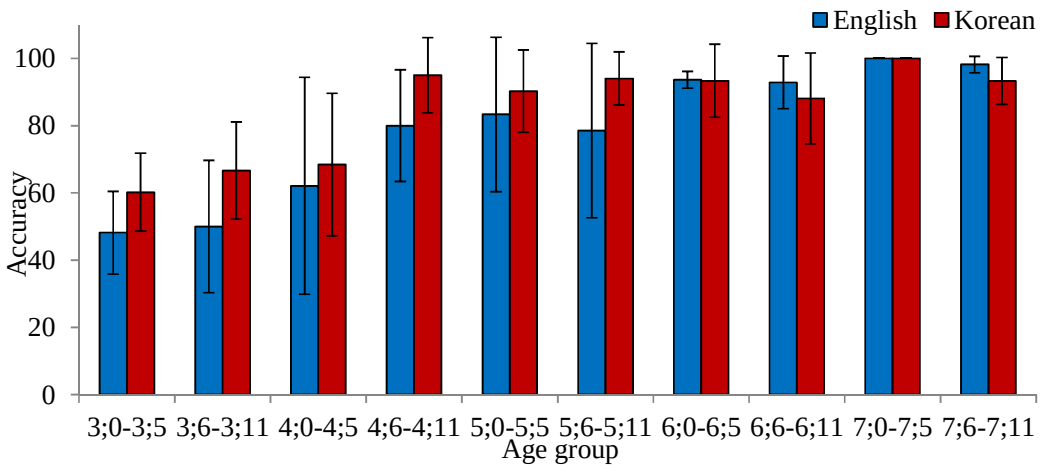

Figure 3.6. Production accuracy of liquids (error bars represent standard deviations)

3.3.7 PRODUCTION OF GLIDES

Only English glides are reported. All KEB children produced /w/, and only by the age of six years did all KEB children produced /j/. In age groups younger than 6;0, there were eight children (3A, 3D, 3H, 3K, 3L, 4C, 5B and 5L) who did not produce /j/, which is reflected in the production accuracy of glides in Figure 3.7.

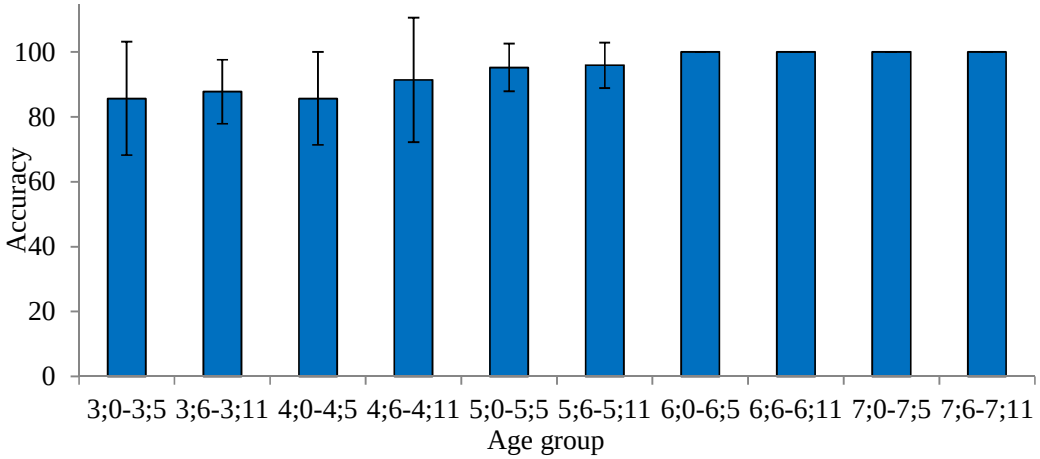

Figure 3.7. Production accuracy of glides (error bars represent standard deviations)

3.3.8 FACTORS INFLUENCING PHONOLOGICAL DEVELOPMENT

Age, gender, age of first English language exposure (EngEx), the proportion of language exposure, the number of contexts in which the children were receiving English and Korean language exposure (EngNum and KorNum, respectively), the annual household income (Income), years of mother's education and mother's age were initially entered into a

multiple linear regression model. The results are summarised in Table 3.6. The variables that were removed by means of the backward elimination method will not be reported in detail.

Age was consistently identified as a statistically significant factor for segmental accuracy in both languages. The number of different Korean language environments to which children were exposed accounted for the variance in Korean PCC scores ($p = 0.007$) and the age of first English language exposure accounted for the variance in Korean PVC scores ($p = 0.004$). The number of different English language environments to which children were exposed approached the level of statistical significance for explaining the variance in the English PVC scores ($p = 0.052$). Nevertheless, our regression models could only account for approximately 50% of the variance in the PCC scores and much less of the variance in the PVC scores in both languages.

Table 3.6. Multiple linear regression results

	Model and ANOVA						Unstandardised coefficients		Standardised coefficients			95% Confidence interval for B	
	R^2	Adjusted R^2	SE	F	*p*		B	SE	Beta	t	*p*	Lower bound	Upper bound
English PCC	0.527	0.507	0.059	26.195	<0.001	Constant	1.650	0.046		35.962	<0.001	1.558	1.743
						Age	0.003	<0.001	0.691	6.868	<0.001	0.002	0.004
						Income	<0.001	<0.001	0.117	1.757	0.085	<0.001	<0.001
English PVC	0.397	0.372	0.011	15.504	<0.001	Constant	1.959	0.006		319.845	<0.001	1.946	1.971
						Age	<0.001	<0.001	0.516	4.334	<0.001	<0.001	0.001
						EngNum	0.003	0.001	0.238	1.996	0.052	<0.001	0.005
Korean PCC	0.498	0.476	0.032	23.281	<0.001	Constant	1.827	0.020		91.145	<0.001	1.786	1.867
						Age	0.002	<0.001	0.635	6.144	<0.001	0.001	0.002
						KorNum	0.008	0.003	0.292	2.819	0.007	0.002	0.015
Korean PVC	0.349	0.322	0.008	12.626	<0.001	Constant	1.971	0.004		441.974	<0.001	1.962	1.980
						Age	<0.001	<0.001	0.449	3.813	<0.001	<0.001	<0.001
						EngEx	<0.001	<0.001	0.362	3.073	0.004	<0.001	<0.001

3.3.9 COMPARISON WITH MONOLINGUAL CHILDREN

The phonetic inventories of individual children were compared against the age of acquisition of speech sounds of the monolingual normative studies in both languages (Table 3.7). For the majority of the children, especially with regard to their English, whether the bilingual children's phonological skills were accelerated or decelerated could not be determined. For example, 3E did not produce /f/ or /v/, suggesting deceleration, but produced /tʃ/ and /dʒ/, suggesting acceleration. In Korean, acceleration was evident in all children younger than seven years, when the phonetic inventory is expected to be completed in MK children. Deceleration in the phonetic inventory was observed only in one child.

Table 3.7. Phonetic inventories of Korean-English bilingual children in comparison to monolingual children

	English		Korean			English		Korean	
	Accelerated	Decelerated	Accelerated	Decelerated		Accelerated	Decelerated	Accelerated	Decelerated
3A	θ, ʃ, ʧ, ʤ	j	p, t, tʰ, k, k*, kʰ, s, s*, ts, ts*, tsʰ, n, m, l, ŋ		5G		ʒ	s, s*	
3B	ʃ, ʧ, ʤ		p, t, tʰ, k, k*, kʰ, s, ts, ts*, tsʰ, n, m, l, ŋ		5H	θ, ɹ		s, s*	
3C	ʃ, ʧ, ʤ, ɹ	f	p, t, tʰ, k, k*, kʰ, ts, tsʰ, n, m, l, ŋ		5I	θ, ð	ʒ	s, s*	
3D	θ, ʃ, ʧ, ʤ, ɹ	j	p, t, tʰ, k, k*, kʰ, s, s*, ts, ts*, tsʰ, n, m, l, ŋ		5J	θ, ð, ɹ		s, s*	
3E	ʧ, ʤ, ɹ	f, v, s, z	p, t, tʰ, k, k*, kʰ, ts, ts*, tsʰ, n, m, l		5K	θ, ð, ɹ		s, s*	
3F	θ, ʃ, ʒ, ʤ		t, k, kʰ, s, s*, ts, ts*, tsʰ, n, m, ŋ		5L	ɹ	s, j	s, s*	
3G	ʃ, ʤ	f, v, z	t, k, kʰ, s, ts, ts*, tsʰ, n, m, ŋ		5M	θ, ð, ɹ		s, s*	
3H	θ, ʃ, ʒ, ʤ	j	t, k, kʰ, s, s*, ts, ts*, tsʰ, n, m, ŋ		6A	θ, ð		s, s*	
3I	θ, ʃ, ʤ		t, k, kʰ, s, s*, ts, ts*, tsʰ, n, m, ŋ		6B	θ	ʒ, ɹ	s, s*	
3G	θ, ʃ, ʤ	z	t, k, kʰ, s, s*, ts, ts*, tsʰ, n, m, ŋ		6C	θ	ʒ	s, s*	
3K	ʃ, ʤ, ɹ	z, j	t, k, kʰ, s, s*, ts, ts*, tsʰ, n, m, ŋ		6D	θ		s, s*	
3L	ʃ, ʤ	z, l, j	t, k, kʰ, s, s*, ts, ts*, tsʰ, n, m, ŋ		6E			s, s*	
4A	ʃ	ʒ	kʰ, s, ŋ		6F	θ, ð	ʒ	s, s*	
4B	θ	f, v, s, z, ʒ, ʧ, ʤ	kʰ, s, ŋ	h	6G	θ, ð	ʒ	s, s*	
4C	θ, ʃ	ʒ, j	kʰ, s, s*, ŋ		6H		ʒ	s, s*	
4D	θ, ʃ	ʒ	s, s*		6I	θ, ð		s, s*	
4E	ʃ, ɹ	ʒ	s, s*		6J	θ, ð		s, s*	
4F	ð, ʃ	ʒ	s, s*		6K	θ, ð		s, s*	
4G	θ, ð, ʃ, ɹ		s, s*		6L	θ, ð		s, s*	
4H	ʃ, ɹ	ʒ	s		7A				
5A	θ, ð, ɹ		s, s*		7B				
5B		j	s, s*		7C		ʒ		
5C		ʒ	s, s*		7D				
5D	θ, ð		s, s*		7E				
5E	ɹ	ʒ	s, s*		7F				
5F	θ, ð, ɹ		s, s*		7G				

The PCC scores of the current study are compared to the previous monolingual studies in Figures 3.8 and 3.9. In younger age groups, there is a trend for higher PCC scores in monolingual children compared to the bilingual children in both languages. Dodd et al. (2003) and M. J. Kim and Pae (2005) included ME and MK children up to the ages of 6;11 and 6;5, respectively. The PCC scores of KEB children older than these ages could not be compared.

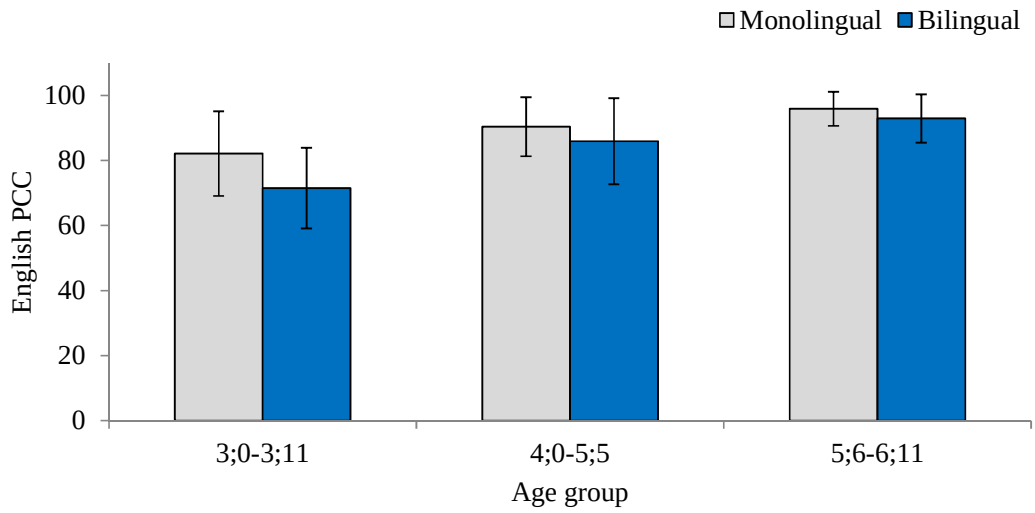

Figure 3.8. Comparison of percentage of consonants correct (PCC) between monolingual English-speaking children (Dodd et al., 2003) and the bilingual children of the current study (error bars show standard deviations)

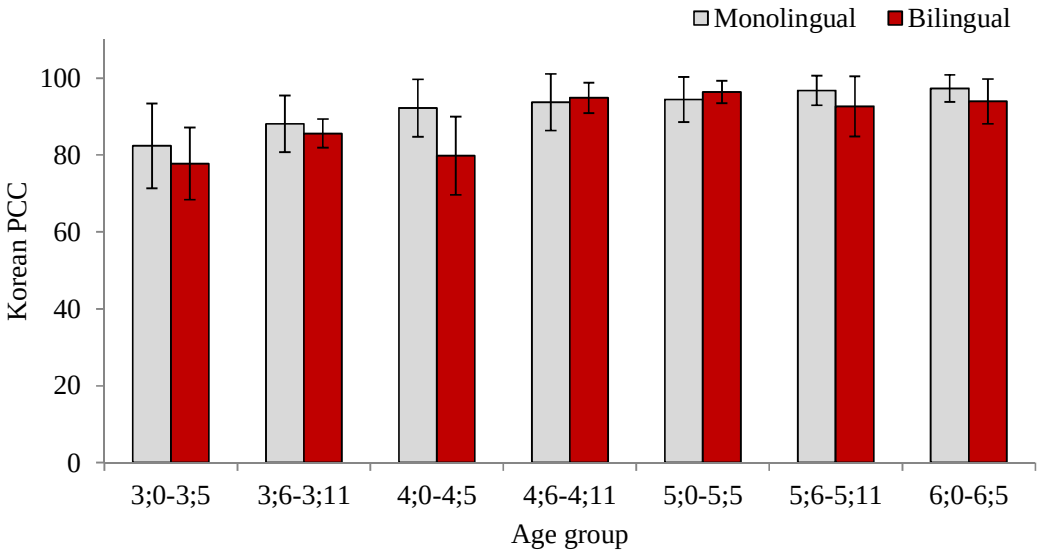

Figure 3.9. Comparison of percentage of consonants correct (PCC) between monolingual Korean-speaking children (M. J. Kim & Pae, 2005) and the bilingual children of the current study (error bars show standard deviations)

When the individual PCC scores of the bilingual children were compared against the ME normative data, 28.89% of the bilingual children aged between 3;0 and 6;11 obtained a PCC score that was one standard deviation below the age group means provided in Dodd et al. (2003). No one obtained a PCC score one standard deviation above the mean of the ME normative data. When compared against the MK normative data, 18.42% of the bilingual children aged between 3;0 and 6;5 obtained a PCC score one standard deviation below the age group means provided in M. J. Kim and Pae (2005). No child scored one standard deviation above the MK normative mean. Of the children who scored one standard deviation below the monolingual means in either language, 42.86% scored one standard deviation below the monolingual means in both languages, 50.00% scored one standard deviation below the monolingual means only in English and 7.14% only in Korean. The percentage of children who obtained a PCC score that is one standard deviation below the monolingual means for each age group is illustrated in Figure 3.10.

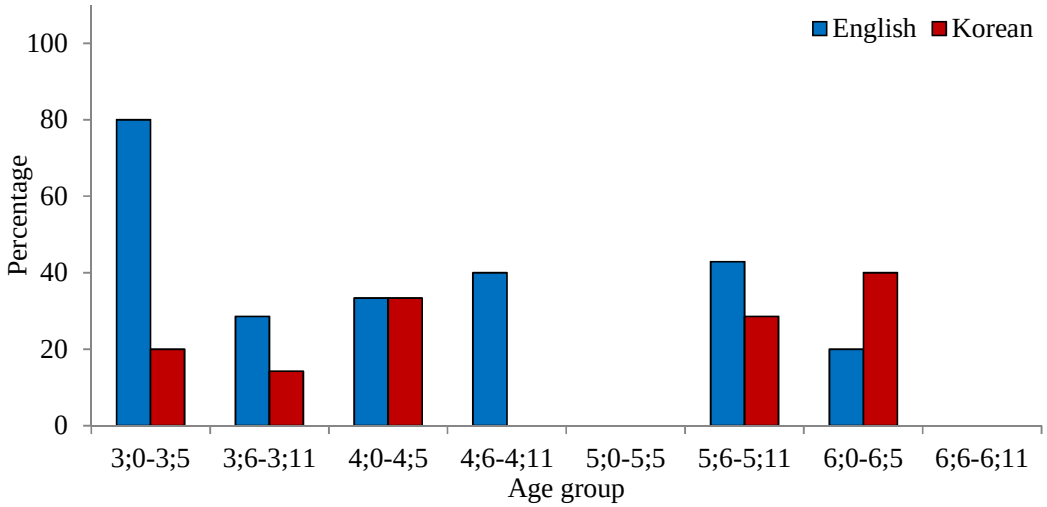

Figure 3.10. Percentage of children who obtained a percentage of consonants correct (PCC) score one standard deviation below the monolingual age group means

To explore potential factors associated with the decelerated rate of phonological development in KEB children, the characteristics of the children who obtained a PCC score one standard deviation below and those that scored within one standard deviation of the monolingual normative means were compared using Mann-Whitney U and Chi-square tests. The results are summarised in Table 3.8. There was no gender difference in the findings for English ($\chi^2(1, N = 45) = 1.171$, $p = 0.337$) or for Korean ($\chi^2(1, N = 38) = 0.175$, $p = 1.000$). In English, the KEB children whose PCC scores were one standard deviation below the ME age group means were statistically significantly younger (median = 51, mean = 52.46, SD = 13.72) than those who scored within one standard deviation (median

= 64, mean = 63.34, SD = 12.97). The KEB children whose PCC scores were one standard deviation below the ME age group means (median = 2.50, mean = 3.67, SD = 3.33) were also exposed to proportionally less English language (i.e. proportionally greater Korean language exposure) than those who scored within one standard deviation (median, 1.58, mean = 1.64, SD = 0.92). The two groups also differed in the number of contexts in which they were receiving English language exposure. Those who scored within the ME normative age group means tended to be exposed to a greater number of English language environments (median = 2, mean = 2.25, SD = 1.107) than those who scored one standard deviation below the ME norms (median = 1, mean = 1.54, SD = 0.660).

In Korean, the two groups differed only in the number of contexts in which they were receiving Korean language exposure. The KEB children who scored within the MK age group means tended to be exposed to a greater number of Korean language environments (median = 3, mean = 3.13, SD = 1.586) than those who scored one standard deviation below the MK norms (median = 1, mean = 1.71, SD = 1.113).

Table 3.8. Comparison of the characteristics between the Korean-English bilingual children whose percentage of consonants correct was one standard deviation below and within one standard deviation of the age group means of monolingual normative studies

	English			Korean		
Mann-Whitney	U	*p*	*r*	U	*p*	*r*
Age	**114.00**	**0.018**	**-0.351**	82.00	0.318	-0.162
Age of first English exposure	191.50	0.673	-0.063	61.00	0.066	-0.347
Proportion of language exposure	**108.00**	**0.012**	**-0.373**	99.50	0.735	-0.055
Number of contexts for English	**128.00**	**0.033**	**-0.117**	68.00	0.105	-0.263
Number of contexts for Korean	177.50	0.433	-0.318	**53.00**	**0.032**	**-0.347**
Mother's age	183.00	0.531	-0.093	96.50	0.651	-0.073
Mother's education	171.50	0.515	-0.099	97.50	0.867	-0.028
Annual household income	197.00	0.780	-0.043	97.00	0.660	-0.071

3.3.10 TRANSFER

There were examples of segmental transfer as defined in Fabiano-Smith and Goldstein (2010). There were two children (4A and 6E in Table 3.3) who substituted [θ] for /s/ or

/s*/ in Korean (five occurrences for each child), which can be taken as evidence of transfer of an English-specific speech sound (interdental fricative) in the productions of Korean words. These two children were siblings. Both were male, born in New Zealand and Korean-language dominant (as revealed by the proportion of language exposure).

Evidence of Korean-language specific consonants produced in English words was also found. Eleven children (21.2%) substituted Korean affricate consonants for English affricate consonants (e.g. [wɔtsʰ] for /wɔtʃ/). Such substitutions were observed only sporadically (i.e. once or twice) for most children. There were no unifying characteristics of these children who produced the Korean-specific consonants in English.

3.4 DISCUSSION

The current study was the first cross-sectional study of phonological skills in KEB children in the field of bilingual phonological development where Spanish-English bilingual children remains the most studied population (Hambly et al., 2013). The current study sought to (1) describe phonological skills in KEB children, (2) identify the potential factors influencing bilingual phonological development, (3) compare phonological skills between KEB children and their monolingual counterparts and (4) contribute to the on-going discussion about cross-linguistic influence in bilingual phonological development. We begin our discussion with the characteristics of phonological skills in KEB children.

3.4.1 CHARACTERISTICS OF PHONOLOGICAL SKILLS

The age of completion of the phonetic inventory in the KEB children was comparable with monolingual children in both languages. However, the trajectories towards the completion were different from the monolingual children. To summarise our findings, the majority of KEB children produced all Korean consonants by the age of three years with the exception of /s*/ (and /l/ in syllable initial position), with four of the 12 three-year-old KEB children (3F, 3I, 3K and 3L) already having a complete phonetic inventory in Korean. As a general trend, /s*/ appears to be mastered after 4;6. Although all children produced /l/, its allophonic variant, [ɾ], appear to be mastered after 4;6. In English, all stops, affricates, nasals, /l/ and /w/ appeared to be mastered before 3;6. Unlike Korean, no three-year-old child had a complete phonetic inventory in English. The youngest child to have a complete English phonetic inventory was 4G (aged 4;11). Age of mastery of /ɹ/ and /j/ appeared to be after 5;6 and 5;0, respectively. Estimating the age of mastery of English fricative consonants was a challenge as there were considerable variations within and across age

groups. As a general trend, fricatives could be categorised into early-, middle- and late-developing groups. Early-developing fricatives were /f, v, s, ʃ, h/, middle-developing fricatives were /z, θ/ and the late group included /ð, ʒ/.

The PPC scores were higher in Korean than in English in younger age groups, whereas the opposite trend was observed in older age groups. English stops and nasals reached 100% production accuracy but KEB children continued to produce errors in Korean stops and nasals at the age of seven years. Lower production accuracy of the Korean fricatives and liquid in older age groups also contributed to this trend. The English PCC scores in younger age groups were particularly low, which can be attributed to low production accuracy in fricatives, affricates and liquids. Errors in English fricative consonants were particularly high, with the mean percentage of fricative consonants correct only at 38.5% in the youngest age group. The PVC scores were generally higher in English than in Korean, except for the youngest age group. The trend for lower PVC scores in Korean can be attributed to the post-consonantal glide deletion in Korean across age groups.

3.4.2 FACTORS INFLUENCING PHONOLOGICAL SKILLS

We also explored potential factors influencing phonological development in KEB children. Chronological age was the most influential factor, which is consistent with a previous cross-sectional study in Cantonese-English bilingual children with a similar sample size (Holm & Dodd, 2006). Age of English exposure was also a statistically significant factor predicting PVC scores in Korean. The interpretation of age of first English exposure is complicated, as most vowel errors in Korean were associated with diphthongs. Although the deletion of glides was treated as an error in the PVC calculation, post-consonantal glide deletion is often observed in natural speech in Korean (Silva, 1991). This stringent PVC calculation method which treated the post-consonantal glide deletion as an error was used in the current study, because it was suspected that such deletion might be less likely in KEB children. That is, the influence of the phonemic status of glides in English on the Korean phonology might lower the chance of post-consonantal glide deletion in the production of Korean words. This was not the case, as such deletion was observed regardless of age and language exposure. In addition, the regression results counterintuitively suggested that the higher PVC scores in Korean were associated with later exposure to the English language. It is unclear whether the age of first English language exposure does influence phonological development in KEB children or whether this was confounded by the PVC calculation method in the current study. Nevertheless, the

impact of the age of the English language exposure, along with the child's age, was marginal on the PVC scores in Korean. As far as segmental accuracy is concerned, the age of English language exposure was not a deterministic factor. Our findings are in agreement with most previous empirical studies including Holm and Dodd (2006). Gildersleeve-Neumann et al. (2009) also found that their sequential Spanish-English bilingual children were comparable to simultaneous bilingual children in terms of phonological skills from a previous study by Goldstein and Washington (2001). The simultaneous Spanish-English bilingual children in Brice et al. (2009) also had phonological skills comparable to sequential Spanish-English bilingual children of the same age group in Prezas et al. (2014).

We found that the number of different contexts in which the children were receiving language input influenced their phonological skills. The greater the number of different Korean language contexts, the higher the Korean PCC scores. The number of language contexts in which KEB children were receiving English input as a predictor of the English PVC scores also approached the level of statistical significance. In this respect our findings are consistent with previous studies examining the properties of language input in bilingual children's language development (Fischer, Church, & Chambers, 2004; Place & Hoff, 2011; Richtsmeier, Gerken, Goffman, & Hogan, 2009). Caution must be exercised, however, when interpreting the regression results of the current study, due to a small sample size in such a heterogeneous population. Although significant, the variables in the regression model only explain approximately half of the variance in the PCC scores in both languages. The (adjusted) R^2 values for PVC scores are considerably lower. Therefore, more than half of the variance of the segmental accuracy in the KEB children in the study was not accounted for by the regression model. For example, age, according to the regression model, predicts the PCC scores, with older age associated with higher PCC scores, in both languages. The English PCC scores of 3D, 3E and 5G are 81.02%, 43.26% and 78.72%, respectively. It is easy to see how 'the older the child, the more accurate their production' may be a statement of overgeneralisation.

3.4.3 ACCELERATION OR DECELERATION?

When the individual PCC scores of the KEB children were compared against their respective monolingual norms, there was evidence that bilingual children's phonological skills were decelerated compared to monolingual children. However, deceleration was not the norm as previously suggested (Goldstein & Gildersleeve-Neumann, 2007; So & Leung, 2006). The majority of the KEB children obtained PCC scores that would be expected in

monolingual children in both languages across age groups. The current study found no evidence that older bilingual children show advanced phonological skills compared to monolingual children of the same age as tentatively alluded to in Hambly et al. (2013). Almost half of the children aged between 5;6 and 6;5 obtained PCC scores that were considerably lower than monolingual children in both languages (Figure 3.10). Moreover, there was no evidence of acceleration in KEB children in any age group in terms of their segmental accuracy in either language. The PCC scores of bilingual children may become comparable to that of monolingual children beyond the age of six years but older bilingual children are not necessarily more accurate than age-matched monolingual children.

KEB children whose Korean PCC scores were lower than the MK age group means tended to be exposed to fewer Korean language contexts than those who scored comparably with the MK children. Children with English PCC scores that were lower than ME age group means were associated with younger age, less exposure to English and fewer English language contexts. Note that the latter two factors were not statistically significant factors predicting segmental accuracy in English from our regression analysis. The factors that influence phonological development of bilingual children do not necessarily have to be consistent with the factors associated with lower or higher PCC scores compared to monolingual children, as the regression and the comparative analyses were addressing different issues. Nevertheless, there may be methodological reasons why there is a difference in the results of the two analyses. The regression analysis included seven-year-old KEB children, whereas Mann-Whitney U tests did not include them because Dodd et al. (2003) only included children up to the age of 6;11. When the regression analysis was re-run without the seven-year-old KEB children whose English PCC scores were stable, (as reflected in the small standard deviations in Table 3.4), the number of English language environments did emerge as a statistically significant predictor of English PCC scores. Hence, these findings appear to support the suggestion that the number of different language contexts to which the KEB children are exposed influences their segmental accuracy.

Segmental accuracy results of the current study therefore supports deceleration, but not acceleration, as predicted by the IDS model. Note that deceleration in the IDS model was defined in quantitative terms (“overall progress”) but acceleration in qualitative terms (“a certain property”) (Paradis & Genesee, 1996). However, the KEB children whose PCC scores were comparable with their monolingual counterparts do not easily fit within the framework of the IDS model, as its hypothesised manifestations of interdependence are

acceleration, deceleration and transfer. Such children have also been reported in previous studies in different bilingual populations (e.g. Goldstein et al., 2005; Lin & Johnson, 2010). Fabiano-Smith and Goldstein (2010) provided an account for the bilingual children whose phonological development was comparable with monolingual children. They claimed that the rates of phonological development in bilingual children can be similar to that in monolingual children because the acceleration and deceleration effects operate simultaneously thereby cancelling out the effects of each other. However, acceleration and deceleration describe how the differences between monolingual and bilingual phonological development could be manifested but not 'effects' that have certain operational reality (Fabiano-Smith & Barlow, 2010; Keshavarz & Ingram, 2002; Paradis & Genesee, 1996; Prezas et al., 2014). As there is no empirical evidence to suggest that acceleration and deceleration are operations that drive phonological development, the *ad hoc* hypothesis made in Fabiano-Smith and Goldstein (2010) is difficult to accept as an explanation for why segmental accuracy between monolingual and bilingual children is comparable. Furthermore, even those who obtained PCC scores comparable to monolingual children were qualitatively different from their monolingual counterparts as revealed by their phonetic inventories (Table 3.7). Although there was no evidence of acceleration in segmental accuracy, acceleration (as well as deceleration in the case of English) was evident in the phonetic inventories. The outcomes of comparison between bilingual and monolingual children differ depending on whether segmental accuracy or phonetic inventory) is used. The previous studies that employed segmental accuracy measures (e.g. Bunta et al., 2009; Gildersleeve-Neumann et al., 2009) also suggested that bilingual children were decelerated in their phonological skills, while the studies that compared phonetic inventories suggested that bilingual and monolingual children had comparable phonological skills (e.g. Fabiano-Smith & Barlow, 2010). However, our comparative analysis of phonetic inventories between KEB bilingual children and their monolingual counterparts does not agree with the findings of Fabiano-Smith and Barlow (2010) that Spanish-English bilingual children had phonetic inventories that were commensurate in complexity with their monolingual counterparts. KEB children younger than 7;0 could not be said to have phonetic inventories that were similar in complexity to monolingual children in either language. KEB children's phonetic inventories could not be determined to be *either* accelerated *or* decelerated (Table 3.7).

Bilingual children are considered fundamentally different from monolingual children in their development of phonological systems (Hambly et al., 2013) and other aspects of

language and cognitive development (e.g. Bialystok, 2009; Bialystok, Craik, Green, & Gollan, 2009; Grosjean, 1989; Meisel, 2006). Of course, there is theoretical knowledge to be gained from comparing bilingual and monolingual bilingual phonological development. However, attempts to determine whether bilingual children are accelerated or decelerated compared to monolingual children are likely to lead to overgeneralised and reductive conclusions about bilingual phonological development. As far as clinical applications are concerned, only general trends and tendencies can be suggested. While Korean /s/ was consistently acquired earlier in KEB children, there is a lack of systematicity in the comparative acquisition of English fricatives. In addition, the IDS model of bilingual phonological development considers deceleration (compared to monolinguals) a 'normal' aspect of phonological development in bilingual children. However, phonological delay is a clinical condition that requires clinical intervention (Dodd, 2005, 2011). Then the question of interest to speech-language therapists is - *how decelerated is typical?* No definitive answer could be offered to this question from the current study (nor from other previous studies). Furthermore, not all KEB children showed decelerated rates of phonological development and it was not possible to identify the factors leading to deceleration in bilingual phonological development. No matter how statistically significant the findings may be, the exceptions to the general trends in how bilingual children differ from monolingual children could potentially reflect misdiagnoses of SSD in clinical practice. Diagnostically relevant conclusions cannot be drawn by comparing bilingual and monolingual children who are fundamentally different in the use and development of their languages.

3.4.4 CROSS-LINGUISTIC EFFECTS

The current study focused on the manifestation of cross-linguistic effects at points of structural overlap between Korean and English. At points of structural overlap, we found equivocal evidence for cross-linguistic effects, as suggested by Hulk and Müller (2000) and Nicoladis and Paradis (2011). With regard to Korean /l/, structural overlap would hypothesise that KEB children are likely to produce [l] for [ɾ], because of the influence of the English structural pattern in which English /l/ is realised as [l] (Nicoladis & Paradis, 2011). However, only three KEB children produced [l] when they should have produced [ɾ]. There does not seem to be a unique profile of these three children, which makes it unlikely that external factors are associated with erroneous productions of [l]. On the whole, the English structural pattern of /l/ influencing production of Korean /l/ was not common.

In addition, the general trend in older KEB children for lower production accuracy of stops in Korean than in English is attributed to KEB children aspirating word final stops. Korean stops are always lax, unreleased and unaspirated in word final position (Chapter 2). According to structural overlap, we would expect the Korean pattern to influence KEB children to unrelease and deaspirate word final stops in English. The opposite case was observed. However, word final voiced obstruents in English were produced as their voiceless counterparts (e.g. [fɹɒk] for /fɹɒg/). Word final stops are always voiceless and voiced and voiceless lax stops are in complementary distribution in Korean (Chapter 2), which likely influenced KEB children to erroneously produce voiceless word final stops in English. Interestingly, aspiration of word final stops in Korean and devoicing of word final obstruents in English were more frequent in younger children than older children (also see Chapter 4). In addition, lower English PVC in younger children mostly reflected errors associated with tense-lax vowel distinction. Errors associated with tense-lax vowel distinction have also been documented in a different study for bilingual children who were exposed to two vowel systems in which one language made phonemic tense-lax vowel distinction while the other language did not (Gildersleeve-Neumann & Wright, 2010). However, unlike the previous study which found such errors in five-year-old bilingual children, lax-tense vowel distinction errors were found almost exclusively in the three-year-old KEB children in the current study. Younger KEB children were exposed to Korean proportionately more than they were to English (see Table 3.3). While it is not possible to tease apart age and the proportion of language exposure in the current study, it may be tentatively suggested that chronological age may be a factor influencing the manifestations of cross-linguistic effects. This suggestion would also be consistent with our earlier discussion that age is a factor influencing phonological development in KEB children and that phonological skills become increasingly commensurate with age for monolingual children.

However, in another aspect of phonological development in KEB children, there was a tentative indication that cross-linguistic effects manifested directionally at a point of structural overlap and that it may be uninfluenced by external factors. English /s/ is realised as [s], while Korean /s/ is realised as either [s] or [sʲ], creating a structural overlap. Consistent with the previous findings (Anderson, 2004), the age of mastery of /s/ in Korean is considerably earlier in KEB children compared to MK children. This could be interpreted as exposure to English facilitating acquisition of /s/ in Korean. There was a clear directionality in this case; from English (one structural pattern) to Korean (two

structural patterns). External factors did not seem to influence this, as almost all KEB children were accelerated in production of Korean /s/. Nevertheless, there were some difficulties in applying the core concepts of structural overlap to explaining the mastery of the Korean allophonic variant, [sʲ]. Structural overlap would hypothesise that mastering this allophonic variant should be delayed, because English /s/ will influence KEB children to use its consistent pattern. This was not the case for KEB children. It could be that the presence of English phoneme, /ʃ/ whose acoustic characteristics share perceptual similarity with Korean [sʲ], has negated the hypothesised delay in mastering the production of the allophonic variant of Korean /s/, providing only ambiguous evidence for structural overlap. An alternative explanation may be that earlier acquisition of /s/ in Korean is due to the transfer from English. As discussed earlier, Gildersleeve-Neumann and Wright (2010) is one of the rare exceptions that found evidence for transfer. They found transfer from the dominant language (Russian) to the other language (English). In the current study, however, the majority of the KEB children were Korean dominant.

Transfer is worth further discussion. Although the evidence for transfer was scarce in previous literature, we found evidence for transfer as framed within the IDS model. However, there are some questions regarding the nature of transfer. The two children who produced [θ] for /s/ in Korean appear to support the hypothesised manifestation in the IDS model, as /θ/ is a phoneme specific to English. Such a pattern of erroneous productions is a common developmental error in MK children (M. J. Kim, 2006). Hence, the substitution of [θ] for /s/ in Korean could reflect the developmental process in bilingual phonological development (Gildersleeve-Neumann et al., 2008). It is interesting to note that the only two children in the study who produced [θ] in Korean were also siblings. In the current study, we are unable to discuss the extent to which inherent characteristics and external factors contribute to developmental processes and cross-linguistic effects in bilingual children. We did however follow up with these siblings (4A and 6E) till 5;1 and 7;4, respectively, and will discuss them further in Chapters 4 and 5.

The other finding relating to transfer was the substitution of [tsʰ] for /tʃ/ in English (e.g. [watsʰ] for /watʃ/). This finding may need to be interpreted in the context of phonological development in KEB children. Age of mastery of Korean /s/ coincided with that of English /s/. In addition, English /ʃ/ appeared to be mastered at the same time as /s/. English /ʃ/ shares perceptual similarity with the palatalised allophonic variant of Korean /s/. Thus, the mastery of /s/ (including its allophonic variant) in Korean corresponded with the mastery of these segments in English. These findings may also be related to age of acquisition of

affricate consonants. The age of acquisition of affricate consonants in KEB children is unexpectedly early in both languages. It is earlier than that reported in respective monolingual children. It may be that earlier mastery of /ʃ/ in English and /s/ in Korean had a 'knock-on' effect, leading to early mastery of affricates in both languages. It should also be noted that the English affricate consonants were not mastered by the three and four year olds in the previous KEB studies (Anderson, 2004; Ha et al., 2009). These studies only included English language learners. The majority of the three and four year olds in the current study were reportedly exposed to both languages from birth. However, even 3G and 4E, who were exposed to English language environments for the duration of two and ten months, respectively, had the English affricates in their phonetic inventory. The difference between the current study and the previous studies may be attributed to the difference in methodology. Anderson (2004) required at least two occurrences of speech sounds for it to be included in the phonetic inventories.

Although KEB children had /s/, /ʃ/ and /tʃ/ in their English phonetic inventory, they were not always produced accurately (see Figure 3.3 and 3.4). For example, some children produced [ʃ] for /s/ (e.g. [ʃɒʃɪdʒ] for /sɒsɪdʒ/) and [s] for /ʃ/ (e.g. [fɪsɪŋ] for /fɪʃɪŋ/) as well as [ts^{h}] for /tʃ/. In the current study, producing [ʃ] for /s/ and [s] for /ʃ/ in English were not considered transfer, as we were investigating transfer as framed within the IDS model, which only considers production of language-specific speech sounds in the production of the other language. When we consider the allophonic variations of Korean /s/ and erroneous productions of /s/, /ʃ/ and /tʃ/ in English, these may reflect reorganisation of phonological systems in bilingual phonological development (Dodd et al., 1996; Gildersleeve-Neumann & Wright, 2010; Holm & Dodd, 1999b). Bilingual children undergo a period during which phonemes and their realisation rules are being learned and re-specified for each language and this period may be characterised by overgeneralisation of realisation rules specific to one language to production of the other language, affecting the efficiency of extracting and following language-specific realisation rules (Ellis, 2008; Gildersleeve-Neumann & Wright, 2010; Holm & Dodd, 1999b). Such reorganisation of phonological systems may be prominently manifested where there are shared segments or points of structural overlap between two phonological systems (Gildersleeve-Neumann & Wright, 2010; Hulk & Müller, 2000), wherein the dynamic processes of specifying the phonemic contrasts and allophonic variations for each language take place (Dodd et al., 1996; Gildersleeve-Neumann & Wright, 2010; Goldstein & Washington, 2001; Holm &

Dodd, 1999b). Then, to suggest that producing [tsʰ] for /tʃ/ in KEB children reflects a language-specific phoneme being 'transferred' to the other language seems too simplistic.

3.4.5 SUMMARY AND CLINICAL IMPLICATIONS

The current study is largely in agreement with Hambly et al. (2013) whose systematic literature review concluded that there is a qualitative difference between bilingual and monolingual phonological development. There are inherent risks in applying monolingual norms for bilingual children with suspected SSD. Therefore, clinical use of available monolingual norms should be avoided for bilingual children. We also suggested that the current approach of comparing bilingual phonological development to monolingual phonological development may need to be reconsidered, as it can lead to overgeneralised and reductive conclusions. We also offered findings that challenged previous suggestions about bilingual phonological development. Specifically, (1) deceleration, compared to monolingual children, was not the norm in bilingual phonological development (Goldstein & Gildersleeve-Neumann, 2007; So & Leung, 2006), (2) older bilingual children did not have more advanced phonological skills than monolingual children (Goldstein & Bunta, 2012; Grech & Dodd, 2008) and (3) cross-linguistic effects were not necessarily more pronounced in sequential bilingual children than they were in simultaneous bilingual children (Goldstein & Gildersleeve-Neumann, 2007).

We suggested that bilingual phonological development was characterised by both developmental processes and cross-linguistic effects (Gildersleeve-Neumann et al., 2008). Cross-linguistic effects reflect manifestations of interdependence between two differentiated phonological systems. Establishing two differentiated but interdependent phonological systems means that for the shared phonemes, if their realisation rules are different for each language, the phonological systems need to be reorganised to specify and refine language-specific realisation rules (Gildersleeve-Neumann & Wright, 2010; Holm & Dodd, 1999b). Although the current study does not offer unequivocal evidence for structural overlap, our findings suggest that cross-linguistic effects are *likely* to be manifested at points of overlap in allophonic variants between the two languages (cf. Fabiano-Smith & Goldstein, 2010). Identifying such points of overlap may be useful for speech-language therapists to consider the potentially problematic areas for bilingual children.

There were considerable individual variations in KEB children. As Hoff (2013, p. 215) states, "expectations for bilingual children must differ depending on the circumstances of

their bilingualism, and the circumstances of bilingual development vary widely on multiple dimensions". Our study suggests the number of different contexts to which bilingual children are exposed may be one of the important dimensions to consider in stratifying normative data (see Hoff & Core, 2013 for a review). In the absence of comprehensive normative data for KEB children, speech-language therapists could utilise a peer-child comparison analysis in conjunction with the information provided in our study (cf. Hemsley, Holm, & Dodd, 2014). For the peer-child comparison analysis, speech-language therapists should consider age-matched KEB children who are receiving similar properties of language exposure as the KEB children in question.

As a final comment, the premise of research in bilingual phonological development conducted by speech-language therapy researchers has been that the availability of information about typical bilingual phonological development will enable speech-language therapists to identify those with SSD. However, without normative data, typically developing bilingual children cannot be reliably identified either. It is possible that some of the KEB children in the current study may have an SSD. Goldstein et al. (2010) took a cautionary approach to ensure that their bilingual children were typically developing by making sure that the PCC scores obtained by the bilingual children were above 80%. However, 25% of the KEB children in the current study obtained a PCC score lower than 80% in either language. This may suggest that the arbitrary criterion used in Goldstein et al. (2010) may not be a valid cut-off PCC score to determine the typicality of bilingual phonological development. The following chapter considers surface-level speech errors to investigate whether types of errors KEB children produce are a better indicator of typical phonological development and whether an error analysis can provide clinically relevant information for speech-language therapists working with KEB children with suspected SSD.

4 ERRORS

4.1 INTRODUCTION

It is widely accepted that children with SSD are not a homogeneous group (Dodd, 2005; Lewis et al., 2006; Shriberg et al., 1997b; Shriberg et al., 2010; Stackhouse & Wells, 1997; Tyler, 2010). Different classification systems have been proposed to explicate the heterogeneity in SSD and have been extensively reviewed in Waring and Knight (2013). One approach to classifying the subgroups of children with SSD is the Differential Diagnosis System (Dodd, 1995, 2005). Based on linguistic symptomatology, the Differential Diagnosis System suggests the best criterion to determine whether a child's phonological development is typical or disordered is the surface-level error patterns. Error patterns are considered a *clinically relevant* descriptive device to represent the consistent and systematic discrepancies between adult's targets and the child's erroneous productions (Peña-Brooks & Hegde, 2000; Zhu & Dodd, 2006). Surveys of speech-language therapists found that error pattern analysis was the most frequently completed phonological analysis procedure for children with suspected SSD (McLeod & Baker, 2014; Skahan et al., 2007). Five occurrences of a particular error type (e.g. stopping, cluster reduction) that are produced by at least 10% of the children in the same group are defined as a typical, age-appropriate error pattern. Children who produce error patterns that are typical in the normative sample but used only by a younger age group are considered delayed (phonological delay). Those who produce error patterns that are used by less than 10% of the normative sample are considered atypical (Dodd et al., 2003). The latter is referred to as phonological disorder in the current chapter. Different subgroups of SSD classified based on error patterns in the Differential Diagnosis System are suggested to reflect distinct underlying processing deficits (Crosbie et al., 2009; Dodd, 2011; Dodd et al., 1989; Holm et al., 2008). Children in the different subgroups have also been shown to respond differentially to different types of treatment (Broomfield & Dodd, 2011; Crosbie et al., 2005; Dodd & Bradford, 2000). The Differential Diagnosis System has now been applied to children who speak languages other than English, including Cantonese (So & Dodd, 1994), Mandarin (Zhu & Dodd, 2000b) and German (Fox & Dodd, 2001), supporting its applicability across different languages. However, the availability of information regarding typical, developmental error patterns and when they are expected to be resolved in bilingual children is scarce. The following section reviews the literature on error production in bilingual children.

4.1.1 ERROR PRODUCTION IN BILINGUAL CHILDREN

Table 4.1 summarises the main findings of 21 articles reporting on error production in bilingual children. It should be noted that there is no universally accepted procedure for analysing errors (Miccio & Scarpino, 2008). As such, there are differences in the methodology used for error analysis in the studies reviewed in Table 4.1. Fifteen articles were identified from the recent systematic literature review on bilingual phonological development (Hambly et al., 2013). Those that reported only on age of acquisition of speech sounds or segmental accuracy were excluded. Three articles were identified via bibliography search of the 15 articles from the systematic literature review (Gildersleeve-Neumann et al., 2009; Salameh et al., 2003; So & Leung, 2006). Two more recent articles have been included in the table (Morrow et al., 2014; Prezas et al., 2014). One article was identified from a literature search using the Research Information Service System International database (J. S. Kim et al., 2010).

Studies with a large sample size were rare, with only three studies in Table 4.1 including more than 50 bilingual children. The youngest children were the two-year-old bilingual children in Grech and Dodd (2008) and the oldest children were Japanese-Korean bilingual children with the mean age of 8.2 years in J. S. Kim et al. (2010). The most studied bilingual population was Spanish-English bilingual children followed by Cantonese-English bilingual children.

Table 4.1. Error production in bilingual children

Study	Participants	Major findings
Anderson (2004)	Five sequential bilingual children with various first languages (3;9 - 4;9)	Four children produced unusual non-target responses in English, including substituting [w] for /v/, dentalisation of alveolar fricatives, lateralisation of fricatives and affricates. Voicing errors were identified in one child (i.e. delayed). Unusual errors were also identified in their first languages, including aspiration of postvocalic unreleased stops in Korean.
Ballard & Farao (2008)	20 Samoan-speaking children (4;0-4;11) growing up in English language dominant environment	Influence of the English phonology can lead to unusual error patterns in Samoan, such as initial glottal stop deletion. Vowel length errors were also observed, suggested to be due to a transfer of the English prosodic pattern into Samoan (only Samoan was investigated).
Brice et al. (2009)	16 simultaneous Spanish-English bilinguals aged four and five years	Bilingual children were different from monolingual children. Occurrences of velar fronting and stopping were higher in English. Interference was uncommon.
Dodd et al. (1996)	16 Cantonese-English bilinguals (2;1-4;3)	Some (but not all) bilinguals produced error patterns that would indicate delayed or atypical development in monolingual children. Cantonese was more susceptible to delayed and atypical errors, even though the children spoken Cantonese as their first language.
Gildersleeve-Neumann et al. (2008)	23 English-Spanish bilinguals (3;0-3;10), assessed twice	Cross-linguistic competition influences erroneous productions, with a higher frequency of errors in bilinguals than in their monolingual counterparts. However, bilingual children produced error patterns that were not due to a cross-linguistic effect, such as the substitution of glottal stop for a word-final consonant (only English was investigated).
Gildersleeve-Neumann et al. (2009)	Six Spanish-speaking children (3;2-3;10) assessed twice before and after English exposure	No obvious effects of English exposure on consonants and syllable structures in Spanish were observed. Vowel errors increased following exposure to English, which has a more complex vowel system than Spanish (only Spanish was observed).
Gildersleeve-Neumann & Wright (2010)	14 Russian-English bilinguals (3;3-5;7)	Bilinguals produced statistically significantly higher rates of substitution errors (both consonants and vowels) compared to the monolingual control group. Bilinguals also produced Russian-influenced speech sounds in the production of English words (only English was investigated).
Goldstein & Washington (2001)	12 simultaneous Spanish-English bilinguals (4;0-4;11)	Bilinguals showed more advanced phonological skills in English, compared to their monolingual counterparts. The opposite pattern was observed in Spanish, in which a higher occurrence of error patterns was produced by bilinguals than monolingual Spanish-speaking children.

Study	Participants	Major findings
Goldstein et al. (2005)	15 Spanish-English bilinguals aged 5;0-5;5	Bilingual children produced similar error patterns compared to their monolingual counterparts. Atypical error patterns by monolingual standards were uncommon in bilingual children.
Goldstein & Bunta (2011)	Ten Spanish-English bilinguals with mean age of 6;0	Bilinguals showed more advanced phonological skills in English than the monolingual control group. There were no significant differences in the percentage of occurrence for error patterns in Spanish between the bilinguals and the monolingual control group.
Grech & Dodd (2008)	92 Maltese-English bilinguals (2;0-6;0)	Bilinguals produced similar error patterns to monolingual Maltese-speaking children up to the age of four years. Bilinguals produced fewer error patterns beyond the age of four years than the monolingual children, suggesting a more rapid acquisition of phonological competence by the bilinguals (only Maltese was investigated).
Ha et al., (2009)	Three sequential Korean-English bilingual children, aged 11 years, 3;10 and 6;0	No error patterns in Korean were identified, even for the child aged 3;10. In English, vowel errors were common in all children and stopping and cluster reduction persisted beyond the age expected of monolingual children.
Holm & Dodd (1999)	Two sequential Cantonese-English bilinguals followed from 2;3-3;1 and 2;9-3;5	Children produced error patterns (in both languages) considered atypical in their monolingual counterparts, following the introduction of English.
Holm & Dodd (2006)	40 sequential Cantonese-English bilinguals (2;2-5;7)	Some (but not all) bilinguals produced error patterns that would indicate delayed or atypical development in monolingual children in both languages.
Kim et al. (2010)	28 Japanese-Korean bilinguals with mean age of 8.2 years	Bilinguals produced error patterns typical of monolingual Korean-speaking children but at a much higher rate and much longer than their monolingual counterparts (i.e. delayed). Bilinguals also produced a greater number of error patterns than the monolingual control group (only Korean was investigated).
Law & So (2006)	100 simultaneous Cantonese-Putonghua bilinguals (2;6-4;11)	Error patterns were similar to their monolingual counterparts. Phonological interference was rare. Language dominance influenced production of error patterns.
Lin & Johnson (2010)	24 sequential Mandarin (Putonghua)-English bilinguals aged four and five years	Children did not show delayed error patterns in either language compared to their monolingual counterparts. There were no atypical error patterns in Mandarin but some Mandarin-influenced error patterns in English.

Study	Participants	Major findings
Morrow et al. (2014)	19 English language learners (5;0-7;6) with various first languages	No atypical error patterns were reported but they produced typical error patterns at a higher rate. Stopping and cluster reduction were present beyond 4;6, which would be indicative of phonological delay by monolingual standards (only English was investigated).
Prezas et al. (2014)	56 sequential Spanish-English bilinguals (4;0-5;8)	No atypical error patterns reported but bilingual children had higher percentages of occurrence than monolingual counterparts. There was no difference between boys and girls.
Salameh et al. (2003)	Ten Swedish-Arabic bilinguals (3;11-6;7)	Bilingual children produced error patterns which would be considered atypical in their monolingual counterparts (e.g. consonant insertion).
So & Leung (2006)	40 Cantonese-Putonghua bilinguals (2;6-5;6)	Bilingual children produced error patterns that would indicate delayed or atypical development in monolingual children. Bilinguals also had persisting vowel errors, reflecting a transfer of vowel segments from one language to another.

The recent literature review (Hambly et al., 2013) and the previous chapter suggested that there were qualitative differences in phonological development between bilingual and monolingual children. However, at least five articles in the literature reviewed in Table 4.1 found that error patterns in bilingual children were similar to monolingual children in at least one language. Lin and Johnson (2010, p. 382) concluded that "the phonological patterns of the bilingual and monolingual children were more similar than different". Goldstein et al. (2005) also found that Spanish-English bilingual children produced error patterns that have also been observed in their monolingual counterparts. N. C. W. Law and So (2006) provided findings from 100 Cantonese-Putonghua bilingual children, which mirrored the findings of these two studies. Other studies have provided more equivocal findings. Grech and Dodd (2008) reported that the error patterns produced by Maltese-English bilingual children were similar to their monolingual counterparts, but only for younger children. Older bilingual children produced fewer error patterns than monolingual children. Both Goldstein and Washington (2001) and Goldstein and Bunta (2012) found that Spanish-English bilingual children demonstrated more advanced phonological skills in English, as evidenced by lower rates of occurrence of error patterns, but worse or commensurate skills in Spanish, compared to their respective monolingual counterparts. Gildersleeve-Neumann et al. (2009) reported that there was no obvious impact on error patterns affecting consonants and syllable structures produced by Spanish-speaking children after they were exposed to English. However, they found a significant increase in vowel errors following exposure to English. Other studies have also reported on vowel

errors in bilingual children beyond the age of three years (Ballard & Farao, 2008; Gildersleeve-Neumann & Wright, 2010; Ha et al., 2009; Lin & Johnson, 2010; So & Leung, 2006). Research suggests monolingual English-speaking children generally master vowels by the age of three years (Dodd et al., 2003; James et al., 2001; McIntosh & Dodd, 2008), which suggests that error patterns in bilingual children may be more persistent than those in monolingual children. Error patterns typical of monolingual children, affecting consonants and syllable structures, have been found to be resolved at an older age or produced at a greater frequency in bilingual children in many studies (Brice et al., 2009; Dodd et al., 1996; Gildersleeve-Neumann et al., 2008; Goldstein & Washington, 2001; Holm & Dodd, 2006; J. S. Kim et al., 2010; Morrow et al., 2014; Prezas et al., 2014; So & Leung, 2006). Given the proportion of the children who produce typical error patterns much longer than their monolingual counterparts, the delayed resolution of typical error patterns likely reflects a characteristic of typical phonological development in bilingual children rather than phonological delay, as described in the Differential Diagnosis System (Dodd, 2005). In particular, J. S. Kim et al. (2010) found that liquid deletion, which is a typical error pattern resolved by the age of three years in monolingual Korean-speaking children, was still prevalent in the sample of Japanese-Korean bilingual children with a mean age of 8;2 years. Clinical use of monolingual norms even for older bilingual children may be diagnostically problematic.

Other studies have found that bilingual children produced error patterns atypical of their monolingual counterparts in at least one language (Dodd et al., 1996; Gildersleeve-Neumann et al., 2008; Holm & Dodd, 1999b, 2006; Salameh et al., 2003; So & Leung, 2006). For example, substitution of glottal stop, word initial consonant deletion and backing have been reported in bilingual children (Dodd et al., 1996; Gildersleeve-Neumann et al., 2008; Holm & Dodd, 1999b, 2006). In ME children, such error patterns would be indicative of a phonological disorder (Dodd, 2005). These studies make a strong case against the clinical use of monolingual norms for bilingual children.

It should be reiterated that the studies reviewed so far have produced discrepant results. The literature points to at least three factors to consider for why the findings have been so inconsistent. The first is language dominance of bilingual children. Paradis (2001) defined language dominance as the language of the greatest exposure. This approach has also been taken in the literature on error production in bilingual children, which conflates language dominance and language exposure. Both Lin and Johnson (2010) and So and Leung (2006) suggested that language dominance plays a crucial role. As summarised in Table 4.1, the

former reported that monolingual and bilingual children are similar, while the latter suggested that bilingual children produce error patterns atypical of monolingual children. Nevertheless, they reached a similar conclusion regarding the role of language dominance in production of error patterns. They suggested language dominance "may help to prevent unusual speech patterns from occurring" (Lin & Johnson, 2010, p. 381) and that dominant language was less influenced by bilingualism (So & Leung, 2006). Interestingly, with regard to language dominance, the opposite was found in Dodd et al. (1996). Cantonese-English bilingual children produced 'atypical' and 'delayed' error patterns more in Cantonese, even though Cantonese was their dominant home language. On the other hand, Gildersleeve-Neumann et al. (2008) on Spanish-English bilingual children and N. C. W. Law and So (2006) on Cantonese-Putonghua bilingual children suggested that language dominance was not a significant factor. N. C. W. Law and So (2006) specifically addressed the issue of language dominance and found that bilingual children produced typical error patterns comparable to monolingual children regardless of language dominance and that the acquisition of the phonology of the dominant language was not faster than that of the non-dominant language. Evidence for language dominance as a factor influencing production of error patterns in bilingual children is inconclusive.

The second potential factor influencing error production in bilingual children is the age of language acquisition. It has been suggested that different underlying mechanisms may operate in bilingual phonological development depending on age of language acquisition. For example, the IDS model assumes that simultaneous bilingual children have two separate phonological systems from the onset of phonological acquisition (Keshavarz & Ingram, 2002; Paradis, 2001). For sequential bilingual children, the second language phonology was suggested to be established initially by superimposing the second language phonology onto the first language phonology (Watson, 1991; Wode, 1980). It was therefore suggested that cross-linguistic effects and differences from monolingual phonological development may be more pronounced in sequential bilingual children (Goldstein & Gildersleeve-Neumann, 2007). Such theoretical discussions suggest 'delayed' and/or 'atypical' error patterns may be more prevalent in sequential bilingual children. Empirical data so far have suggested otherwise. Gildersleeve-Neumann et al. (2009) found that sequential Spanish-English bilingual children were comparable to simultaneous bilingual children from a previous study by Goldstein and Washington (2001) in terms of phonological skills. Comparing the error patterns produced by simultaneous Spanish-English bilingual children in Brice et al. (2009) and sequential Spanish-English bilingual

children of the same age group in Prezas et al. (2014), there are no remarkable differences, with both groups producing velar fronting and stopping of fricatives more in English than Spanish. One exception is Morrow et al. (2014) who found that the earlier exposure to a second language was associated with more advanced phonological skills in sequential bilingual children. The length of duration of second language exposure was also associated with advanced phonological skills. However, most findings in the literature are consistent with Holm and Dodd (2006) and the previous chapter in this doctoral thesis which found that age of second language acquisition was not a significant factor in bilingual children. Nevertheless, the number of studies directly addressing the age of second language acquisition is limited.

The third potential factor is phonological typology. To account for both 'atypical' and 'delayed' error patterns in bilingual children, the literature has offered explanations relating to differences in phonological typologies in the languages to which bilingual children are exposed (e.g. Dodd et al., 1996; Gildersleeve-Neumann et al., 2009; Holm & Dodd, 1999b, 2006; N. C. W. Law & So, 2006; Prezas et al., 2014). According to Dodd et al. (1996), bilingual children produce 'atypical' error patterns when the languages to which they are exposed markedly differ in the constraints that limit the segmentation of speech signals. A relative complexity of one phonological system compared to the other has also been suggested to be a potential factor determining how the phonological systems are reorganised in bilingual children (Gildersleeve-Neumann et al., 2009; N. C. W. Law & So, 2006). Gildersleeve-Neumann et al. (2009), for example, attributed an increase in vowel errors in Spanish-speaking children following the introduction of English to the reorganisation of the vowel system as a result of being exposed to a more complex vowel system in English. All studies on Cantonese-English bilingual children have consistently reported that the bilingual children produce 'atypical' error patterns (Dodd et al., 1996; Holm & Dodd, 1999b, 2006). On their own, these findings may support the notion that differences in phonological typology play a role in reorganisation of phonological systems whose processes are manifested as error patterns atypical of monolingual children. Such an approach, however, would require a firm theoretical framework that determines what constitutes complexity and a metric to compare the relative complexity of two phonological systems for it to have a cross-linguistic application (N. C. W. Law & So, 2006). In addition, there is only equivocal evidence to suggest that exposure to the two phonologies that differ in their typology is necessarily associated with production of 'atypical' error patterns in bilingual children. In Spanish-English bilingual children,

Gildersleeve-Neumann et al. (2008) suggested the bilingual children produced 'delayed' and 'atypical' error patterns, while Goldstein et al. (2005) found that there were no obvious differences between the Spanish-English bilingual children and their monolingual counterparts. The same discrepancy between studies of the same language pair was also documented with Cantonese-Putonghua bilingual children as summarised in Table 4.1 (N. C. W. Law & So, 2006; So & Leung, 2006). Furthermore, Lin and Johnson (2010) found that Mandarin (Putonghua)-English bilingual children did not produce 'atypical' error patterns compared to their monolingual counterparts, even though the Mandarin and English phonologies could be argued to have marked typological differences. Therefore, whether the difference in phonological typology is a factor influencing production of error patterns in bilingual children requires further investigation.

4.1.2 THE CURRENT STUDY

In the absence of valid normative data for bilingual children, it is tempting to compare bilingual children with available monolingual norms. Of the 21 studies we reviewed, only three studies suggest that production of error patterns in bilingual children is comparable to that of monolingual children in *both* languages. However, the findings of these studies were inconsistent with other studies investigating bilingual children exposed to the same language pairs (compare the two studies reporting on Cantonese-Putonghua bilingual children in Table 4.1). Weighing the evidence in the literature, the clinical use of monolingual norms for bilingual children is likely to lead to a misdiagnosis. In particular, as the majority of the studies reviewed in Table 4.1 suggest delayed resolution of or a greater frequency of occurrence of typical error patterns in bilingual children, the use of monolingual norms is likely to lead to inaccurate identification of bilingual children with a phonological delay.

The primary aim of the current study is to describe the type of errors produced by KEB children. The type of errors produced by KEB children will be compared to that produced by ME (Dodd et al., 2003) and MK children (M. J. Kim, 2006). Factors associated with production of different types of errors are also explored. Finally, the current study will consider the clinical application of the Differential Diagnosis System (Dodd, 1995, 2005) for KEB children with suspected phonology delay and disorder. Before we outline the Methodology, we first provide brief descriptions of error patterns in ME and MK children, as this information will be relevant to our discussion.

Dodd et al. (2003) identified six typical, developmental error patterns found in ME children aged between 3;0 and 5;11; gliding, deaffrication, cluster reduction, fronting, weak syllable deletion and stopping. No error patterns were reported in six-year-old children. Gliding, in which liquids are realised as glides, was the most persisting error pattern, only resolved after 5;11. Deaffrication and cluster reduction were typical until 4;11. Deaffrication refers to "modification of the affrication feature" (Dodd et al., 2003, p. 642) and its examples include [ʃ] for /tʃ/ and [dz] for /dʒ/. Cluster reduction refers to deletion of a segment in the consonant cluster. Fronting of velar consonants and weak syllable deletion are typical until 3;1l and stopping of fricatives till 3;5. In two-year-old ME children, additional error patterns of final consonant deletion, voicing error, fronting fricatives, assimilation and vowel errors were identified as typical, all of which are expected to be resolved by the age of three years (McIntosh & Dodd, 2008). Note that the label, *fronting*, was used to refer to an error pattern in which "place or articulation is moved to a more anterior position" in both ME studies (Dodd et al., 2003, p. 642; McIntosh & Dodd, 2008, p. 469). *Fronting fricatives* reported in McIntosh and Dodd (2008) included producing [f] for /θ/ in *teeth*.

M. J. Kim (2006) identified five typical, developmental error patterns in MK children aged between 3;0 and 6;5. The most persisting error pattern was dentalisation of alveolar fricatives. Even in the age group of 6;0-6;5, 20% of the MK children were producing dentalisation. Stopping of fricatives and affricates was typical till 4;11. Affrication of alveolar stops and fricatives was typical till 4;5. Typical simplification of word medial cluster was also typical till 4;5. Typical simplification of word medial cluster refers to word medial syllable final deletion (e.g. [ho.ɾa.i] for /ho.laŋ.i/), adjacent regressive assimilation (e.g. [ts^{h}in.de] for /ts^{h}im.de/) or coalescence. Simplification of liquid, in which the liquid is deleted (e.g. [ko.e] for /ko.le/) *or* realised as a glide (e.g. [ko.je] for /ko.le/), was typical till 3;11. In younger children (aged between 2;6 and 2;11), reduplication, consonant harmony, word final consonant deletion, tensification of lax or aspirated segments (e.g. [p*o.t*o] for /p^{h}o.to/), fronting of velar consonants, nasalisation of liquid and stopping of liquid were identified as additional error patterns.

4.2 METHODOLOGY

The participants were the same 52 KEB children whose phonological skills were presented in Chapter 3. The children's productions in the Phonology subtest of the DEAP and the APAC were analysed (Dodd et al., 2002; M. J. Kim et al., 2007, respectively) for errors.

In the absence of a universally accepted method of analysing for error, a three-stage analysis was conducted based on the notion that error patterns are a clinically relevant descriptive device to represent the systematic and consistent discrepancies between the target form and the child's realisation. The analysis was conducted separately for each language.

In the first stage, all discrepancies were codified based on the surface-level errors in detail. That is, the discrepancies were codified according to the type of error (e.g. stopping), the target segment affected (e.g. /f/ to [t]) and word position (except in cases of weak syllable deletion and assimilation). Different patterns of assimilation were also codified. Examples of initial codification include word initial /f/ stopping to [t], word initial tri-cluster /spl/ reduction to [pl], and distant regressive nasal assimilation. The codification was also differentiated based on the child's erroneous realisation, as well as the segments or the syllable structures affected. M. J. Kim (2006), on error patterns in MK children, used the codification, liquid simplification, to describe both deletion of liquid (e.g. [ko.e] for /ko.le/ and gliding of liquid (e.g. [ko.je] for /ko.le/). Such errors were codified differentially into deletion and substitution in the initial stage of the analysis, rather than to assume that these belong to the same error pattern of the monolingual study.

More than one codification could be used to describe the discrepancies between target form and the child's erroneous realisation for a single lexical item. For example, if a child produced [plas] for /splaʃ/, then both word initial tri-cluster /spl/ reduction to [pl] and depalatalisation of word final /ʃ/ to [s] were used to codified the discrepancies. For each discrepancy, however, only one codification was used. That is, word initial /s/ deletion could not be used in conjunction with word initial tri-cluster /spl/ reduction to [pl] to codify the discrepancy in the example above. While some error types can be codified with little or no ambiguity, other errors could incorporate more than one error type. For example, if a child produced [ɒɹɪn] for /ɒɹɪndʒ/, then both word final /dʒ/ deletion and word final /ndʒ/ cluster reduction to [n] could be used to codify this error. The codification in such a case was determined based on the proportion of the error types produced for other words in the assessment by the same child. In other words, this error was considered word final /ndʒ/ cluster reduction to [n], if the same child produced cluster reduction proportionately more than word final consonant deletion for the rest of the words in the assessment.

In the second stage, the initial codification was categorised by error types to determine (1) whether an error type affects a specific phoneme (e.g. /f/) or a specific consonant class (e.g. fricative) and (2) whether an error type affects phonemes in a particular word position.

The patterns of assimilation were also further analysed by examining whether a specific pattern of assimilation (e.g. distant regressive assimilation) was present. For example, the vast majority of stopping errors in English affected all fricative consonants irrespective of word position. The only other stopping error was stopping of liquid (i.e. [d] for /l/), which only occurred twice in the whole sample. Therefore, the initial codifications of stopping errors were conflated to stopping of fricative and stopping of liquid, respectively. On the other hand, deletion in word final position affected all consonant classes, such that, the initial codifications were conflated to one error type, word final consonant deletion.

In the third stage, the codification of errors was eliminated if no child in the sample produced the error type more than twice. The eliminated error types in English included palatalisation of /s/, metathesis, weak syllable deletion, stopping of liquid, backing of alveolar stops, nasalisation of fricative, liquidisation of nasal and lax-tense vowel distinction. In Korean, palatalisation of /s/, metathesis, monophthongisation of diphthongs, stopping of nasal and gliding of affricate were eliminated. A particular error type had to be produced at least five times by a child and by at least 10% of the children in the age band for it be to classified as an error pattern in the normative study of ME children by (Dodd et al., 2003). On the other hand, only three occurrences of the same error type were required in the MK study by M. J. Kim (2006), which makes it difficult to determine how error patterns should be defined in a bilingual context. In the current study, the data will be presented in a way that differentiates the error types produced at least three times and those produced at least five times to allow comparison with the monolingual studies. However, the small sample size of the current study limited us to determine error *patterns* by using the criterion described in the monolingual studies (i.e. the error types produced by at least 10% of the children in each age band of six months). The error types that were produced at least three or five times by individual children will simply be referred to as *common error types* in the thesis.

We also compared the common error types in the KEB bilingual children with those found in the monolingual children (Dodd et al., 2003; M. J. Kim, 2006). Bilingual children were classified into four groups for each of their languages; (1) those who produced common error types atypical of monolingual children, (2) those who produced common error types typical of monolingual children but produced beyond the age at which such error types are expected to be resolved in monolingual children, (3) those who produced common error patterns comparable with monolingual children of the same age group, and (4) those whose production of common error types was considered more advanced than

monolingual children. For a valid comparison with monolingual children, English common error types with five examples or more were used to be consistent with the criterion used in Dodd et al. (2003). The criterion of three examples was used for comparison with MK children (M. J. Kim, 2006). We conducted Kruskal-Wallis one-way analysis of variance (ANOVA) and Chi-square (χ^2) test to investigate whether there were any factors differentiating these four groups of bilingual children for each of their languages.

4.3 RESULTS

4.3.1 COMMON ERROR TYPES IN ENGLISH

The three-stage analysis identified 16 common error types in English (Table 4.2). Note the codifications were categorised based on whether the error type was phoneme-specific and/or position-specific. Thus, fronting in English refers to the substitution in which either velar nasal or velar stop is realised as alveolar nasal or stop, respectively, while affrication only refers to the substitution in which fricative consonant (but not stop) is realised as an affricate. Gliding of liquid refers to the erroneous production of [w] for /ɹ/. Depalatalisation affects both fricative and affricate consonants. Cluster reduction at syllable boundary refers to a deletion of the coda or onset. Word initial consonant deletion refers to deletion of both singletons and clusters in word initial position. An additional common error type that is not listed in Table 4.2 is the substitution of [f] for /θ/. This is a common substitution in New Zealand English speakers (Wood, 2003).

Table 4.2. Common error types in English

Common error type	Description	Example
cluster reduction (CR)	consonant cluster within a syllable is reduced	[plaʃ] for /splaʃ/
cluster vowel epenthesis (CVE)	insertion of a vowel in the consonant cluster	[sineɪk] for /sneɪk/
cluster reduction at syllable boundary (CRSB)	consonant cluster at the syllable boundary is reduced	[helikɒtə] for /helikɒptə/
gliding of liquid (GLIDE)	liquids are realised as [w]	[tweɪn] for /tɹeɪn/
stopping of fricative (STOP)	fricative consonant is realised as stop	[pedə] for /feðə/
affrication (AFF)	alveolar or palatal fricative consonant is realised as affricate	[tʃip] for /ʃip/
fronting (FRONT)	velar stop or nasal is realised as alveolar stop or nasal, respectively	[twin] for /kwin/
dentalisation (DENTAL)	alveolar fricative consonants are realised as interdental consonants	[θɒθɪdʒ] for /sɒsɪdʒ/
depalatalisation (DEPAL)	palatal consonants become alveolar	[wɔts] for /wɔtʃ/
word final obstruent devoicing (WFDEV)	voiced word final obstruent become voiceless	[fɹɒk] for /fɹɒg/
word final consonant deletion (WFDEL)	word final consonant is deleted	[bɹe] for /bɹed/
word final vowel epenthesis (WFVOW)	vowel is inserted word finally	[dʌkʰɨ] for /dʌk/
word final consonant epenthesis (WFCON)	consonant is inserted word finally	[tɹeɪnk] for /tɹeɪn/
word initial consonant deletion (WIDEL)	consonant is deleted word initially	[eb] for /web/
distant assimilation (DISASS)	one sound is influenced by another	[zɪzəz] for /sɪzəz/

Table 4.3 illustrates he frequency at which each English common error type was produced by individual children.

Table 4.3. Production of English common error types in Korean-English bilingual children

	CR	CVE	CRSB	GLIDE	STOP	AFF	FRONT	DENTAL	DEPAL	WFDEV	WFDEL	WFVOW	WFCON	WIDEL	DISASS	[f] for /θ/
3A	11	6	2	6	7	1	0	0	6	6	2	0	0	0	3	0
3B	5	1	1	3	10	7	0	0	5	5	2	0	0	0	0	0
3C	7	0	1	7	17	0	1	0	0	0	9	0	0	0	0	0
3D	4	1	0	7	4	0	0	0	6	2	0	0	0	0	2	0
3E	9	8	3	4	17	11	3	0	1	0	20	2	0	0	2	0
3F	0	1	0	10	6	4	0	0	0	1	3	7	1	0	0	0
3G	6	4	2	6	17	5	3	0	3	4	0	5	5	0	1	0
3H	1	0	0	11	6	0	0	0	0	0	0	0	0	0	1	1
3I	4	0	0	9	6	0	0	0	0	0	0	0	0	0	0	2
3J	4	3	1	9	4	1	1	0	0	5	0	0	0	0	2	0
3K	4	4	1	0	5	3	0	0	0	1	5	0	0	0	0	1
3L	10	1	3	9	5	2	2	0	1	1	3	0	0	0	2	1
4A	3	2	2	2	3	1	0	5	0	5	4	0	4	0	1	1
4B	14	0	1	2	17	2	2	0	1	0	9	0	0	11	2	0
4C	5	2	0	5	2	0	0	0	1	1	1	0	0	0	1	1
4D	4	2	3	5	4	1	0	0	1	2	4	0	0	0	0	0
4E	2	3	0	0	4	1	0	0	0	2	0	0	0	0	0	0
4F	3	0	0	8	4	0	0	0	1	1	0	0	1	0	0	0
4G	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
4H	1	2	0	2	16	2	0	0	2	0	10	0	0	0	0	0
5A	0	1	0	0	0	1	0	0	0	1	1	0	0	0	0	0
5B	1	0	0	0	1	0	0	0	0	0	2	0	0	0	1	3
5C	1	0	0	8	6	0	0	0	1	0	0	0	0	0	0	1
5D	4	3	0	2	3	0	0	0	1	2	0	0	0	0	1	1
5E	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	1
5F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	CR	CVE	CRSB	GLIDE	STOP	AFF	FRONT	DENTAL	DEPAL	WFDEV	WFDEL	WFVOW	WFCON	WIDEL	DISASS	[f] for /θ/
5G	3	0	1	11	4	1	0	0	2	2	0	0	0	0	0	2
5H	1	0	0	0	2	0	0	0	0	0	0	1	0	0	0	3
5I	1	0	1	11	2	0	0	0	0	1	4	0	0	0	0	1
5J	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5K	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
5L	7	1	0	8	10	2	0	0	0	2	2	8	0	0	1	2
5M	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1
6A	2	1	0	0	1	0	0	0	0	1	0	3	0	0	0	0
6B	1	2	0	0	1	1	0	0	2	2	3	3	0	0	0	0
6C	0	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0
6D	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
6E	1	3	0	1	4	2	0	9	1	0	0	0	0	0	0	1
6F	0	0	0	1	1	1	0	0	0	0	2	2	0	0	0	0
6G	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1
6H	0	0	0	1	3	0	0	0	0	0	1	0	0	0	0	3
6I	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
6J	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6K	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6L	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0
7A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
7B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7C	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	1
7D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7F	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
7G	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2

4.3.2 COMMON ERROR TYPES IN KOREAN

Table 4.4 lists the 17 common error types in Korean. Word medial syllable final consonant deletion and word medial syllable initial consonant deletion were differentiated for Korean. While affrication in English only referred to the substitution of a fricative consonant for an affricate consonant, affrication in Korean affected both stop and fricative consonants. Dentalisation in Korean refers to producing interdental fricative for alveolar fricative consonants. Distant and adjacent assimilations were differentially codified. Adjacent assimilation occurs at syllable boundary, as exemplified in Table 4.4.

Table 4.4. Common error types in Korean

Common error type	Description	Example
word medial syllable final consonant deletion (WMSFDEL)	consonant in word medial syllable final position is deleted	[o.s*.su] for /ok.s*u.su/
word medial syllable initial consonant deletion (WMSIDEL)	consonant in word medial syllable initial position is deleted	[mʌ.i] for /mʌ.li/
gliding of flap (GLIDEFLAP)	flap is realised as [j]	[ko.je] for /ko.le/
lateralisation of flap (LATFLAP)	flap is realised as [l]	[ho.laŋ.i] for /ho.laŋ.i/
stopping of flap (STOPFLAP)	flap is realised as [d]	[ho.daŋ.i] for /ho.laŋ.i/
stopping of fricative (STOP)	fricative consonant is realised as stop	[t*a] for /s*a/
affrication (AFF)	stop or fricative consonant is realised as affricate	[u.dzan] for /u.san/
deaffrication (DEAFF)	affricate consonant is realised as stop	[t^him.de] for /ts^him.de/
fronting (FRONT)	velar stop or nasal is realised as alveolar stop or nasal, respectively	[ho.ɾa.ni] for /ho.laŋ.i/
dentalisation (DENTAL)	alveolar fricative consonants are realised as interdental consonants	[θi.θo] for /si.so/
tensification (TENSE)	lax or aspirated segment is realised as tense segment	[p*it] for /pit/
laxing (LAX)	tense segments are laxed	[sa] for /s*a/
word final stop aspiration (WFASP)	word final stop is aspirated	[ts^hek^h] for /ts^hek/
word final consonant deletion (WFDEL)	word final consonant is deleted	[i.p*a] for /i.p*al/
word final vowel epenthesis (WFVOW)	vowel is inserted word finally	[k*o.di] for /k*ot/
distant assimilation (DISASS)	one sound is influenced by another at distance	[pip] for /pit/
adjacent assimilation (ADJASS)	assimilation at syllable boundary	[ham.mʌ.ni] for /hal.mʌ.ni/

Table 4.5 illustrates he frequency at which each Korean common error type was produced by individual children.

Table 4.5. Production of Korean common error types in Korean-English bilingual children

	WMSF DEL	WMSI DEL	GLIDE FLAP	LAT FLAP	STOP FLAP	STOP	AFF	DEAFF	FRONT	DENTAL	TENSE	LAX	WFASP	WFDEL	WFVOW	DISASS	ADJASS
3A	4	0	3	0	0	0	3	0	0	0	3	3	4	0	0	0	2
3B	0	0	0	0	2	1	0	0	0	0	0	3	0	1	0	1	0
3C	1	0	0	0	0	0	7	0	0	0	0	1	0	0	0	2	0
3D	0	1	0	0	0	0	0	0	0	0	6	0	3	1	0	0	1
3E	3	0	0	0	3	2	10	0	3	0	0	0	0	6	0	3	3
3F	2	2	0	0	0	0	3	0	0	0	2	0	0	0	0	4	2
3G	0	1	1	0	0	1	6	0	0	0	1	0	0	0	0	2	0
3H	1	2	0	0	0	0	2	0	0	0	2	1	0	1	0	1	2
3I	2	0	0	2	0	0	1	0	0	0	0	0	0	2	0	0	1
3J	2	1	0	1	0	0	0	0	0	0	2	2	4	0	0	0	2
3K	2	3	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0
3L	5	0	0	0	1	0	1	0	0	0	1	1	0	5	1	0	2
4A	1	0	0	0	0	1	0	1	0	5	1	1	0	1	0	0	2
4B	1	1	2	1	0	6	0	4	0	0	1	2	0	1	2	3	2
4C	2	4	1	1	0	0	0	0	0	0	3	0	2	1	0	0	3
4D	1	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	2
4E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4F	1	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0
4G	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
4H	0	0	0	3	0	4	2	0	0	0	0	0	1	0	0	0	1
5A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5B	2	0	0	1	0	0	0	0	0	0	2	0	0	1	0	0	1
5C	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
5D	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
5E	1	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0
5F	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0

	WMSF DEL	WMSI DEL	GLIDE FLAP	LAT FLAP	STOP FLAP	STOP	AFF	DEAFF	FRONT	DENTAL	TENSE	LAX	WFASP	WFDEL	WFVOW	DISASS	ADJASS
5G	0	0	0	2	0	0	0	0	0	0	1	1	2	0	0	2	0
5H	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5I	1	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	1
5J	0	0	0	0	0	1	1	0	0	0	0	1	0	0	0	0	0
5K	1	0	0	0	0	0	0	0	0	0	3	1	0	0	0	0	0
5L	0	0	0	2	0	6	3	3	0	0	0	0	0	0	3	0	2
5M	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
6A	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
6B	3	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	2
6C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6E	0	0	0	0	0	0	0	0	0	5	2	0	0	0	0	0	0
6F	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
6G	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
6H	1	0	0	4	0	0	0	0	0	0	0	1	0	0	0	0	0
6I	0	0	0	0	0	0	0	0	0	0	2	1	1	1	0	0	0
6J	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6K	0	0	0	2	0	0	0	0	0	0	1	1	1	1	0	0	1
6L	0	0	0	1	2	0	0	0	0	0	1	0	0	1	0	0	0
7A	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
7B	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
7C	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0
7D	1	1	0	0	0	1	0	0	0	0	2	0	0	1	0	0	0
7E	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0	0	0
7F	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
7G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

4.3.3 FACTORS

Figures 4.1 and 4.2 show the proportion of KEB children whose common error types were considered atypical, delayed, the same or advanced, compared to monolingual children in English and Korean, respectively. Note that some of the same codifications used in the current study and the monolingual studies refer to different types of error. For example, we separated stopping of fricatives and deaffrication (to stop) in Korean, whereas M. J. Kim (2006) used stopping of fricatives and affricates as a single codification. Therefore, deaffrication in KEB children was not considered 'atypical'. In cases such as the child 4H who produced stopping of fricatives and word final consonant deletion (Table 4.3), which are developmental error patterns in ME children typical until 2;5 and 3;5, respectively (Dodd et al., 2003; McIntosh & Dodd, 2008), these children were considered 'delayed'.

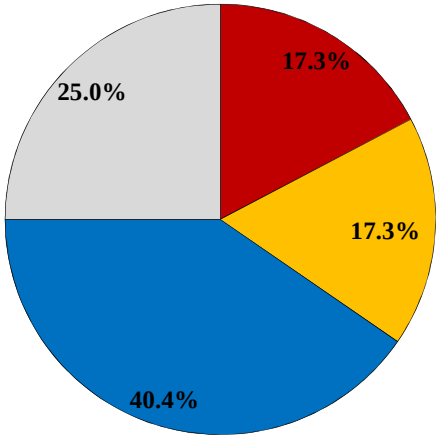

Figure 4.1. The proportion of Korean-English bilingual children whose common error types were atypical, delayed, the same or advanced, compared to monolingual English-speaking children

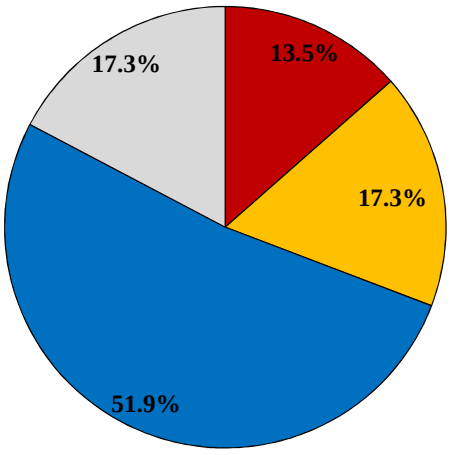

Figure 4.2. The proportion of Korean-English bilingual children whose common error types were atypical, delayed, the same or advanced, compared to monolingual Korean-speaking children

In English, there was a statistically significant difference in age among the four groups ($H = 31.933$, $p < 0.001$) but no difference in terms of gender ($\chi^2(3, N = 52) = 1.042$, $p = 0.791$), age of first English language exposure ($H = 6.514$, $p = 0.089$), the proportion of language exposure ($H = 6.314$, $p = 0.097$), mother's years of education ($H = 0.215$, $p = 0.975$), mother's age at the time of child's birth ($H = 2.034$, $p = 0.566$) and annual household income ($H = 1.787$, $p = 0.618$). In terms of the number of different contexts in which KEB children were exposed to each language, there was no difference in the number of Korean

language environments (H = 7.411, p = 0.060) but there was a statistically significant difference in the number of English language contexts (H = 8.391, p = 0.039). The mean age for each group is illustrated in Figure 4.3 and the mean number of English language contexts to which children were exposed is illustrated in Figure 4.4.

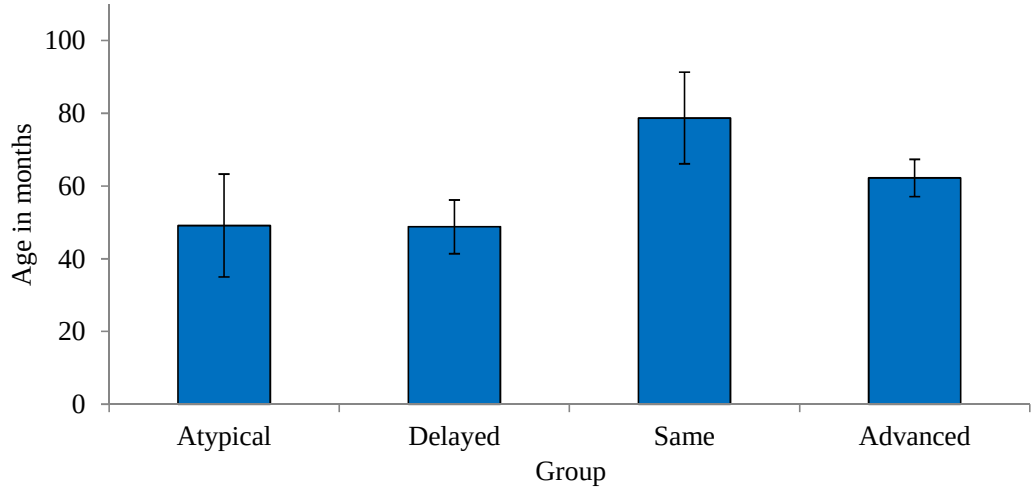

Figure 4.3. Group age means of Korean-English bilingual children whose production of common error types was atypical, delayed, the same and advanced compared with monolingual English-speaking children (error bars indicate standard deviations)

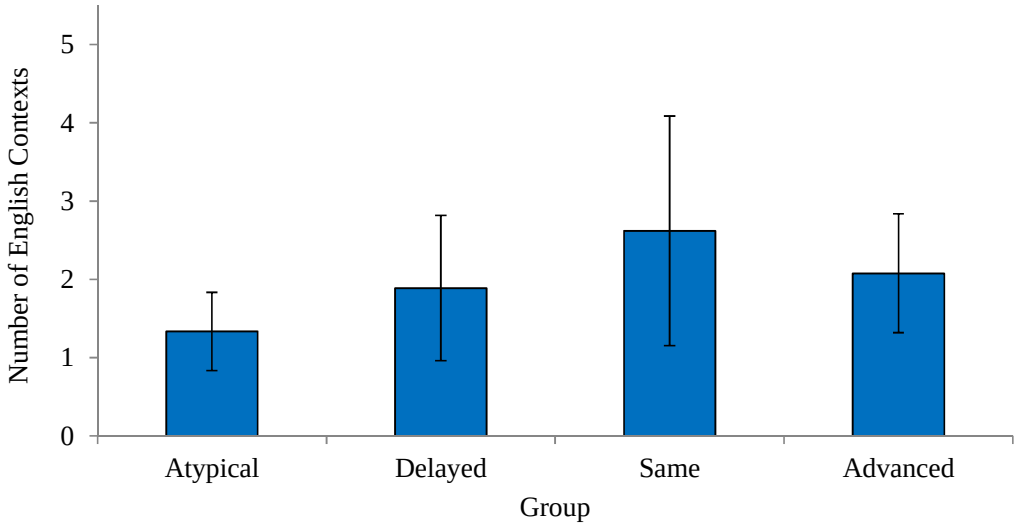

Figure 4.4. Mean number of different language contexts in which Korean-English bilingual were exposed to English by the four groups who produced atypical, delayed, the same and advanced common error types compared with monolingual English-speaking children (error bars indicate standard deviations)

The findings regarding the Korean common error types were largely the same as English. There was a statistically significant difference among four groups in age (H = 12.940, p = 0.005) but not gender ($\chi^2(3, N = 52) = 3.033$, p = 0.387), age of first English language

exposure (H = 4.342, p = 0.227), the proportion of language exposure (H = 3.003, p = 0.391), mother's years of education (H = 0.487, p = 0.922), mother's age at the time of child's birth (H = 4.720, p = 0.193) and annual household income (H = 1.431, p = 0.698). There was no statistically significant difference in the number of English language contexts (H = 6.889, p = 0.076) or in the number of Korean language contexts (H = 3.497, p = 0.321) among the four groups. Age by group is illustrated in Figure 4.5.

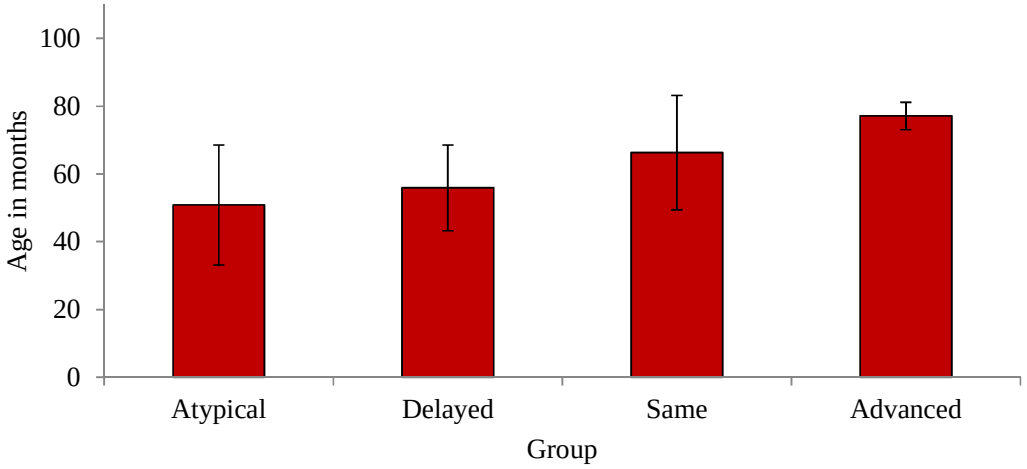

Figure 4.5. Group age means of Korean-English bilingual children whose production of common error types was atypical, delayed, the same and advanced compared with monolingual Korean-speaking children (error bars indicate standard deviations)

4.4 DISCUSSION

The type of errors produced by a child is considered the best criterion to determine whether the child's phonological development is typical or disordered (Dodd, 1995, 2005, 2014). Despite the increasing number of bilingual children, our understanding of error production in bilingual children is still limited. To identify bilingual children with a phonological disorder, speech-language therapists require information about their typical, developmental error patterns. To identify bilingual children with a phonological delay, speech-language therapists require information about the age at which each typical, developmental error pattern is expected to be resolved.

The research into bilingual phonological development thus far has mainly focused on whether the rates and patterns of phonological development in bilingual children are the same as or different from monolingual children (Hambly et al., 2013). The common error types produced by the KEB children and the comparison with the monolingual children in the current study suggest that such group comparisons may be inadequate in describing

phonological development in bilingual children (Figures 4.1 and 4.2). Our findings are discussed below.

4.4.1 'ATYPICAL' AND 'TYPICAL' COMMON ERROR TYPES

As Table 4.1 illustrated, opinions have been divided as to whether bilingual children produce 'atypical' error patterns. Some KEB children in the current study did produce 'atypical' error patterns, but these children were not the majority (17.3% and 15.4% of children in English and Korean, respectively). 'Atypical' common error types could be categorised into two groups; those that are cross-linguistic in nature (cross-linguistic) and those that cannot be easily explained by the interaction of the two phonological systems (ambiguous). Table 4.6 shows the categorisation of the common error types atypical of monolingual children in each language.

Table 4.6. 'Atypical' common error types in Korean-English bilingual children

	Cross-linguistic		Ambiguous
	Pattern	Feature	
English	Affrication	Word final vowel epenthesis	Word final consonant epenthesis
	Dentalisation	Cluster vowel epenthesis	Word initial consonant deletion
	Cluster reduction at syllable boundary*		
Korean		Word final stop aspiration	Word medial syllable initial consonant deletion
		Lateralisation of flap	
		Laxing	
		Word final vowel epenthesis	

* No children produced cluster reduction at syllable boundary more than three times.

Two subgroups of 'atypical' common error types that are cross-linguistic in nature can be identified. The first subgroup reflects developmental error patterns specific to one language in the other language, in terms of the surface-level speech errors. KEB children produced affrication and dentalisation in English (as well as in Korean), which are typical error patterns in MK children (M. J. Kim, 2006) but atypical in ME children (Dodd et al., 2003). Dentalisation in KEB children has significant clinical relevance and requires discussion. Only two children (4A and 6E) produced dentalisation in English. They are also the only two children to produce dentalisation in Korean. Interestingly, these two

children are siblings. It is not possible to speculate on whether the monolingual developmental error pattern was produced in only these two bilingual children because of external factors (e.g. age of English language acquisition, proportion of language exposure) or internal factors (i.e. genetics) at this stage. What makes dentalisation clinically relevant is the fact that the siblings consistently substituted alveolar fricatives for interdental fricatives irrespective of distribution and irrespective of the elicitation method (i.e. spontaneously or in imitation) in both languages. This is consistent with the description of articulation disorder (a phonetic disorder) as described in the Differential Diagnosis System (Dodd, 1995, 2005). It is possible that they have an articulation disorder, particularly because our findings are inconsistent with Anderson (2004) who reported production of dentalisation in four-year-old KEB children only in English but not in Korean. With currently limited knowledge in phonological development in KEB children, however, it may also be possible that our findings relating to dentalisation may reflect typical phonological development in at least some KEB children. If the latter is the case, then such KEB children may be misdiagnosed as having an articulation disorder. Although the current chapter cannot engage in further discussion about these two siblings, they were followed up twice at six-monthly intervals and will be discussed further in Chapter 5.

Unlike dentalisation, not all children who produced affrication in English produced affrication in Korean. Likewise, some children who produced affrication in Korean did not produce it in English. The previous chapter suggested that English /s/ and /ʃ/ could be problematic for KEB children, because these two segments are in complementary distribution in Korean. The previous chapter also found that /s/ and /ʃ/ were present in the English phonetic inventory of all three-year-old KEB children, except for one child (3E) (see Table 4.5). These erroneous productions could be due to developmental processes and cross-linguistic effects that operate simultaneously during phonological development in bilingual children (Gildersleeve-Neumann et al., 2008). In other words, the transient and inconsistent pattern of erroneous productions of English /s/ and /ʃ/ may reflect underspecified realisation rules of these speech sounds due to the presence of two phonological systems that are being reorganised (Gildersleeve-Neumann & Wright, 2010; Holm & Dodd, 1999b, 2006). Such reorganisation of phonological systems is likely manifested in /s/ and /ʃ/ (Gildersleeve-Neumann & Wright, 2010; Hulk & Müller, 2000), because these two segments must be organised into two separate phonemic categories in English but into a single phonemic category in Korean.

The second subgroup of 'atypical' common error types reflects influence of the phonological features of the other language. Cluster vowel epenthesis in English is one example. It reflects the influence of Korean phonology, which does not permit consonant clusters within a syllable. Word final stop aspiration in Korean reflects the influence of the realisation rules of the English word final stops. In parallel, word final obstruent devoicing is likely influenced by the realisation rules of the Korean word final stops which are always voiceless (Chapter 2). These erroneous productions of word final consonants in both languages reflect a characteristic of bilingual phonological development in which the realisation rules specific to one language are overgeneralised to production of the other language (Gildersleeve-Neumann & Wright, 2010; Holm & Dodd, 1999b). Lateralisation of flap and laxing in Korean are also cross-linguistic in nature, as they are likely influenced by the realisation rules of English. For example, English /l/ is always realised as lateral, whereas Korean /l/ is realised as either [l] or [ɾ]. It is likely that the English-specific realisation rule of /l/ has influenced the production of Korean /l/, leading KEB children to produce [l] for [ɾ] (Hulk & Müller, 2000; Nicoladis & Paradis, 2011). There is an alternative explanation for lateralisation of flap and laxing. Discussing phonological development in two Cantonese-English bilingual children, Holm and Dodd (1999b, p. 375) suggested that "the overgeneralisation of phonological rules appears to have occurred both across languages and within each language". It is difficult to separate out which common error types are due to a between-language process or a within-language process in the current study because only surface-level speech errors are being investigated. Nevertheless, both explanations support the suggestion that these 'atypical' errors in Korean are likely manifestations of cross-linguistic effects. That is, within-language overgeneralisation could occur because of the interactions with the phonological system of the other language.

Word final vowel epenthesis is one of the English loanword adaptation rules in the Korean language. Y. Kang (2003, p. 220) put forward that the vowel epenthesis in English loanwords is motivated by "the maximisation of the perceptual similarity between the English input and the Korean output". Word final vowel epenthesis in English, therefore, likely reflects the influence of the Korean phonology. It could be that the influence of Korean whose word final obstruents are always voiceless, unreleased and unaspirated is manifested in two ways in English; devoicing of word final voiced obstruents and word final vowel epenthesis. The former likely reflects realisation of English word final obstruents conforming to the realisation rules of Korean word final obstruents. The latter allows for the realisation of 'word final' obstruents as specified by English phonology,

including soft release/aspiration and voiced consonants (e.g. [dʌkʰɨ] for /dʌk/; [egɨ] for /eg/). Word final vowel epenthesis in Korean could be considered overgeneralisation of word final vowel epenthesis in English (Holm & Dodd, 1999).

As discussed in Chapter 3, it was not possible for us to recruit typically developing KEB children, because we do not have sufficient information about what constitutes the characteristics of typical phonological development in KEB children. While we cannot suggest definitively that the common error types discussed so far necessarily reflect typical phonological development in KEB children, why KEB children might produce such 'atypical' errors could be explained based on what we know about phonological development in ME and MK children and the features of English and Korean phonologies. The ambiguous common error types listed in Table 4.6 are more difficult to explain solely based on cross-linguistic interactions. Word medial syllable initial consonant deletion in Korean, for example, is not a typical, developmental error pattern in MK or in ME children and cannot be easily suggested to have been influenced by the features of English phonology. Word medial syllable *final* consonant deletion is a typical, developmental error pattern in MK children (M. J. Kim, 2006). Coupled with cluster reduction (within syllable) in English (Dodd et al., 2003), faulty overgeneralisation could have resulted in word medial syllable initial consonant deletion in Korean and cluster reduction at syllable boundary in English (Ellis, 2008; Holm & Dodd, 1999b). Word final consonant epenthesis and word initial consonant deletion in English are also difficult to explain. An explanation that accounts for word final consonant epenthesis could be postulated, considering the children who produced word final consonant epenthesis in the current study were exposed to English after Korean. Before they were exposed to English, their lexicon would have consisted of words with the maximal phonological structure of C_1VC_1 (consonant-vowel-consonant) consistent with the Korean phonology. The child's hypothesis about how a word is shaped has to be re-thought with the introduction of English that allows more than one consonant in word final position (Chapter 2). Having to differentiate and master different language-specific sets of constraints forces the child to re-evaluate the previous hypothesis and generate and refine new ones that are consistent with English (Holm & Dodd, 1999b). During this period of re-specifying the phonological systems, the child may derive false hypotheses about the phonological structure of English (e.g. C_1VC_1 for Korean and C_1VC_{n+1} for English) leading to word final consonant epenthesis (cf. Dodd et al., 1989). In addition, different sets of realisation rules, as well as phonotactic constraints, on word final position for each language may mean that the segments in word final position are

vulnerable (Müller, 2003) or fragile (Ellis, 2008; Goldin-Meadow, 1982) in the sense that they are prone to errors and difficult to master for KEB children. Note that there are several other common error types that are specifically related to word final position, including word final consonant deletion, word final obstruents devoicing and word final vowel epenthesis in KEB children in both of their languages (Tables 4.2 and 4.4). It should be considered, however, that these ambiguous common error types may be signs of atypical phonological development in KEB children. In particular, only one child (4B) produced word initial consonant deletion, for which no reasonable explanation can be offered. The child 4B obtained percentage of consonant correct scores of 48.20% and 68.04% in English and Korean, respectively, which were the lowest in her age group (see Table 3.4), although there were only three children in the age group to which 4B belongs. The child 3G, who produced word final consonant epenthesis, also obtained the lowest English PCC score in her age group. Further studies with a larger sample are required to investigate whether these two common error types constitute characteristics of typical phonological development in KEB children.

KEB children who produced such 'atypical' common error types were not the majority. The majority of KEB children produced the common error types expected of monolingual children of the same age group in both languages (Figures 4.1 and 4.2). Gliding of liquids in English, for example, reflects a developmental trajectory that would be expected in ME children. It is prevalent in younger children and the number of children who produced gliding of liquids decreased with age such that none of the six- and seven-year-old KEB children produced gliding of liquid, suggesting that the age of resolution may be comparable with ME children (Dodd et al., 2003). Stopping of fricatives in English also shows a similar developmental sequence, in which the common error type is progressively resolved with age, although the age of resolution of stopping of fricatives in KEB children appears to be much later than ME children. Other common error types typical of monolingual children seemed to be resolved much earlier. Weak syllable deletion in English was not identified as a common error type and none of the KEB children produced fronting of velar consonants more than three times. For most common error types, however, it is difficult to estimate the age of resolution. Affrication in Korean, for example, was produced by five three-year-old and one five-year-old KEB children, but none of the four-year-old KEB children. Scattered and intermittent distribution across the wide age range in the current study differs from previous monolingual studies in which the typical error patterns quantitatively and qualitatively decrease with age.

4.4.2 'DELAYED' COMMON ERROR TYPES

In the literature, it has been almost accepted and expected that bilingual children will be delayed, compared to their monolingual counterparts (e.g. Dodd et al., 1996; Goldstein & Gildersleeve-Neumann, 2007; So & Leung, 2006). For example, Dodd et al. (1996, p. 132) stated "delayed phonological acquisition is probably not surprising given the need to master two phonological systems in the preschool years and, perhaps proportionately less exposure to each language compared with monolingual children". In the current study, only 17.3% of KEB children were 'delayed' compared to monolingual children. However, what we defined as 'delay' compared to monolingual children in the current study does not necessarily suggest that those KEB children's acquisition of phonologies was slower than monolingual children. Consider the child 4H (aged 4;11), who produced word final consonant deletion and stopping of fricatives in English. These error patterns are typical till 2;11 and 3;5 in ME children, respectively (McIntosh & Dodd, 2008). According to Dodd et al. (2003), gliding of liquids, deaffrication and tri-cluster reduction are typically produced in ME children aged between 4;6 and 4;11. Although 4H was considered 'delayed' in our analysis, because the child produced common error types that are typical of ME children but expected at much younger age, this apparent 'delay' does not reflect quantitatively slower rates but reflects qualitative differences in phonological acquisition between bilingual and monolingual children. If 4H's phonological development was quantitatively delayed, then we would expect the child to produce gliding, deaffrication and cluster reduction as well as stopping and word final consonant deletion. Such findings are consistent with the argument made in the previous chapter that comparing bilingual children with monolingual children is likely to result in overgeneralised and reductive conclusions about bilingual phonological development in bilingual children.

4.4.3 FACTORS AND CONSIDERATIONS FOR FUTURE RESEARCH

Given the variations in KEB children (Figures 4.1 and 4.2), it is worth discussing whether there are factors influencing production of the 'atypical', 'delayed', 'same' or 'advanced' common error types. The current study can suggest that younger children are more *likely* to produce common error types deemed atypical of monolingual children in both of their languages and that children who are exposed to a fewer number of English language contexts are more *likely* to produce English common error types atypical of ME children. It is important to emphasise that these are only general trends (compare the mean ages of KEB children who produced 'atypical' common error types and those who produced

'delayed' common error types). When only English is considered (Figure 4.3), there does not seem to support the tentative claim that older bilingual children have advanced phonological skills than monolingual children (Goldstein & Bunta, 2012; Grech & Dodd, 2008). Our findings suggest that bilingual children's production of error types becomes comparable to monolingual children with age. In Korean, however, there is a trend for advanced phonological skills in older KEB children (Figure 4.5). This trend is attributed to dentalisation in six-year-old typically developing MK children (M. J. Kim, 2006), which was produced by only two KEB children. Nevertheless, it cannot be concluded that older bilingual children have more advanced phonological skills than monolingual children because six-year-old KEB children produced gliding of flap and word medial syllable final deletion, which are error patterns typically produced till 3;11 and 4;5 in MK children, respectively (M. J. Kim, 2006).

Language dominance, age of second language acquisition and phonological typology have been discussed as potential factors influencing types of error patterns in bilingual children. Firstly, we found no strong evidence that language dominance, as reflected in the proportion of language exposure (Paradis, 2001), was a significant factor in either language. The current study does not support the suggestion that 'atypical' error patterns are not produced in the dominant language or that the dominant language is less influenced by bilingualism (Lin & Johnson, 2010; So & Leung, 2006). There were eight children who produced 'atypical' common error types belonging to the pattern subgroup as illustrated in Table 4.6 (3B, 3E, 3G, 3K, 3L, 4A, 4D and 6E), all of whom were Korean dominant. However, these common error types were not produced in other sequential, Korean-dominant KEB children. In addition, the phonological features of Korean make it impossible to produce ME-specific error patterns in Korean, such as cluster reduction or weak syllable deletion.

There are two aspects to consider when interpreting the non-finding of language dominance as a significant factor in the current study. Morrow et al. (2014) found no relationship between the use of English at home and the children's phonological skills in English, if English was the non-dominant language of the parents. The majority of the KEB children in the current study were exposed to English in their home environment but to varying extents, with approximately half of parents reporting that they speak to their children in English sometimes or frequently (Figure 3.1). Although we did not directly measure the English language proficiency of their parents, Korean adults in New Zealand generally have poor English skills (Morris et al., 2007; H.-J. Park & Anglem, 2012) and

have even been identified as being least competent in everyday use of English among all ethnic groups in New Zealand (Statistics New Zealand, 2004). Exposure to non-dominant language at home environments may have little or no influence on production of error patterns in bilingual children, if the source of exposure to the non-dominant language is the parents who are not dominant in that language and therefore are not able to provide a robust model for bilingual children to learn and differentiate phonological systems (Hoff & Core, 2013; Hoff, Welsh, Place, & Ribot, 2014). In addition, the literature suggests that shared language experiences such as book reading are supportive of language development (Patterson, 2002; L. Song, Tamis-Lemonda, Yoshikawa, Kahana-Kalman, & Wu, 2012). Mere exposure may not impose significantly on learning phonemic contrasts and reorganisation of phonological systems (e.g. Best, McRoberts, & Sithole, 1988; Bosch & Sebastián-Gallés, 2003). Most KEB children were receiving secondary English language input at church or in group activities, such as soccer and swimming (see Chapter 3), in which they were likely passive participants than they were actively engaged in shared language experience. The proportion of language exposure obtained in the current study conflated qualitatively different properties of language exposure. This may be the reason why the number of different English language environments to which KEB children were exposed was a significant factor (Figure 4.4) but the KEB children who were delayed and advanced compared to ME children, appeared to be exposed to the same number of English language environments. Qualitative, rather than quantitative, approaches to language exposure in future studies may help explicate the discrepancies in the findings related to error production and language dominance in bilingual children.

Secondly, the age of English language exposure was not a significant factor in the current study. Our findings are largely in line with previous studies. Gildersleeve-Neumann et al. (2009) noted that phonological skills in sequential Spanish-English bilingual children were comparable to those in simultaneous bilingual children from a previous study (Goldstein & Washington, 2001). Comparing the error patterns produced by simultaneous Spanish-English bilingual children in Brice et al. (2009) and sequential Spanish-English bilingual children of the same age group in Prezas et al. (2014), no difference can be found. Thus far, there is little empirical evidence to support the claim that cross-linguistic effects may be more pronounced in sequential bilingual children (Goldstein & Gildersleeve-Neumann, 2007) because the second language phonology is established by initially superimposing onto (and therefore influenced to a greater extent by) the existing first language phonology (Watson, 1991; Wode, 1980). However, studies

examining the role of age of second language acquisition have had relatively small sample sizes or unbalanced sample sizes. Future studies with a larger sample size should consider age of second language acquisition in context with other external factors, such as the proportion of language exposure and language dominance, rather than examining its influence on error production in isolation.

Finally, the differences in phonological typology between the two languages to which bilingual children are exposed have been a topic of discussion in the literature as it relates to error productions (e.g. Dodd et al., 1996; Gildersleeve-Neumann et al., 2009; Holm & Dodd, 1999b, 2006; N. C. W. Law & So, 2006). The majority of 'atypical' common error types in the current study could be accounted for by interactions between English and Korean phonologies. In addition, it is likely that the features of Korean phonology have 'prevented' production of ME-specific error patterns, such as cluster reduction and weak syllable deletion, rather than external factors. In terms of relative complexity between two phonologies, Gildersleeve-Neumann et al. (2009) found that the Spanish vowel system was negatively affected by the more complex English vowel system in Spanish-English bilingual children. KEB children, however, appeared to experience more difficulty acquiring and mastering comparatively more complex aspects of phonologies, for example, consonant clusters and fricatives in English. Although the English vowel system could be argued to be more complex than the Korean vowel system, due to the phonemic lax-tense vowel contrast in English, KEB children did not produce more vowel errors than MK children. On the other hand, interaction with English phonology appeared to have negatively affected production of word final consonants in Korean. In terms of the number of and type of consonants permitted in word final position, English could be considered more complex than Korean. Nevertheless, the absence of a theoretically grounded metric to systematically compare the phonologies of two languages to which bilingual children are exposed is a challenge in explicating the role of phonological typology in error productions in bilingual children (N. C. W. Law & So, 2006). As such, it is not clear how *relative complexity* should be defined in a way that is meaningful and relevant to understanding error production in bilingual children.

Specifically pertaining to production of 'atypical' error patterns in bilingual children, Dodd et al. (1996, p. 134) suggested "… there is a cognitive mechanism that allows children to parse heard speech and derive an understanding of the constraints that limit how speech sounds may be combined to make up words in a particular language. When children are exposed to two languages where those constraints differ markedly… it could

be predicted that atypical error patterns might arise". The current study is in partial disagreement with their claim. Explanations that are solely based on typological differences between two phonological systems seem insufficient to account for why only some KEB bilingual children produce 'atypical' error patterns while others do not. Future studies could consider whether bilingual children who produce 'atypical' error patterns have a distinct profile of cognitive abilities compared to those who do not.

4.4.4 METHODOLOGICAL CHALLENGES AND CLINICAL IMPLICATIONS

Our three-stage error analysis identified 16 and 17 common error types for English and Korean, respectively. The number of common error types identified for each language in the current study is comparable to those identified in 40 Cantonese-English bilingual children aged between 2;2 and 5;7 in Holm and Dodd (2006) but considerably greater than reported in monolingual children (Dodd et al., 2003; M. J. Kim, 2006). This may reflect the greater degree of variation inherent in phonological development in bilingual children compared to that in monolingual children (Hambly et al., 2013). Consequently, true error patterns could not be identified in the current study. Dodd et al. (2003, p. 631) defined atypical error patterns as "error patterns not used by more than 10% of children of any age in the normative sample". If we applied the criterion used in Dodd et al. (2003) to the current study, it would suggest that 13 of the 16 common error types in English and 16 of the 17 common error types in Korean were atypical as framed within the Differential Diagnosis System. Of course, the current study was not a normative study and a much larger sample is required to identify typical, developmental error *patterns* in KEB children. However, there may be a methodological issue underlying the number of common error types identified in the current study, which may not be addressed simply with a larger sample size.

Error patterns have always been considered a clinically relevant descriptive device to represent the consistent and systematic discrepancies between adults' targets and the child's erroneous productions (Peña-Brooks & Hegde, 2000; Zhu & Dodd, 2006). In the current study and the previous studies listed in Table 4.1, the target productions against which bilingual children's erroneous productions were analysed were based on correct productions by monolingual speakers. However, most adult bilingual speakers, especially those who learn a second language after the age of six years, tend to have speech that is impressionistically different from adult monolingual speakers (Flege, Munro, & MacKay, 1995; Major, 1987, 2001; Piske, MacKay, & Flege, 2001; Scovel, 1988). According to

Munro (2008, p. 194), impressionistically different speech in adult bilingual speakers is "a common, normal aspect of late second language acquisition". Although considerably less research has been conducted in adult bilinguals who were exposed to both languages in early childhood, Piske et al. (2001) argued that no convincing evidence exists to suggest that adult bilinguals who were exposed to a second language early in childhood will produce monolingual-like speech. Some studies suggest that prolonged exposure to a second language can also lead to changes in speech production in bilingual adults' first language (e.g. Carlson, 1981; Tomaszczyk, 1980). This is not to say that no adult bilingual speakers can achieve monolingual-like speech (Bongaerts, Planken, & Schils, 1995). Whether adult bilingual speakers will have speech that is impressionistically different from monolingual speakers depends on a variety of factors, including age of second language acquisition and the extent of second language use (Hansen Edwards, 2008; Piske et al., 2001; Scovel, 1988). The differences in speech production between adult bilingual and monolingual speakers can be observed in voice onset times of stops, vowel durations, prosodic features and sound substitutions (Ioup, 2008; Zampini, 2008 for reviews). Although perception of differences between adult bilingual and monolingual speakers is influenced by both segmental and suprasegmental aspects of the first language, Flege (1981) argued that sound substitutions (i.e. mispronunciations), if present, are the most readily apparent speech characteristic in bilingual speakers. For example, native German speakers learning English as a second language often devoice English word final voiced stops (Eckman, 1977). Lombardi (2003) notes native Japanese speakers learning English tend to produce [t] for /θ/ in English, while native Russian speakers tend to produce [s] for /θ/. In the literature (Zampini, 2008), the 'mispronunciations' in second language learners are attributed to a systematic influence of first language phonology. English word final stop devoicing in native German speakers, for example, is likely influenced by devoicing of word final stops in German phonology.

If we accept that speech productions between bilingual and monolingual speakers are different, we should compare bilingual children's speech productions to bilingual adults' speech productions for error pattern analysis. This would require a comprehensive normative database of typical speech productions in adult KEB speakers. Given the considerable variations in typical speech productions in bilingual adults, which are influenced by multiple factors (Hansen Edwards, 2008; Piske et al., 2001), it is highly questionable as to whether a valid comparison with bilingual adults for error pattern analysis will ever be possible. For adult KEB speakers, some studies have already been

done. Studies which have reported on sound substitutions in adult English language learners observed that Koreans produced [s, d] for English interdental fricatives (Ioup, 2008) and devoiced word final voiced obstruents in English while producing word final voiceless obstruents accurately (Major & Faudree, 1996). The current study also found that KEB children substituted [d] for /ð/ and devoiced word final voiced consonants in English. Word final consonant devoicing found in adult Korean learners of English and KEB children is clearly cross-linguistic in nature. It is due to the systematic influence from Korean whose word final consonants are always realised as voiceless. It could not unequivocally be suggested, however, that word final obstruent devoicing in KEB children, as found in the current study, is truly developmental, because adult Korean learners of English produce the same type of errors. Of course, this is not to suggest that there are only two mutually exclusive types of error patterns in bilingual children; developmental and cross-linguistic. Some errors are likely both developmental and cross-linguistic in nature. One such example may be affrication in English in KEB children, as discussed earlier.

Without more comprehensive data on speech productions in both KEB children and adults, it is difficult to determine whether there are error patterns in bilingual children that arise solely from cross-linguistic effects, rather than developmental progression. If there are error patterns in KEB children that are cross-linguistic in nature and they do not necessarily reflect developmental progression, resolution of such errors may not be strictly associated with chronological age as found in monolingual studies (e.g. Dodd et al., 2003). If so, it will have a direct implication on how we diagnose phonological delay framed within the Differential Diagnosis System (Dodd, 1995, 2005) for bilingual children. As such, it has to be questioned whether such purely cross-linguistic errors are clinically relevant. Munro (2008) argued that the differences in speech characteristics between bilingual and monolingual speakers should not be considered inherently problematic but that we should accept such differences in adult bilingual speakers as a part of normal variation in human speech in a society that is increasingly becoming linguistically diverse. If certain types of 'mispronunciations' or error patterns in bilingual children result solely from cross-linguistic effects (but not developmental) and are therefore a typical characteristic of bilingual phonological development, then further studies are warranted to determine whether these errors should still be used as a clinically relevant descriptive device in phonological assessment and whether such errors should be targeted in therapy.

4.5 SUMMARY

The current study reported on common error types in 52 KEB children aged between 3;0 and 7;11. Reaffirming the argument put forward in the previous chapter, a comparison with monolingual children likely leads to reductive and overgeneralised conclusions about bilingual phonological development. The common error types produced by the KEB children could be categorised into developmental, cross-linguistic (pattern and feature) and ambiguous. Common error types that are deemed atypical in monolingual children were produced by some KEB children, possibly due to underspecification and faulty overgeneralisation of realisation rules resulting from reorganisation of phonological systems during this period. There is a need for future studies with a much larger sample size to identify typical, developmental and clinically relevant error patterns in KEB children.

5 FOLLOW-UPS

5.1 INTRODUCTION

Clinical application of the Differential Diagnosis System (Dodd, 2005) depends on the availability of information about typical, developmental error patterns and the age at which each error pattern is expected to be resolved. The majority of studies reporting on such information in monolingual children have used a cross-sectional design (e.g. Dodd et al., 2003; James, 2001b; M. J. Kim, 2006; Roberts et al., 1990; So & Dodd, 1995; Zhu & Dodd, 2000a). Cross-sectional studies typically involve a large number of children observed at one specific point in time and employ systematic data collection and analysis procedures applied to all children. With a sufficiently large sample of children who are representative of the population of interest, cross-sectional studies can provide valuable normative data essential in identifying children with SSD. In addition, the systematic methodology used in data collection and analysis procedures in cross-sectional studies allows for replication in research and a standardised assessment procedure in clinical practice (McLeod, 2013; Zhu & David, 2008). However, there are pitfalls associated with a cross-sectional design. There is an issue of ambiguity about the causal influence between variables observed in a cross-sectional design. Examination of factors influencing phonological skills can only be based on the retrospective accounts of the factors that have already influenced phonological skills before that specific point in time when the cross-sectional data are collected (Bryman, 2012; Zhu & David, 2008). Cross-sectional studies are also unable to measure developmental changes that occur over time and can overlook individual differences. Therefore, cross-sectional studies can only provide a probabilistic statement about phonological development (Dodd et al., 2003; Menn & Stoel-Gammon, 1995). That is, individual children may not necessarily follow the developmental trend revealed by cross-sectional studies (Stoel-Gammon & Dunn, 1985).

Speech-language therapists are encountering an increasing number of bilingual children with suspected SSD (American Speech-Language-Hearing Association, 2012; Roseberry-McKibbin et al., 2005; Speech Pathology Australia, 2002; Winter, 1999). Bilingual phonological development has received significant attention in research, as speech-language therapists require information about typical, developmental error patterns in different bilingual populations. The majority of studies in bilingual phonological development have also employed a cross-sectional design (see Table 4.1). While such studies have undoubtedly provided valuable information about phonological development

in bilingual children, they suffer from the pitfalls of a cross-sectional design. Zhu and David (2008) suggest the limited availability of bilingual samples poses an additional issue to cross-sectional studies in bilingual phonological development. Studies with a large sample size are rare in the field of bilingual phonological development. Bilinguals tend to be a minority population in English-speaking countries and sampling a large number of bilingual children in a way that is representative of the population is a significant challenge (Hambly et al., 2013). The heterogeneity of the bilingual population also makes it difficult to generate knowledge about typical performance expected for children with a specific set of variables from cross-sectional data with a small sample size (Zhu & David, 2008).

A longitudinal design may be able to counter the issues associated with a cross-sectional design. Longitudinal studies repeatedly sample usually a small number of children over a period of time and are therefore able to measure changes over time (Zhu & David, 2008). Recruitment of a small number of children can enable examination of individual differences that are often 'averaged out' in cross-sectional studies. McLeod (2013) suggested that such information made available in longitudinal studies could enhance the differential diagnosis of children with SSD and yield a better understanding of phonological development, which could be utilised in intervention strategies. Nevertheless, a longitudinal design still cannot directly address the causal relationships between variables. However, if a potentially significant independent variable can be identified at the first point of data collection, a longitudinal design can put researchers in a better position to deduce the effects of the variable on phonological development at subsequent points of data collection (Bryman, 2012). Therefore, longitudinal studies could be used to enhance our understanding of bilingual phonological development, since most studies thus far have employed a cross-sectional design. Below, we review the longitudinal studies in bilingual phonological development. As the type of errors produced in children is considered the best criterion to determine whether their phonological development is typical or disordered (Dodd, 2005, 2014), our review focuses on the studies reporting on error productions rather than those solely reporting on phonological skills.

5.1.1 LONGITUDINAL STUDIES IN BILINGUAL PHONOLOGICAL DEVELOPMENT

The majority of longitudinal studies in bilingual phonological development have focused on sequential bilingual children (Anderson, 2004; Gildersleeve-Neumann et al., 2009; Holm & Dodd, 1999b; Morrow et al., 2014). In all studies, English was the children's second language. The only longitudinal study not to focus specifically on sequential

bilingual children is Gildersleeve-Neumann et al. (2008). The number of participants varied from two (Holm & Dodd, 1999b) to 23 (Gildersleeve-Neumann et al., 2008) and the number of points of data collection varied from two (Gildersleeve-Neumann et al., 2008; Gildersleeve-Neumann et al., 2009) to ten (Holm & Dodd, 1999b).

Gildersleeve-Neumann et al. (2008) examined 23 Spanish-English bilingual children, grouped into those who were English-dominant (n = 20) and those who were considered balanced bilinguals (n = 3). Single word samples were collected twice; in the beginning and end of a preschool term (eight months apart). Only English was assessed. Across the two time points, the PCC and PVC scores increased, albeit only marginally. There was a greater variability in the changes in error productions. While some error patterns, such as word final consonant deletion, decreased in frequency, the frequencies of other error patterns remained almost the same or even increased eight months later in both groups of Spanish-English bilingual children. There were some tentative indications that language dominance was associated with the type of error patterns that increase in frequency. For example, glottal substitution, which is atypical of ME children, increased in frequency only in English-dominant bilingual children. Vocalisation, in which the liquid was realised as a vowel or glide, increased only in balanced bilingual children. However, no measures were taken to track the changes in external variables (e.g. proportion of language exposure and use) between the two points of data collection, limiting the interpretation of the influence of such factors on error production.

Gildersleeve-Neumann et al. (2009) assessed six three-year-old monolingual Spanish-speaking children and assessed their Spanish again after eight months of English language exposure. Unlike the previous study, Gildersleeve-Neumann et al. (2008), both the PCC and PVC scores decreased slightly in Spanish at the second point of data collection, although this difference was not statistically significant. Despite the quantitatively negligible changes across the two points of data collection, there were noticeable changes in error productions. Cluster reduction decreased in frequency in all children, while fronting showed no change. In other errors, individual variations were observed at the second point of data collection, with some children producing an error pattern less frequently and others producing it more frequently than the initial session.

Anderson (2004) followed five sequential bilingual children (various first languages) over five sessions conducted every one or two months. The number of sessions in which the individual bilingual children participated varied due to scheduling conflicts and participant attrition. Over the sessions, there were considerable fluctuations in their PCC

scores in both of their languages, with some children having a lower PCC score in the last session than their initial session in one of their languages. The frequency of occurrence of error patterns reportedly showed variability during the study, although the changes in error productions were not reported in detail.

Morrow et al. (2014) assessed 19 sequential bilingual children with various first languages, aged between 4;2 and 6;9, every six months for 24 months (five points of data collection), without any reported participant attrition. Only English was assessed. Similar to Gildersleeve-Neumann et al. (2008), PCC scores steadily increased over the five sessions. Percentage of occurrence of error patterns also decreased from the initial session to the last session. However, there were fluctuations in the percentage of occurrence across five sessions, rather than a steady decrease.

Holm and Dodd (1999b) conducted a longitudinal study with two sequential Cantonese-English bilingual children; a girl aged 2;3 and a boy aged 2;9 at the time of the initial session, which took place after the children had been exposed to English for three months. They were assessed every month for ten and eight sessions, respectively. Both their Cantonese and English were assessed. The PCC scores for both children in both languages increased over the sessions, although the Cantonese PCC scores of the boy remained unchanged for the first few sessions. The two children showed a different profile of error productions. For example, the girl produced word final consonant deletion and fronting in English (typical of ME children) but the boy did not. Both children produced error patterns deemed atypical in monolingual children in both of their languages. With prolonged exposure to English, production of 'atypical' as well as developmental error patterns became inconsistent and transient. The girl produced final consonant deletion in Cantonese at the first point of data collection, did not produce it during the second and third sessions but produced it again at fourth and fifth sessions. Holm and Dodd (1999) also noted that some error patterns *appeared* in both of their languages, which were not present in the previous sessions. For example, the girl began to produce affrication in English only at the seventh session and the boy began to produce initial consonant deletion in Cantonese at the fourth session. Although Holm and Dodd (1999) suggested that the emergence of 'atypical' error patterns coincided with when the children began to use English spontaneously, there were considerable differences in the age of emergence of such 'atypical' error patterns in both Cantonese and English for both children.

Although the longitudinal studies of error production in bilingual children in the current literature shed some light on the age-related changes in error production and potentially

significant factors to be examined with larger cross-sectional studies, some limitations are apparent. For the studies that only reported on error production in only one language, it is difficult to examine the cross-linguistic interactions between two phonological systems in both languages, particularly in the case of Morrow et al. (2014) in which the percentage of occurrence of error patterns in English was averaged out from the data obtained from 19 sequential bilingual children with various first languages. Descriptive statistics (e.g. means and standard deviations) used in Gildersleeve-Neumann et al. (2008) and Morrow et al. (2014) with relatively large sample sizes for a longitudinal study also had the risk of masking individual variations. A small sample size with detailed analyses that can reveal individual variations, however, has limited generalisability of the research findings (Bryman, 2012; Zhu & David, 2008).

5.1.2 THE CURRENT STUDY

The current chapter outlines a quasi-longitudinal study of error productions in 23 KEB children. We report on common error types (see Chapter 4) in both English and Korean from a heterogeneous sample in terms of age of second language acquisition, language dominance and chronological age. The PCC scores and common error types will be reported for individual children. The changes in their language environments during the course of the study will also be reported. The aim of the current study is to supplement the cross-sectional study presented in Chapter 4, by providing age-related changes in error productions in the context of changing language environments in the 23 KEB children.

5.2 METHODOLOGY

5.2.1 PARTICIPANTS

Parents of the 52 KEB children who participated in the studies outlined in Chapters 3 and 4 were invited to allow their child/children to participate in six-monthly follow-ups. Parents of 23 KEB children agreed to their participation in one follow-up session. Twelve children were seen for a second follow-up session (participant attrition rate of 47.8%). The duration between the points of data collection is greater than six months for most children, due to difficulties in arranging the follow-up sessions. Table 5.1 describes the characteristics of the 23 children. The participant code shown in Table 5.1 is consistent with the code for each child presented in Table 3.3.

Table 5.1.Characteristics of the participants

Participant	Gender	Birth Country (age of arrival)	Age of English exposure	Age		
				Time 1	Time 2	Time 3
3B	M	New Zealand	36	3;1	3;9	
3F	F	New Zealand	0	3;6	4;1	
3G	F	Korea (12)	41	3;7	4;1	
3K	M	New Zealand	0	3;11	5;3	
3L	F	New Zealand	27	3;11	4;7	5;5
4A	M	New Zealand	34	4;0	4;7	5;1
4B	F	Korea (7)	7	4;3	4;11	
4E	F	Korea (35)	46	4;8	5;4	5;10
4F	F	New Zealand	12	4;8	5;3	5;9
4G	M	New Zealand	0	4;11	5;7	6;1
4H	M	New Zealand	0	4;11	5;5	
5A	M	New Zealand	39	5;0	5;6	6;0
5E	F	New Zealand	0	5;3	5;9	
5F	F	New Zealand	34	5;5	6;1	6;9
5G	M	New Zealand	48	5;6	6;3	
5M	M	New Zealand	27	5;11	6;7	7;5
6A	M	Korea (17)	30	6;0	6;8	7;3
6C	M	New Zealand	42	6;1	6;8	
6D	M	New Zealand	42	6;2	6;9	
6E	M	New Zealand	18	6;3	6;10	7;4
6G	M	New Zealand	36	6;6	7;2	
6I	F	New Zealand	24	6;7	7;2	7;9
6J	M	New Zealand	0	6;9	7;5	7;11

All children in the study were exposed to the Korean language from birth, regardless of where they were born. For those who were born in South Korea, the age of arrival in New Zealand (in months) is given in parentheses in Table 5.1. At each point of data collection, parents were asked to describe their children's typical week, including the activities the children are engaged in and in which language the activities were conducted. Table 5.2 shows the proportion of language exposure, calculated by the total hours of Korean language exposure divided by the total hours of English language exposure in a child's typical week (Goldstein et al., 2010) and the number of English and Korean language environments to which each child was exposed.

Table 5.2. Proportion of language exposure and the number of different language environments to which children were exposed

	Proportion of language exposure			Number of English environments			Number of Korean environments		
	Time 1	Time 2	Time 3	Time 1	Time 2	Time 3	Time 1	Time 2	Time 3
3B	7.17	3.64		1	2		1	5	
3F	3.09	2.39		2	3		2	1	
3G	4.06	1.02		2	1		5	2	
3K	2.28	1.16		2	4		3	4	
3L	2.16	3.05	2.06	2	4	3	4	5	5
4A	1.33	2.27	0.46	1	1	3	1	3	3
4B	4.83	2.06		1	1		2	2	
4E	5.05	1.61	1.17	1	2	3	6	5	2
4F	1.77	2.03	1.65	2	1	2	3	2	4
4G	1.03	0.86	0.56	2	2	4	5	4	4
4H	2.50	1.97		1	1		3	5	
5A	2.03	2.16	0.52	1	2	3	2	4	4
5E	0.70	0.51		3	5		3	2	
5F	1.65	1.00	1.67	3	4	3	4	3	4
5G	1.11	1.11		2	2		1	1	
5M	1.86	1.77	1.97	3	4	3	4	5	6
6A	2.27	2.00	2.03	1	1	1	6	6	5
6C	1.88	1.97		3	3		3	2	
6D	1.67	1.07		3	3		4	5	
6E	1.33	2.27	0.73	1	1	4	1	3	4
6G	1.71	1.65		5	3		4	5	
6I	1.18	1.58	1.58	2	5	2	3	1	1
6J	0.86	1.33	0.49	2	3	4	4	5	5

5.2.2 DATA COLLECTION AND ANALYSIS

Data collection procedures in the follow-up sessions were identical to the procedure outlined in the previous chapters. That is, each child completed the phonology subtest of the DEAP (Dodd et al., 2002) and the APAC (M. J. Kim et al., 2007) to obtain single word samples in English and Korean, respectively. In each session, children chose which language to complete first. Imitated responses were elicited if (1) the child indicated that he or she did not know the target word, (2) no response was given after five seconds had elapsed or (3) the child provided a wrong name and did not self-correct (e.g. lion for tiger). Children's responses were audio-recorded using a digital voice recorder.

Single word samples collected at each time point were phonetically transcribed and subjected to relational phonological analyses to obtain percentage of consonants correct and common error types for each language. The methods outlined in Chapter 3 and Chapter 4 were employed for percentage of consonants correct and common error types, respectively.

5.3 RESULTS

The PCC scores and common error types for individual children for each session are presented here. The findings in English are presented first. The English PCC scores obtained for each session for each child are shown in Table 5.3 below. For the majority of children the English PCC scores increased from the initial to the final session. Six children showed fluctuations in the PCC scores across the sessions (4F, 4G, 5F, 5M, 6E and 6J), but the differences in the PCC scores only ranged from 0.71 to 4.26.

Table 5.3. Percentage of consonants correct in English

	3;0-3;5	3;6-3;11	4;0-4;5	4;6-4;11	5;0-5;5	5;6-5;11	6;0-6;5	6;6-6;11	7;0-7;5	7;6-7;11
3B	68.79	78.01								
3F		78.01	82.98							
3G		57.45	68.79							
3K		84.40			92.20					
3L		63.83		81.56	83.69					
4A			81.56	88.65	92.25					
4B			48.20	60.99						
4E				90.78	92.20	97.16				
4F				86.52	96.45	95.04				
4G				99.29	95.04		99.30			
4H				74.47	89.43					
5A					97.16	99.29	99.30			
5E					95.74	97.16				
5F					97.87		97.16	97.87		
5G						78.72	83.69			
5M						97.87		100	99.29	
6A							96.45	99.29	99.29	
6C							96.45	97.87		
6D							97.16	99.29		
6E							85.82	97.87	95.07	
6G								97.87	100	
6I								97.89	100	100
6J								100	100	98.59

Table 5.4 shows the English common error types produced by each child in each session. The codifications correspond to the common error types identified in Table 4.2. The codifications with an asterisk represent the common error types produced five times or more and those without an asterisk represent the common error types produced more than three times but fewer than five times by each child. When the three-stage analysis for error (see Chapter 4) was conducted, three additional common error types were identified from the data collected in the follow-up sessions. One child produced palatalisation (PAL), in which /s/ was erroneously produced as [ʃ] (3G). One child produced deaffrication (DEAFF), in which affricate consonants were realised as alveolar stops (4B). Three children erroneously produced [s] for /θ/ (3B, 4E and 4H). However, none of these children produced them five times or more. For most children, the number of common error types that were produced decreased in the follow-up sessions, except for one child (4B). In addition, seven children produced at least one common error type in the follow-up session, which was not produced in the initial session.

Table 5.4. Production of English common error types in each session

	3;0-3;5	3;6-3;11	4;0-4;5	4;6-4;11	5;0-5;5	5;6-5;11	6;0-6;5	6;6-6;11	7;0-7;5	7;6-7;11
3B	CR*, GLIDE, STOP*, AFF*, DEPAL*, WFDEV*	CR*, GLIDE, STOP*, AFF, DEPAL, [s] for /θ/								
3F		GLIDE*, STOP*, WFDEL, WFVOW*	GLIDE*							
3G		CR*, CVE, GLIDE*, STOP*, AFF*, DEPAL, WFDEV, WFCON*	CR*, CVE*, GLIDE, STOP*, WFDEV, PAL							
3K		CR, CVE, STOP*, AFF, WFDEL			STOP, [f] for /θ/					
3L		CR*, CRSB, GLIDE*, STOP*, WFDEL		CR*, CVE, GLIDE*, STOP	CR*, GLIDE*, STOP					
4A			CR, STOP, DENTAL*, WFDEV*, WFDEL, WFCON	CR, STOP	CR					
4B			CR*, STOP*, WFDEL*, WIDEL*	CR*, CVE*, GLIDE*, STOP*, AFF, DEAFF, WFDEL*						
4E				CVE, STOP	GLIDE, [s] for /θ/	CVE				
4F				CR, GLIDE*, STOP	STOP	STOP				
4G										
4H				STOP*, WFDEL*	DEPAL, [s] for /θ/					

	3;0-3;5	3;6-3;11	4;0-4;5	4;6-4;11	5;0-5;5	5;6-5;11	6;0-6;5	6;6-6;11	7;0-7;5	7;6-7;11
5A										
5E										
5F										
5G						CR, GLIDE*, STOP	GLIDE*, STOP*			
5M										
6A							WFVOW			
6C										
6D										
6E							CVE, STOP, DENTAL*		WFDEV	
6G										
6I										
6J										

Table 5.5 below shows the Korean PCC scores in Korean each session for each child. Compared to the English PCC scores, there were more individual variations in the Korean PCC scores. In more than half of the children, the PCC score decreased in at least one follow-up session. The PCC score decreased by almost 5% in one child (5G) and 6J's PCC scores decreased in every follow-up session from 100% to 97.03%.

Table 5.5. Percentage of consonants correct in Korean

	3;0-3;5	3;6-3;11	4;0-4;5	4;6-4;11	5;0-5;5	5;6-5;11	6;0-6;5	6;6-6;11	7;0-7;5	7;6-7;11
3B	86.67	96.04								
3F		83.33	86.14							
3G		89.11	94.06							
3K		89.11			93.07					
3L		76.24		88.12	87.13					
4A			86.14	93.07	97.03					
4B			68.04	74.26						
4E				99.01	100	100				
4F				95.05	93.07	99.01				
4G				96.04	97.03		96.04			
4H				89.11	99.01					
5A					100	100	97.03			
5E					95.96	94.06				
5F					97.03		100	98.02		
5G						91.09	86.14			
5M						97.03		100	100	
6A							99.01	98.02	98.02	
6C							100	97.03		
6D							100	100		
6E							93.07	99.01	98.02	
6G								100	100	
6I								93.81	98.02	96.04
6J								100	98.02	97.03

Table 5.6 shows the Korean common error types produced by each child in each session. The codifications correspond to the common error types identified in Table 4.4. The codifications with and without an asterisk bear the same meaning as Table 5.4. One additional common error type was identified in a follow-up session; palatalisation (PAL), in which the lax alveolar fricative was realised as its palatal variant (3G). Six of the children who produced at least one common error type in the initial session produced at least one common error type in the follow-up session that was *not* produced in the initial session

(3B, 3F, 3G, 3K, 4A and 4B). Four of the children who did not produce any common error types produced at least one common error type in the follow-up session (4F, 4G, 5G and 6C).

Table 5.6. Production of Korean common error types in each session

	3;0-3;5	3;6-3;11	4;0-4;5	4;6-4;11	5;0-5;5	5;6-5;11	6;0-6;5	6;6-6;11	7;0-7;5	7;6-7;11
3B	LAX	LATFLAP								
3F		AFF, DISASS	TENSE							
3G		AFF*	PAL							
3K		WMSIDEL			WFASP					
3L		WMSFDEL*, WFDEL*								
4A			DENTAL*	ADJASS						
4B			STOP*, DEAFF, DISASS	STOP, DEAFF*, WFDEL						
4E										
4F					WFASP*					
4G							TENSE			
4H				ADJASS, STOP, LATFLAP						
5A										
5E										
5F										
5G							WFASP, DISASS			
5M										
6A										
6C								TENSE		
6D										
6E							DENTAL*			
6G										
6I										
6J										

5.4 DISCUSSION

The Differential Diagnosis System of SSD suggests that the type of errors a child produces should be the best criterion to determine whether the child's phonological development is typical, delayed or disordered (Dodd, 2005, 2014). Clinical application of the Differential Diagnosis System for bilingual children has been a significant challenge because of a lack of large-scale cross-sectional studies from which to obtain normative information. The previous chapter outlined a cross-sectional study reporting on common error types in 52 KEB children aged between 3;0 and 7;11. To identify KEB children with a phonological disorder, speech-language therapist require information about their typical, development error pattern. To identify KEB children with a phonological delay, speech-language therapists require information about the age at which each typical, developmental error pattern is expected to be resolved. The relatively small size of the cross-sectional study outlined in the previous chapter made it difficult to provide normative information about typical, developmental error patterns and the age at which each error pattern is expected to be resolved. The aim of the current study was to supplement the cross-sectional study by employing a longitudinal design that can enhance clinically relevant knowledge of characteristics that constitute typical development (McLeod, 2013), reveal individual differences and describe age-related/developmental changes (Bryman, 2012; Zhu & David, 2008). Below, we discuss our findings and their clinical implications for assessing KEB children with suspected SSD in clinical practice.

5.4.1 CHILDREN WITH SUSPECTED SPEECH SOUND DISORDERS

A lack of available information about the characteristics that constitute typical phonological development in KEB children has meant that recruiting typically developing KEB children who did not have SSD could not be assured. Of the children in the current study were those from the previous cross-sectional study whose profile of common error types raised concerns about whether they did have an SSD. Two of those children were 4A and 6E, the siblings who produced dentalisation. At the first point of data collection, these two children were substituting [θ] for /s/, irrespective of distribution and elicitation method (spontaneously and in imitation). This is a description consistent with a phonetically based articulation disorder framed with the Differential Diagnosis System (Dodd, 2005). At the subsequent points of data collection, which took place seven and 13 months after the initial session, neither child produced dentalisation. There are two possible accounts for the

resolution of dentalisation. The first is that they did have an articulation disorder at the first point of data collection which subsequently resolved with spontaneous recovery. However, given the lack of evidence for spontaneous recovery of an articulation disorder (cf. Culton, 1986), it seems unlikely that both children spontaneously recovered from an articulation disorder at the same time. The other more plausible explanation is that dentalisation is a characteristic of typical phonological development in KEB children. Dentalisation is a typical, developmental error pattern in monolingual Korean-speaking (MK) children (M. J. Kim, 2006). The previous cross-sectional study found that such Korean-specific error patterns could be produced in English as well as in Korean in KEB children (Table 4.6). These findings add weight to the suggestion that production of dentalisation, which resembles an articulation disorder in monolingual children, could reflect typical phonological development, rather than an SSD, in KEB children.

The other child whose profile of common error types raised concerns about phonological disorder from the cross-sectional study was 4B. At the first point of data collection, at the age of 4;3, she consistently deleted singletons and consonant clusters in word initial position in English and was the only KEB child to do so. Solely based on the phonological features of English and Korean and developmental error patterns in the monolingual children, word initial singleton/cluster deletion could not be explained. None of the follow-up sessions from three-year-old KEB children revealed word initial singleton/cluster deletion at the age of four years. At the second point of data collection (at the age of 4;11), 4B no longer deleted word initial singletons and cluster reductions. As Table 5.4 shows, 4B produced a greater number of common error types at the second point of data collection than the first. When 4B began producing word initial singletons and consonant clusters, albeit erroneously, those erroneous productions were analysed, resulting in a greater number of common error types. At the second point of data collection, she produced affrication and deaffrication in English and word final consonant deletion in Korean, albeit fewer than five times. Based on both the cross-sectional study and the current longitudinal study, no KEB children aged four years or older produced affrication and deaffrication in English or word final consonant deletion in Korean. Compared to the other children of the same six-month age band (4;6-4;11), 4B's PCC scores were the lowest in her age group in the current study and were more than 20 points lower than the age group mean PCC scores obtained from the cross-sectional study (Table 3.4) in both languages. Such a 'unique' profile of phonological skills and error productions suggests that her phonological development may be atypical. Previous research suggested that

bilingual children with SSD should have symptoms of disorder in both of their languages (Dodd, Holm, & Li, 1997; Holm & Dodd, 1999a). *If* 4B's error profile reflects SSD and *if* the other KEB children in the doctoral research (including the previous chapters) are typically developing, then this previous claim might need to be reconsidered, because all Korean common error types 4B produced were produced by at least one other child in the cross-sectional (Chapter 4) and the current study.

5.4.2 INDIVIDUAL DIFFERENCES

One of the advantages of employing a longitudinal design with a relatively small sample is its ability to reveal individual variations that are often masked in a cross-sectional design with a large sample size. In the current study, most age-matched KEB children did not follow the same developmental trajectory in terms of the type of errors they produced, revealing considerable individual variations. Consider 4E and 4F, who were first seen when they were aged 4;8 and followed up at a similar interval. These two children showed different profiles of common error types across three sessions in both languages. The same finding applies to other age-matched children, including 3F and 3G; 3K and 3L; 4G and 4H. The profiles of common error types in 6A, 6C, 6D and 6E are also interesting to discuss as the ages of these four children are similar but they have different language backgrounds. The previous cross-sectional study identified chronological age and the number of language environments to which children are exposed as potentially significant factors associated with the type of error produced in KEB children. These two factors alone cannot easily explain why these KEB children with similar ages are different in terms of the common error types they produced in both languages across different points of data collection. It could be suggested that the external factors investigated in previous research, such as the proportion of language exposure (Goldstein et al., 2010) and language dominance (N. C. W. Law & So, 2006), may not be adequate in quantifying the language environments of bilingual children in a way that can account for the individual variations in their phonological development. In addition, age-matched children who were similar in terms of the proportion of language exposure and the number of language exposures, who showed different profiles of common error types, tended to differ in terms of the age of English language acquisition (e.g. 6A, 6C, 6D and 6E). Note that the previous two chapters did not find age of English language acquisition to be a significant factor associated with phonological skills or error productions. It could suggest that age of language acquisition

should be examined further and more systematically in future studies with a much larger sample size.

5.4.3 AGE-RELATED CHANGES

The Differential Diagnosis System (Dodd, 2005), which considers error patterns to be the best criterion to determine whether a child's phonological development is typical, delayed or disordered, implicitly assumes that there is a set of error patterns produced by typically developing children and that those error patterns are progressively resolved with age. Cross-sectional studies with monolingual children (including speakers of languages other than English) have shown that this assumption generally holds true (Dodd et al., 2003; James, 2001b; M. J. Kim, 2006; Roberts et al., 1990; So & Dodd, 1995; Zhu & Dodd, 2000a). Cross-sectional studies, however, can only offer a probabilistic statement of phonological development, because sampling occurs only once for individual children at one specific point in time in their development. Longitudinal studies of young monolingual children have shown and discussed extensively that the developmental sequence is not linear and that regression or U-shaped learning in phonological development occurs in typically developing children (Becker & Tessier, 2011; Bernhardt & Stemberger, 1998; Bleile & Tomblin, 1991; Stemberger, Bernhardt, & Johnson, 1999). It is well recognised that regression is not a loss of skill but reflects reorganisation of the phonological system (Werker, Hall, & Fais, 2004). If a typically developing child does not follow the developmental trend in resolution of error patterns based on a cross-sectional study used to derive normative data for clinical purposes, then sensitivity and specificity of the Differential Diagnosis System, based solely on normative data derived from cross-sectional studies should be questioned. Sensitivity and specificity of the Differential Diagnosis System have not surfaced as a significantly problematic issue at least for monolingual children. Recently, however, Waring and Knight (2013) pointed out that there is a lack of evidence for sensitivity and specificity of the Differential Diagnosis System.

The findings of the current study suggest that sensitivity and specificity of the Differential Diagnosis System could be a genuine clinical issue for bilingual children, if the normative data used for clinical purposes is solely based on cross-sectional studies. The current study suggests that an error pattern could emerge during the course of development and such a phenomenon is not rare. Holm and Dodd (1999b) also found that error patterns atypical of monolingual children appeared in young sequential bilingual

children and suggested that the appearance of such error patterns coincided with when the children began to use English spontaneously. However, we found that emergence of common error types in KEB children was not necessarily associated with the age of exposure or of spontaneous use of English or Korean. In addition, although individual variations and regressions in phonological development have been discussed with young children, emergence of common error types was observed even in older bilingual children in the current study. Emergence, rather than resolution, of common error types with age and/or in response to changing language environments can be considered regression in their phonological development. Regression, reflecting reorganisation in the phonological system, may be more common in bilingual children than in monolingual children, because reorganisation in bilingual children involves both within-language and between-language specification of phonemes and their realisation rules. This means that cross-sectional studies which can only provide a probabilistic age range at which certain error patterns are expected to be resolved may not be adequate in capturing the typical developmental sequence in bilingual children in a way that is clinically meaningful.

5.4.4 CLINICAL IMPLICATIONS AND FUTURE RESEARCH DIRECTIONS

The aim of the current study was to supplement the findings of the cross-sectional study presented in Chapter 4 by following up 23 of those who participated in the cross-sectional study. In many ways, the longitudinal data from the current study added clinically significant information to the cross-sectional data. Speech-language therapists find it a challenge to accurately identify bilingual children with SSD, due to a lack of bilingual-specific information about the characteristics that constitute their typical phonological development. Even with cross-sectional data with 52 KEB children, there were some children whose typicality of phonological development was questioned (4A, 4B and 6E). Speech-language therapists may also encounter such bilingual children for whom cross-sectional studies are already available. Follow-up sessions may be useful for speech-language therapists in making clinical decision as to whether treatment should be provided or not. The PCC scores were not sensitive to changes in common error types across follow-up sessions, as previously suggested in Holm and Dodd (1999b). However, in the case of 4B, the information about her PCC scores, as well as about the common error types she produced, were useful in considering whether her phonological development was typical or not.

Even with pitfalls, a large-scale cross-sectional study is still useful and in need. The current study identified additional common error types (palatalisation, deaffrication and producing [s] for /θ/), which were not identified in the cross-sectional study. Palatalisation, in particular, was produced by some children in the cross-sectional study but no child produced palatalisation more than three times and was therefore considered sporadic rather than a common error type. A cross-sectional study with a much larger sample size could help identify typical error patterns in KEB children, which will facilitate identification with KEB children with phonological disorder. However, even with such a study, identifying KEB children with phonology delay is likely to still remain a challenge. If an already 'resolved' error pattern re-emerges at an older age, then it is difficult to define the age of resolution in a way that is clinically relevant. A series of controlled, prospective longitudinal studies may be able to provide more detailed and clinically relevant information about the changes in error production in bilingual children in a way that can enhance our understanding of when typical error patterns should be resolved.

There are three specific issues that future studies should address. The first is *how* the Differential Diagnosis System should be applied to bilingual children in clinical practice. The current study already suggested that dentalisation, which is consistent with the description of the phonetically based articulation disorder framed within the Differential Diagnosis System (Dodd, 2005), may be a typical error pattern in KEB children. Regression or emergence of error patterns, which appears to be a characteristic of typical phonological development in KEB children, may reduce the sensitivity of the Differential Diagnosis System by putting typically developing KEB children at an increased risk of being misdiagnosed with phonological delay. The second is whether the error patterns that emerge with age and/or in response to the changing language environments should necessarily reflect typical error patterns. If (1) regression is a reflection of reorganisation of phonological system(s), (2) re-emergence of error patterns reflects regression and (3) reorganisation of phonological systems in bilingual children necessarily occurs during development, then there does not seem to be a reason to suggest that error patterns indicative of SSD in bilingual children should re-emerge during the course of development. The third is whether there are error patterns that are clinically relevant in identifying bilingual children with SSD and whether there are error patterns that are solely cross-linguistic rather than developmental. This possibility was raised in the cross-sectional study (Chapter 4). We brought attention to adult second language learners and word final devoicing errors produced by Korean adults in English words (Major & Faudree, 1996).

Devoicing of word final voiced consonants was only identified as an English common error type in the third session at the age of 7;4 in 6E. Word final stop aspiration and tensification in Korean were the common error types that were most frequently observed as emerging in follow-up sessions, all of which have clear cross-linguistic bases. It is worth considering whether the presence of such error patterns signifies a disorder and whether speech-language therapists should target such error patterns in treatment in the future studies.

6 PARENT-RATED MEASURES[1]

6.1 INTRODUCTION

SSD is one of the most common developmental disorders in childhood (J. Law et al., 2000b). Children with SSD display a clinically significant deviation from typical speech sound development which is not accounted for by an impairment in sensory, motor or structural functions (Flipsen et al., 2013; Shriberg, 1980). Many children with SSD experience long-term adverse consequences, which can have a negative effect on education and academic attainment (Bird et al., 1995; Larrivee & Catts, 1999; Leitão & Fletcher, 2004; Lewis et al., 2000, 2002; McCormack et al., 2009). Furthermore, Felsenfeld and colleagues suggested that children with a history of SSD continue to experience adverse consequences into adulthood (Felsenfeld, Broen, & McGue, 1992; 1994). Speech-language therapy interventions can be effective in managing children with SSD, thereby minimising the long-term consequences (Almost & Rosenbaum, 1998; Broomfield & Dodd, 2005, 2011; Crosbie et al., 2005; Gierut, 1998; J. Law et al., 2010).

McLeod et al. (2013) recently reported that a significant number of pre-school children with SSD in the community are not being identified by speech-language therapy services. Such children are at risk of experiencing significant education or academic challenges, especially as the demand on literacy increases throughout the school years. The situation appears to be worse for bilingual children. Although there is no evidence to suggest that the prevalence of SSD is any higher or lower in bilingual children (Goldstein & McLeod, 2012; Hambly et al., 2013; Winter, 2001), Stow and Dodd (2005) reported that bilingual children are much less likely to be referred to clinical services with concerns regarding their speech than monolingual children. The issue of possible under-representation of bilingual children in speech-language therapy services has been discussed in the literature and has gained more attention in recent years (International Expert Panel on Multilingual Children's Speech, 2012; Stow & Dodd, 2003; Winter, 2001). While there have been major publicity campaigns to raise public awareness of communication disorders in children, for example, the Identify the Signs campaign (American Speech-Language-Hearing Association, 2014) and the Raise Awareness of Language Learning Impairments (RALLI) campaign (Bishop et al., 2012), such programmes tend to be conducted in English and may

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fail to reach bilingual communities (Stow & Dodd, 2005). Therefore, the public awareness of SSD and the associated long-term consequences may be lower in the bilingual community of English-speaking countries. Parents, being one of the major sources of referral to speech-language therapy services, are unlikely to seek appropriate services for SSD if they lack awareness and knowledge of them.

One way to address this issue is to implement a universal speech screen to all children in a population to identify those who require further clinical assessment. The justifications for a universal speech screen already exist, including the high prevalence rate, the adverse long-term consequences and the positive research evidence for the effectiveness of speech-language therapy interventions for children with SSD. If a universal speech screen were to be implemented, then it must be done in a way that meets the needs of bilingual children as well as monolingual children. The under-representation of bilingual children in speech-language therapy services emphasises the need for a universal speech screen to be inclusive of bilingual children. As yet, there is no universally accepted measure of a speech screen (J. Law et al., 2000a; Nelson et al., 2006). One approach that is worth considering is to use parental report of their child's speech to identify those who require full, comprehensive clinical assessment by a speech-language therapist. Targeting parents, rather than teachers, may need to be considered for bilingual children, because a previous research (Bedore et al., 2011) suggests parents, rather than teachers, can report on both languages of their bilingual children. There is a growing body of literature to suggest that parental report can be used in a speech screen. McLeod et al. (2012a) developed the Intelligibility in Context Scale (ICS), based on the International Classification of Functioning, Disability and Health - Children and Youth (ICF-CY) (World Health Organization, 2007), as a parent-rated measure of children's intelligibility. Parents are asked to rate how much of their child's speech was understood by different people over the previous month on a five-point Likert scale (Table 6.1). McLeod et al. (2013) found that parental ratings on items 1, 2, 3 and 7 were statistically significantly different between children with and without SSD. The ICS mean score is calculated by averaging the ratings on all seven items. McLeod, Harrison, and McCormack (2012b) found a statistically significant difference in the ICS mean scores between children whose parents or teachers expressed concerns about their speech and those without any concerns.

The ICS has now been translated into over 40 languages, including Traditional Chinese and Korean. Using the Traditional Chinese version of the ICS (ICS-TS), Ng, To, and McLeod (2014) found that the ICS-TS mean score was able to discriminate Cantonese-

speaking children with and without SSD with a large effect size. They also suggested a cut-off ICS-TS mean score of 4.29, based on the clinical diagnosis of SSD derived from standardised, norm-referenced assessment results, to be used in a speech screen.

Table 6.1. The Intelligibility in Context Scale

Question	Always	Usually	Sometimes	Rarely	Never
1. Do *you* understand your child?	5	4	3	2	1
2. Do *immediate members of your family* understand your child?	5	4	3	2	1
3. Do *extended members of your family* understand your child?	5	4	3	2	1
4. Do your *child's friends* understand your child?	5	4	3	2	1
5. Do other *acquaintances* understand your child?	5	4	3	2	1
6. Do your *child's teachers* understand your child?	5	4	3	2	1
7. Do *strangers* understand your child?	5	4	3	2	1

The above research findings suggest that a parent-rated measure of children's speech can be used as a tool for a universal speech screen at least for monolingual children. However, little research evidence is available to determine whether a parent-rated measure is useful for bilingual children for speech screening purposes. While some researchers have investigated parental ratings of bilingual children's language abilities (Bedore et al., 2011; Restrepo, 1998), to our knowledge, Stertzbach and Gildersleeve-Neumann (2006) is the only study to have investigated whether parents are reliable and valid judges of their bilingual children's speech. With 24 Spanish-English bilingual children aged between 3;0 and 4;11, they found that parents were able to provide valuable diagnostic information about their bilingual children's speech. In particular, the perception of others, rather than parents, was important in identifying the children's speech difficulties. This is consistent with the more recent findings of McLeod et al. (2013) with monolingual children. However, they investigated the children's phonological skills only in Spanish but not English. Therefore, little is known about whether parents can judge their bilingual children's speech accuracy or intelligibility in a reliable way.

The current preliminary study aims to investigate whether parents can reliably judge their KEB children's speech. We explore the correlation between parental-rated measures of KEB children and the bilingual children's speech accuracy measured by means of percentage of consonants correct. We then consider whether a parent-rated measure of children's speech could be used as a tool for a universal speech screen that is sensitive enough to discriminate bilingual children with and without SSD. More specifically, we consider what questions should be included in a potential screening tool which utilises a

parent-rated measure of bilingual children's speech. Based on our preliminary findings, we suggest research directions for future studies.

6.2 METHODOLOGY

6.2.1 PARTICIPANTS

A total of 33 KEB children (18 girls, 15 boys) aged between 3;0 and 5;11 and their parents participated in the study. All participants were recruited from Auckland, New Zealand, a predominantly English-speaking country. Most participants in the current study were identified via chain-referral sampling, in which the existing participants recommended the study to their acquaintances who were then recruited to the study. Children were considered bilingual if (1) they were receiving language input in both English and Korean regularly and consistently and (2) the parents reported their children were bilingual. As this study was preliminary and exploratory in nature, strict criteria, which could potentially exclude some bilingual children, were not imposed.

Eight children were born in Korea and 25 were born in New Zealand. For those who were born in Korea, the mean age of arrival in New Zealand was 22.50 months (SD = 16.32, min = 3, max = 45). Regardless of where they were born, all children were exposed to the Korean language from birth. But the age of first English language exposure varied greatly from birth to 46 months (mean = 18.36, SD = 18.98). Of the 25 children who were born in New Zealand, only 14 were exposed to both languages from birth.

To calculate the proportion of language exposure, the total hours of Korean exposure were divided by the total hours of English exposure in a child's typical week (Goldstein et al., 2010). The mean proportion of language exposure of the sample was 2.45 (SD = 2.42, min = 0.31, max = 13.0), which indicates that on average the children were exposed to Korean 2.45 times more than they were to English. Only six children were exposed to English more than Korean. Five of them had a monolingual English-speaking (ME) father. For all children, the primary source of Korean exposure (i.e. the greatest proportion of exposure to Korean) was the home environment. The primary source of English exposure was kindergarten or school for the majority of the children (n = 25). For the remaining children, the home environment was the primary source of English exposure. Excluding home and kindergarten/school environments, Table 6.2 illustrates the secondary sources of language exposure. On average, children were exposed to 2.85 different Korean language environments (SD = 1.54, min = 1, max = 6) and 1.97 different English language environments (SD = 0.95, min = 1, max = 5). The difference was statistically significant

(z = -2.782, p = 0.005). Except for the five children with a ME father, all parents were Korean and spoke Korean as their first language.

Table 6.2. Sources of secondary language exposure in English and Korean

Sources	English	Korean
Weekend language school	0	17
Church	4	10
Playgroup	4	13
Individual lessons (e.g. piano)	3	1
Group activities (e.g. choir, swimming)	7	8
Private language tutoring	1	5
Private maths tutoring	0	2

Figure 6.1 shows how often the Korean parents reportedly spoke to their KEB children in Korean, in English and frequency of code-switching between the two languages. The majority of parents (77.4%) reported that they speak to their children in Korean all the time, while no parents reported speaking to their children in English all the time. The majority reported that they rarely or never speak to their children in English (54.8%). Code-switching was not common. Most parents (61.3%) reported they never or rarely code-switch when they speak to their children.

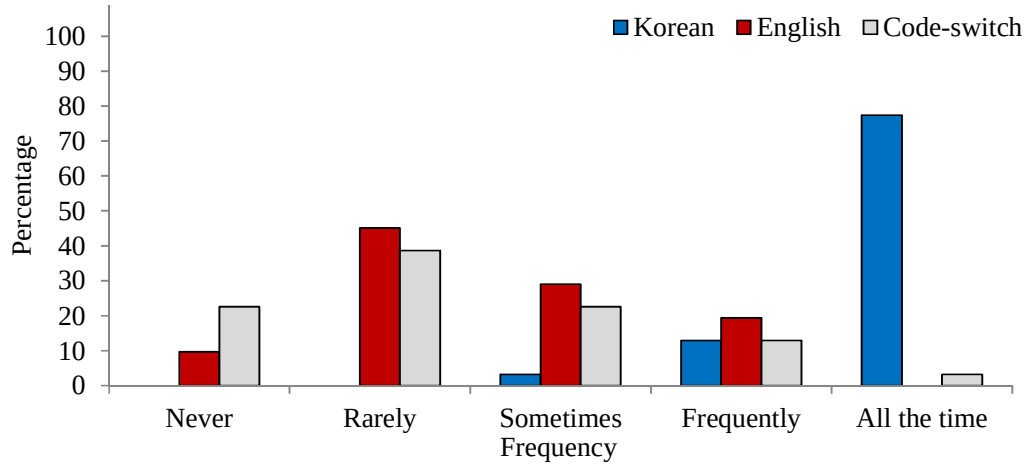

Figure 6.1. Code-switching behaviours of the primary carers when speaking to their children

The mean age of the mother when the participating child was born was 31.92 years (SD = 3.47). The mean years of education of mothers was 16.94 years (SD = 2.45) and for fathers 17.17 years (SD = 2.70). The mean annual household income of the participants was higher

than the national mean household income of $85,588 NZD (Statistics New Zealand, 2014b).

None of the children had a history of developmental conditions that are known to impact on speech/language development. There were no reports of prolonged or repeated episodes of middle ear infections. No parents reported specific concerns about their child's speech. However, to varying degrees, approximately 40% of the parents reported that they were concerned about their child's ability to socialise with peers and follow instructions at kindergarten or at school due to poor English skills. In most cases, parents explicitly stated that their child's poor English skills (compared to ME peers) were due to the fact that their child was only exposed to English at kindergarten or at school.

To include KEB children with SSD, we contacted speech-language therapists working in Auckland, where the Korean population is concentrated in New Zealand (Friesen, 2008). None of the speech-language therapists contacted were seeing KEB children for (suspected) SSD.

6.2.2 MATERIAL AND PROCEDURE

The phonology subtest of the DEAP (Dodd et al., 2002) for English and the APAC (M. J. Kim et al., 2007) for Korean were completed for all children. Parents completed a questionnaire including the ICS (McLeod et al., 2012a) and the set of ten questions used in Stertzbach and Gildersleeve-Neumann (2006) (henceforth GNS for Gildersleeve-Neumann Scale). The researchers requested that the parent who spends most time with his/her child should complete the questionnaire. All parents completed the questionnaire in Korean.

The questions used in the GNS are listed in Table 6.3. For each question, a five-point Likert scale is given (*Never-Rarely-Sometimes-Frequently-All the time* for questions 1 to 8; *No-Probably not-Maybe-Probably-Yes* for questions 9 and 10). Unlike the ICS, which was completed once without specific mention of any particular language, parents were asked to complete the same questions on the GNS twice; in relation to their child's speech about English and about Korean. Appropriate examples of deletion and substitution of speech sounds in Korean were used for questions 6 and 7, respectively, when parents completed the GNS about Korean.

Table 6.3. Gildersleeve-Neumann Scale

1.	Is your child's pronunciation difficult to understand?
2.	In comparison to other children his/her age, do you think your child is difficult to understand?
3.	Do other people think your child is difficult to understand?
4.	Does your child have difficulty pronouncing words?
5.	Does your child have problems producing certain sounds?
6.	Does your child leave out sounds when he/she speaks? For example, saying "ca" for "cat" or "tar" for "star"?
7.	Does your child change sounds when he/she speaks? For example, saying "too" for "shoe" or "wun" for "run"?
8.	Is your child frustrated when he/she speaks?
9.	In comparison to other children his/her age, do you think your child has speech problems?
10.	Do other people think your child has speech problems?

6.2.3 DATA ANALYSIS

The single-word samples collected using the DEAP and the APAC were phonetically transcribed and subsequently subjected to a relational phonological analysis to obtain the PCC for each language. The PCC scores and the parental ratings on the GNS and the ICS (including the ICS mean scores) were entered into the IBM SPSS Statistics for Windows, Version 22.0 (International Business Machines Corporation, 2013) and were analysed using descriptive and inferential statistics. There is an inherent sampling bias in studies of bilinguals in a country where they are a minority population (Hambly et al., 2013). Due to this non-random sampling, the measurement of parental ratings (ordinal) and the small sample size, our analyses employed distribution-free or nonparametric statistical tests which do not make stringent assumptions about the population (Linebach, Tesch, & Kovacsiss, 2014; Siegel, 1956). The alpha-level was set at 0.05 for statistical significance. Because we were unable to include any KEB children with SSD, we compared the ICS mean scores of the current study with those from previous studies (McLeod et al., 2012b; Ng et al., 2014). Independent samples *t*-tests were used for the comparisons as we did not have access to the raw data from the previous studies to establish the ranks for a nonparametric statistical test. In addition, we applied the cut-off ICS mean score of 4.29 suggested by Ng et al. (2014) to the current sample to determine whether the same cut-off score could be applied to bilingual children.

6.3 RESULTS

Figure 6.2 shows the PCC scores in each language. The PCC scores were higher in Korean than in English (z = -3.99, $p < 0.001$). Only seven children obtained higher PCC scores in English than in Korean.

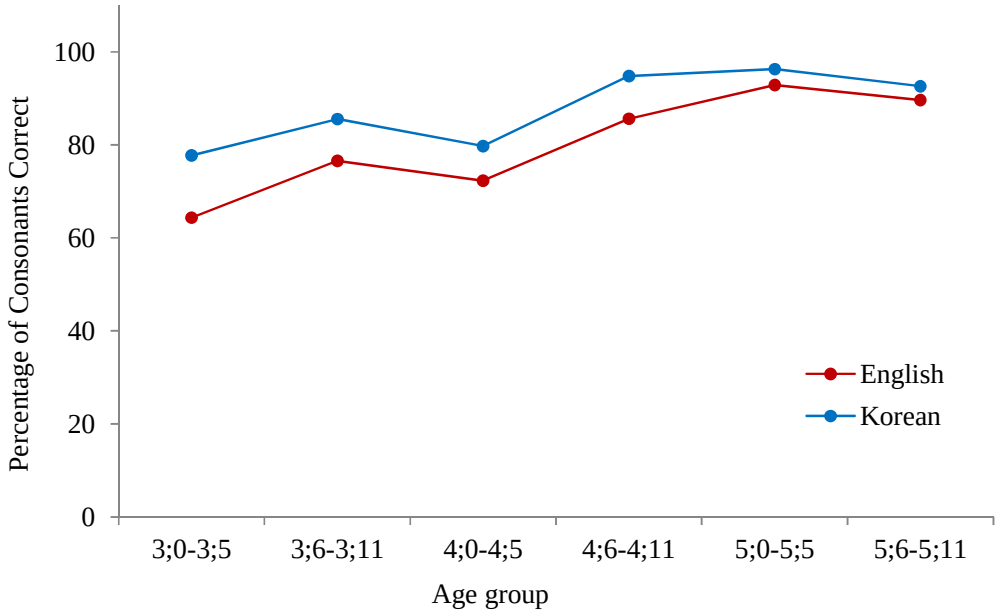

Figure 6.2. Percentage of consonants correct

Table 6.4 shows the mean ratings on each question of the GNS and the Spearman rank correlation coefficient (r_s) and their corresponding two-tailed p values from the correlation analysis of the parental ratings and the PCC scores. The parental ratings about Korean were not correlated with the children's Korean PCC scores on any of the GNS questions. On the other hand, the parental ratings about English were correlated with the children's English PCC scores on six GNS questions, as illustrated in Table 6.4.

Table 6.4. Mean ratings and the Spearman rank correlation coefficients (r_s) on the Gildersleeve-Neumann Scale

	English			Korean		
GNS	Mean (SD)	r_s	p	Mean (SD)	r_s	p
1	4.27 (0.76)	0.328	n.s.	4.00 (1.03)	- 0.058	n.s.
2	4.45 (0.90)	0.428	0.013	4.18 (0.88)	0.198	n.s.
3	4.09 (0.91)	0.238	n.s.	4.00 (1.20)	0.285	n.s.
4	3.91 (0.91)	0.317	n.s.	4.00 (0.97)	0.133	n.s.
5	3.86 (0.99)	0.505	0.003	4.06 (0.90)	0.294	n.s.
6	4.27 (1.07)	0.427	0.013	4.27 (0.98)	0.271	n.s.
7	4.09 (1.04)	0.440	0.010	4.15 (1.03)	0.196	n.s.
8	4.09 (0.91)	0.069	n.s.	4.30 (0.77)	0.315	n.s.
9	4.18 (0.98)	0.536	0.001	4.03 (0.88)	0.309	n.s.
10	4.24 (0.97)	0.436	0.011	3.03 (0.92)	0.341	n.s.

*n.s. = not significant

Wilcoxon signed rank tests were also performed to determine whether there was a difference in the parental ratings on the GNS between English and Korean. There were no statistically significant differences in the parental ratings on any of the questions. Excluding the seven children who obtained higher PCC scores in English than in Korean, Wilcoxon signed rank tests were performed on the parental ratings on the GNS. The results revealed that the parental ratings for *Do other people think your child has speech problems?* were statistically significantly different (z = -2.309, p = 0.021). It indicates that parents were more likely to believe that their child had speech problems when answering the question about Korean (median = 4.00, mean = 3.88, SD = 0.95) than about English (median = 5.00, mean = 4.23, SD = 0.99), even though their PCC scores were higher in Korean than in English. The difference in parental ratings for *In comparison to other children his/her age, do you think your child is difficult to understand?* also showed a statistical trend towards significance (z = -1.877, p = 0.06). Despite the higher PCC scores in Korean, parents were likely to indicate that their child was more difficult to understand in Korean (median = 4.00, mean = 4.00, SD = 0.89) than in English (median = 5.00, mean = 4.42, SD = 0.90). There were no statistically significant differences in the parental ratings on any of the questions for the seven children who obtained higher PCC scores in English.

Table 6.5 illustrates the mean parental ratings on the ICS. The parental ratings for *Do strangers understand your child?* were correlated with the PCC scores in both languages. This was the only question to yield a statistically significant correlation with the PCC scores in English. On the other hand, parental ratings for *Do extended members of your*

family understand your child? and *Do other acquaintances understand your child?* were statistically significantly correlated with the PCC scores in Korean.

Table 6.5. The mean parental ratings and the Spearman rank correlation coefficients (r_s) on each item of the Intelligibility in Context Scale

ICS item	Mean (SD)	English		Korean	
		r_s	p	r_s	p
1	4.80 (0.39)	0.310	n.s.	0.342	n.s.
2	4.56 (0.64)	0.075	n.s.	0.204	n.s.
3	4.35 (0.67)	0.324	n.s.	0.478	0.005
4	4.47 (0.59)	0.234	n.s.	0.204	n.s.
5	4.38 (0.52)	0.279	n.s.	0.399	0.022
6	4.45 (0.62)	0.273	n.s.	0.168	n.s.
7	4.06 (0.79)	0.346	0.049	0.358	0.041

The ICS mean score of the current sample was 4.44 (SD = 0.42). The ICS mean scores were statistically significantly correlated with the PCC scores in English (r_s = 0.360, p = 0.039) and in Korean (r_s = 0.443, p = 0.010). Mann-Whitney U test revealed that there was no statistically significant difference in the ICS mean scores between the children with parental concerns about their English language skills (median = 4.29, mean = 4.39, SD = 0.45) and those without any concerns (median = 4.57, mean = 4.50, SD = 0.39) (U = 107.00, p = 0.521). We compared the ICS mean scores of the KEB children and the ICS mean scores from previous studies with monolingual children (McLeod et al., 2012b; Ng et al., 2014). The results are summarised in Table 6.6.

Table 6.6. Comparison of the Intelligibility in Context Scale mean scores between the current and the previous studies (McLeod et al., 2012; Ng et al., 2014)

		N	Mean	SD	t	p
McLeod et al. (2012)	Concern	109	3.85	0.50	6.15	< 0.001
	No concern	11	4.69	0.51	1.62	n.s.
Ng et al. (2014)	SSD	33	4.14	0.65	2.23	0.030
	No SSD	39	4.56	0.48	1.12	n.s.

Figure 6.3 plots the individual ICS mean scores of the bilingual children in the current study. The dotted line indicates the cut-off ICS mean score of 4.29 suggested by Ng et al. (2014). If the cut-off score were applied to the current sample of bilingual children, it would identify 15 or 45.5% of the children as needing comprehensive clinical assessment.

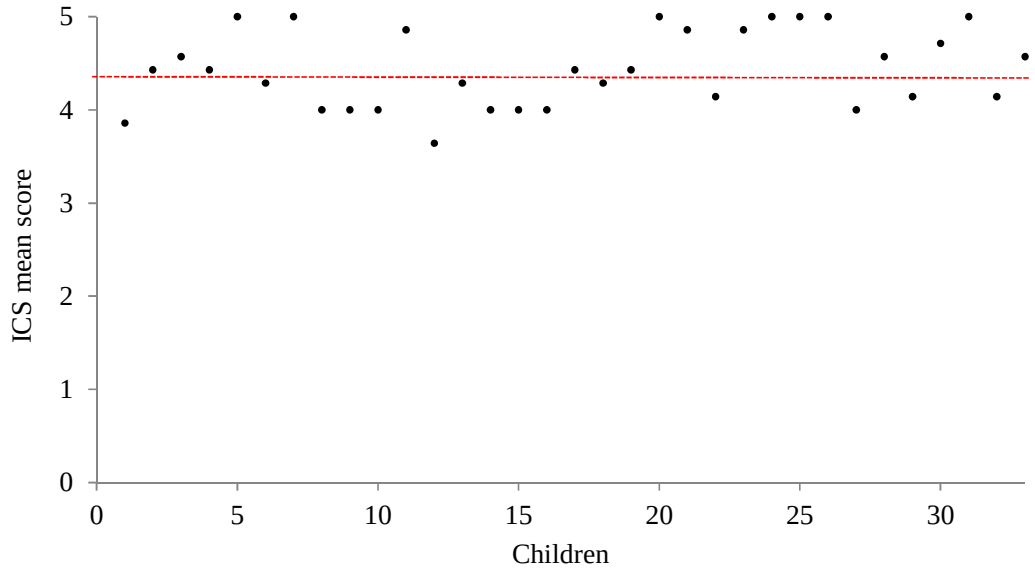

Figure 6.3. The Intelligibility in Context Scale mean scores of the current sample with the dotted line showing the cut-off score of 4.29 suggested in Ng et al. (2014)

6.4 DISCUSSION

It is not difficult to justify why a universal speech screen should be implemented for all children. It is difficult to determine how it should be done. We investigated one of the approaches to a universal speech screen, a parent-rated measure of children's speech. Unlike previous research, the current preliminary investigation had a specific focus on bilingual children and whether a universal speech screen can be implemented in a way that does not disadvantage bilingual children. This is particularly important because bilingual children now comprise a significant portion of the population in many English-speaking countries.

Before we discuss our findings, we address two limitations of the current study. Firstly, an obvious limitation is the small sample size. There were significant issues with recruiting participants during the data collection phase which lasted for approximately 20 months. Although the current study was approved by the ethics committee of the university affiliated with the researchers, the local early education provider (providing education for

up to 14,000 children) did not give the researchers permission to recruit potential participants for the study. The reason for the refusal was that they did not believe the study would benefit the organisation. In addition, the first author visited a Korean language school and met with more than 50 parents of KEB children with the permission of the school. The aims of the study were explained and an information sheet with contact details was provided in person for each parent. Not one of the parents subsequently contacted the researchers. We suspect that at least a part of the difficulty with participant recruitment can be attributed to the lack of awareness of SSD and the associated adverse consequences. This again supports the argument for implementing a universal speech screen, as it can bring attention to SSD and its adverse consequences and encourage parents to monitor their children's phonological development (Nelson et al., 2006).

Secondly, the chain-referral sampling in participant recruitment could have attracted parents who already had some concerns about their children's speech/language development. Therefore, we acknowledge that some children in the current study may not be typically developing or may even have SSD. The high proportion of children with parental concerns about language development may reflect this sampling bias. However, the characteristics of the participants of the current study reflect those of the wider KEB community in New Zealand, including Korean language dominance, high level of education and relative affluence (Friesen, 2008; Ho et al., 2003; H.-J. Park & Anglem, 2012; Statistics New Zealand, 2004). In addition, concerns about language development are not uncommon in parents of bilingual children (Bedore et al., 2011; King & Fogle, 2006) and none of the parents expressed specific concerns about their child's speech, although it would be an over-estimation to assume that the public are educated about the distinction between speech and language.

6.4.1 GILDERSLEEVE-NEUMANN SCALE

One aim of the current study was to explore whether Korean parents were reliable in judging their KEB children's speech. The second aim was to consider the questions to be asked in a universal speech screen. Our findings suggest that these two issues are related and may depend on which language the parents are asked to judge. Parental ratings were correlated with PCC scores in English when parents were asked specific questions about their children's speech errors; deletion errors (GNS 6) and substitution errors (GNS 7), which suggests that parents may be sensitive to deletion and substitution errors of their children at least in English. Bedore et al. (2011) also found that one of the commonly cited

concerns from the parents of Spanish-English bilingual children was that the children used incorrect vowel and consonant sounds. It is to be noted that only the parents of Spanish-dominant children, but not the parents of English-dominant children, raised such specific concerns. The majority of the current sample could be categorised as being Korean-dominant and therefore the findings of the current study may not hold true for parents of English-dominant bilingual children.

There was equivocal evidence from the correlation analysis to support the suggestion made by Stertzbach and Gildersleeve-Neumann (2006) that the perceptions of others could be the key to identifying the children with speech difficulties. The parental ratings for *Do other people think your child is difficult to understand?* (GNS 3) were not correlated with the PCC scores. Only when parents were asked whether other people think their child has speech problems (GNS 10), were the English PCC scores correlated with parental ratings. Interestingly, this was also the only question in which there was a statistically significant difference in parental ratings between English and Korean, for the majority of the children who obtained higher PCC scores in Korean than in English. Parents believed that their children were more likely to be judged to have speech problems in Korean than in English. A similar trend was observed with another question, *In comparison to other children his/her age, do you think your child is difficult to understand?* (GNS 2), with parents believing their children were more difficult to understand in Korean than in English, despite the higher PCC scores in Korean.

Such findings may be attributed to the parents, as well as children. Korean adults in New Zealand have been identified as being the least competent in their use of everyday English (Morris et al., 2007; H.-J. Park & Anglem, 2012; Statistics New Zealand, 2004). While the English language proficiency of parents stays relatively poor, their children become increasingly more proficient in English as they are exposed in kindergarten or school environments, which tend to promote the use of English. Such a sociolinguistic trend may mean that Korean parents over-estimate their child's English skills. Poor English proficiency of the parents of KEB children may also have another implication in a universal speech screen employing a parent-rated measure. Parental ratings and responses on questions regarding whether Korean parents understand their bilingual children could be attributed to both parents and their child. That is, the reason why a KEB child is not understood when speaking English could be due to the limited English proficiency of the parents, as well as the child's speech errors. Taken together, our findings suggest that the language proficiency of the parents influences their ratings and responses about their

bilingual children's speech. This is also supported by our finding that all questions on the GNS that yielded statistically significant correlations with PCC scores in English directly addressed "problems" (GNS 5) or "speech problems" (GNS 9 and 10). The inclusion of the word, problems, in the questions may attribute the parental ratings to the children's speech errors but not to both children and parents.

6.4.2 INTELLIGIBILITY IN CONTEXT SCALE

The items on the ICS reflect relevant communicative contexts drawn from the ICF-CY Environmental Factors and they are designed to reflect a "range of contexts/listeners and communication partners with whom children communicate" (McLeod et al., 2012b, p. 649). It is unclear whether this approach is best suited for bilingual children. For the majority of the current sample, Korean was the dominant language used at home. Questions such as *Do you/immediate members of your family understand your child?* (ICS 1 and 2) may only apply to the Korean language for the majority of the participants, while ratings for *Do your child's teachers understand your child?* (ICS 6) are solely based on the English language for the children who were only exposed to English at school. On the other hand, for the 17 children who were also attending a weekend Korean language school, it is difficult for parents to determine how to answer item 6 (*teachers*), if they believe their child is understood by the Korean teacher but not by the English-speaking teacher at the mainstream school.

The findings from the ICS, however, do shed light on the importance of the *others* in identifying children's speech difficulty as previously reported by Stertzbach and Gildersleeve-Neumann (2006). Four of the communication partners reflected in the ICS, *child's friends, acquaintances, child's teachers,* and *strangers,* would be classified as *others* in the GNS. The PCC scores in both English and Korean were correlated with parental ratings on *Do strangers understand your child?* in the ICS, while only the PCC scores in Korean were correlated with the parental ratings for *Do other acquaintances understand your child?* The items addressing child's friends and teachers did not yield statistically significant correlations with the PCC scores in either language. Our findings suggest that the perception of *strangers* on the child's speech as judged by the parents may be significant in identifying children's speech difficulty in both languages.

Interpreting the significant correlation on item 5 (*acquaintances*) with the PCC scores in Korean is more complicated. A large number of acquaintances of Korean families in New Zealand tend to be Koreans (Morris et al., 2007), which suggests limited

communication opportunities between the child and other acquaintances in English. Interpreting the significant correlation on *Do extended members of your family understand your child?* with the PCC scores in Korean is equally complex. A large proportion of the Korean community in New Zealand comprises of recent immigrants (Statistics New Zealand, 2006, 2014a). Therefore, communicating with extended members of family in South Korea is likely to take place over the phone or internet (e.g. Skype) and in the Korean language. Furthermore, extended members of the family in South Korea are unlikely to have any experience with bilingual children and thus bilingual speech/language development. Their judgment of the degree to which they understand bilingual children and speech/language development of bilingual children is likely to be based on their experience with MK children. A growing body of research evidence suggests that bilingual children's phonological development is different from their monolingual counterparts (Goldstein & McLeod, 2012; Hambly et al., 2013 for reviews). Therefore, the perception of extended family members on bilingual children's speech, even as judged by parents, may not be a suitable measure of bilingual children's speech difficulty.

While it is informative to discuss the within-scale correlations, if the ICS is to be considered a potential tool for a universal speech screen, it is pertinent to examine its sensitivity to discriminate bilingual children with and without SSD. The ICS mean scores were statistically significantly correlated with the PCC scores in both languages. The ICS mean scores were also statistically significantly different from those derived from monolingual children with a diagnosis of SSD or concerns about their speech in previous studies (McLeod et al., 2012b; Ng et al., 2014). This provides some positive support for the use of the ICS as a tool for a universal speech screen. However, when the cut-off ICS mean score suggested by Ng et al. (2014) was applied to the current sample, 45.5% of the children were identified as needing a comprehensive clinical assessment. Admittedly, some children in the current sample may have SSD. However, given the prevalence data of SSD (J. Law et al., 2000b), 45.5% seems too high. We simply cannot afford to implement a speech screen that fails over 40% of the screened children. While this cut-off score was suggested from a study with Cantonese-speaking children, it does raise questions about the applicability of a cut-off score derived from monolingual children to bilingual populations.

6.4.3 FUTURE RESEARCH DIRECTIONS

Based on our findings, screening just one of the languages of bilingual children may not be sufficient. As revealed by the results on the GNS, the parental ratings on bilingual children's speech may be language-dependent. This warrants further investigation with a larger sample size. We also suggested that language dominance may influence the parent-rated measures of bilingual children's speech. From the findings on the GNS, it is not yet clear whether it is the language dominance of the parents, the children, or both that influences parental ratings in a way that potentially invalidates parent-rated measures of children's speech as a tool for a universal speech screen. Further investigations are required to determine which language dominance should be accounted for.

Future research investigating the use of parental ratings of children's speech as a potential tool for a speech screen should also be used to formulate the questions to be included, so that parental ratings are attributed to the children's speech and not to the parents. We suggest directly and specifically addressing speech problems in the questions. Specific questions about the type of speech errors produced by the children (e.g. deletion and substitution of speech sounds) may be useful in a speech screen. The current study cannot determine whether parents are sensitive to the types of speech errors produced by their children or whether they are sensitive to any errors. The examples provided in the GNS are word final consonant deletion, consonant cluster reduction, stopping of fricative and gliding of liquid. Future research should include examples that are atypical in phonological development. Determining whether parents are able to report different types of speech errors will have significant implications in a universal speech screen, as error patterns are considered to be the best criteria to determine whether a child's phonological development is typical or atypical (Dodd, 2005). However, backing of alveolar consonants and word initial consonant deletion are typical error patterns in Cantonese-English bilingual children (Dodd et al., 1996; Holm & Dodd, 1999b). Therefore, a speech screen which relies on the parental reports of error patterns in children may not be implemented universally. Language-pair specific approaches for bilingual children, however, could be considered.

Further studies are required to determine the suitability of the ICS for bilingual children. If the ICS were to be used as a speech screen tool, then a different cut-off ICS mean score may need to be considered for bilingual children. The different cut-off score may need to be based on or take into consideration the sociolinguistic factors of different bilingual

communities (e.g. language dominance). We again question whether a truly universal speech screen is possible.

The current study was not able to include KEB children with (suspected) SSD. There is a need for a comparative study that includes both typically developing bilingual children and bilingual children with SSD, to investigate the sensitivity of a parent-rated measure of bilingual children's speech. Including bilingual children with SSD may be difficult until we have a better understanding of typical phonological development in bilingual children. Without knowledge of typical phonological development in bilingual children, identifying those with SSD is a significant challenge. This should not discourage researchers from continuing to build best evidence for the implementation of a universal speech screen. This should mean that research into phonological development in bilingual children is encouraged and promoted.

6.5 SUMMARY

This chapter reported on the parental ratings of bilingual children's speech and the implications for a universal speech screen. J. Law et al. (2000a) advised against a universal speech/language screen due to a lack of a single universally accepted measure and poor sensitivity of the existing screen tools. Fifteen years since the publication of J. Law et al. (2000a), we still cannot recommend the introduction of a universal speech screen for the very same reasons. We also raised issues specific to bilingual children, which subsequently questioned whether a speech screen can be implemented universally for all children. There is little argument over whether a universal speech screen should be implemented. Future research needs to consider how it can be done.

7 CONCLUSION

This concluding chapter summarises the major findings of the three studies presented in this doctoral thesis, suggests future directions and offers recommendations to speech-language therapists working with KEB children with suspected SSD.

7.1 PHONOLOGICAL SKILLS

The study outlined in Chapter 3 suggested that phonological development in Korean-English bilingual children was qualitatively different from their monolingual counterparts. Although the age of completion of phonetic inventories was comparable with monolingual children, the trajectory towards is was considerably different in both languages. Segmental accuracy also showed an incomparable trajectory towards mastery. The qualitatively distinct rates and patterns of phonological development in KEB children reflect the process of reorganisation of phonological systems, wherein the dynamic processes of specifying language-specific phonemes and their realisation rules take place (Dodd et al., 1996; Gildersleeve-Neumann & Wright, 2010; Holm & Dodd, 1999b). The study also offered findings that challenged previous suggestions about bilingual phonological development. Specifically, (1) deceleration, compared to monolingual children, was not the norm in KEB children (Goldstein & Gildersleeve-Neumann, 2007; So & Leung, 2006), (2) older KEB children did not have more advanced phonological skills compared to their monolingual counterparts (Goldstein & Bunta, 2012; Grech & Dodd, 2008) and (3) cross-linguistic effects were not more pronounced in sequential bilingual children than in simultaneous bilingual children (Goldstein & Gildersleeve-Neumann, 2007).

There is a need for a theoretically sound, clinically applicable framework for describing and explicating the rates and patterns of bilingual phonological development. We argued that the IDS model (Fabiano-Smith & Goldstein, 2010; Paradis & Genesee, 1996) had limited clinical applicability. The model was not adequate in differentiating the decelerated rates of phonological development as a typical characteristic in bilingual children from phonological delay for which clinical intervention is required (Dodd, 2005, 2011). Commensurate phonological skills observed in KEB children compared to their monolingual counterparts could not be explained easily within the framework of the IDS model, as it only proposes three hypothesised manifestations; acceleration, deceleration and transfer (Fabiano-Smith & Goldstein, 2010; Paradis & Genesee, 1996). This doctoral thesis also considered structural overlap (Hulk & Müller, 2000; Nicoladis & Paradis, 2011).

Cross-linguistic effects were evident, as predicted by structural overlap, but only in some children. It could be useful for identifying the points of overlap because the shared phonemes, whose realisation rules are distinct for each language, may be potentially problematic for bilingual children. Nevertheless, structural overlap is specifically focused on 'where' cross-linguistic effects may be manifested. We suggested that bilingual phonological development is characterised by both developmental processes and cross-linguistic effects. Therefore, structural overlap may not be an adequate framework for all aspects of bilingual phonological development. It is a challenge to formulate a theoretically sound and clinically meaningful framework to describe and explain phonological development in bilingual children who are extremely heterogeneous. However, heterogeneity is arguably one of the defining characteristics of bilingual children. As such, future research should continue to examine relevant factors influencing phonological development in bilingual children.

Consistent with many previous studies, we did not find evidence for the age of second language acquisition being a significant factor influencing phonological skills in KEB children. Nevertheless, there is a need for more systematic investigations. There are three ways in which the age of second language acquisition can be examined. The first is to use the age of second language acquisition as a continuous variable, in the same way that this doctoral thesis has done. The second is to consider it a categorical variable and group children into simultaneous and sequential bilinguals. The third is to consider the age of second language acquisition only in sequential bilingual children. So far the age of second language acquisition was found to be a significant factor only when the third approach was taken (Morrow et al., 2014). However, previous studies that have taken the first two approaches tended to have a relatively small sample size. A large sample size is required especially because factors such as the age of second language acquisition has to be taken into consideration in the context of external language factors, such as the proportion of language exposure or language dominance. There were some tentative indications that the external language variables, such as the proportion of language exposure, may not be adequate in describing the language environments to which bilingual children are exposed (see Chapter 5). We suggested that considering the nature of the language exposure may be useful. This includes the number of different language contexts to which bilingual children are exposed and the degree to which bilingual children are involved in the language environments.

Phonological development in bilingual children has to be considered as fundamentally different from that in monolingual children. The direct clinical implication is that monolingual normative data should not be used to make clinical decisions regarding the typicality of a bilingual child's phonological development. To address the current lack of clinically meaningful normative data for bilingual children, one obvious recommendation is that studies with a much larger sample size are needed. Reflecting the inherent heterogeneity, bilingual children may need multiple levels of norm for clinical application. Our study suggested that the language environments to which bilingual children are exposed should be considered in stratifying normative data. In the absence of such comprehensive normative data at present, we suggested that speech-language therapists could utilise a peer-child comparison analysis in conjunction with the information provided in this doctoral thesis when assessing KEB children with suspected SSD.

7.2 Applying the Differential Diagnosis System for Bilingual Children

The Differential Diagnosis System considers error patterns to be the best criterion to determine whether a child's phonological development is typical or not (Dodd, 2005). The studies outlined in Chapters 4 and 5 found that KEB children could produce error patterns indicative of phonological disorder in monolingual children. Not all KEB children produced such 'atypical' error patterns. We suggested that producing these 'atypical' error patterns may be due to underspecification and faulty overgeneralisation associated with reorganisation of phonological systems. The studies did not find a reliable factor differentiating KEB children who produce 'atypical' error patterns and those who do not. The use of available monolingual norms puts KEB children at risk of being misdiagnosed, leading to inappropriate service provision.

A large-scale cross-sectional study of error productions in KEB children could identify typical error patterns, facilitating diagnosis of a phonological disorder. However, we pointed out potential issues that may not be easily addressed even with studies with a much larger sample size. We suggested that there may be a methodological issue associated with comparing bilingual children's erroneous productions with target productions based on monolingual speakers. We queried whether there are 'error patterns' produced by bilingual children, which are not *clinically relevant*. It has to be said that the normative data currently used in clinical practice is based on a deterministic view of phonological development. The quasi-longitudinal study outlined in Chapter 5 urges us to question whether the use of

normative data based on a cross-sectional study accurately reflects bilingual phonological development and whether a diagnosis of SSD in bilingual children should be made solely on the data derived from a cross-sectional study. The age-related changes in error production in KEB children did not follow the neat developmental sequence presented in monolingual cross-sectional studies, in which error patterns are resolved with age. We suggested that regression, reflecting reorganisation, may be more prominent in bilingual phonological development because both within-language and between-language reorganisation processes take place in bilingual phonological development. It may not be uncommon for an error pattern to appear to re-emerge rather than to be resolved with age. This has a direct implication for the way speech-language therapists use the normative data derived from a cross-sectional study to identify bilingual children with phonological delay. As Waring and Knight (2013) suggested, further evidence for sensitivity and specificity of the Differential Diagnosis System is needed for both bilingual and monolingual children. Future studies could consider applying the research finding that distinct cognitive-linguistic deficits are present in a phonological disorder (Crosbie et al., 2009; Dodd, 2011; Dodd et al., 1989; Holm et al., 2008) to identify bilingual children with phonological disorder and its clinical markers for a specific bilingual population.

Speech-language therapists assessing KEB children with suspected SSD should consider a follow-up session. The quasi-longitudinal study outlined in Chapter 5 showed how follow-up sessions may provide additional information regarding whether a KEB child's phonological development is typical or not. A follow-up session could be particularly useful in facilitating the clinical decision as to whether treatment should be provided, especially given the extent of individual variations observed in the cross-sectional study outlined in Chapter 4. Our recommendation to speech-language therapists is that if an SSD is suspected during the initial assessment sessions (based on the available information from cross-sectional studies), then at least a home-based programme should be prescribed. A watchful waiting approach should be avoided. A follow-up session should be conducted. In the follow-up session, speech-language therapists should consider any age-related changes in error production, as well as the cross-sectional data. As we suggested, information about the children's segmental accuracy may contribute to the clinical decision making. We followed up KEB children six months after the initial session. Exactly how far apart the initial and the follow-up sessions should be needs to be considered in future research in order to inform clinical practice. A series of controlled, prospective longitudinal studies are needed.

7.3 UNIVERSAL SPEECH SCREEN

The availability of clinically meaningful normative data for bilingual children will undoubtedly facilitate the work of speech-language therapists. Even with such data made available, issues still remain, if bilingual children are not referred to or identified by speech-language therapists (Stow & Dodd, 2005; Winter, 1999, 2001). The preliminary study outlined in Chapter 6 considered whether parent-rated measures could be used as a tool for a universal speech screen to identify children who require a comprehensive clinical assessment by a speech-language therapist. The major finding in this study mirrored the findings of the studies outlined in previous chapters in this doctoral thesis. That is, the acceptable standards for monolingual children cannot be assumed to be applicable for bilingual children.

As this study was preliminary and exploratory in nature, our findings require further investigations. Firstly, we suggested that the question – *Do strangers think your child has a speech problem?* – could be sensitive in identifying KEB children with SSD. Further studies including bilingual children with SSD are needed to examine whether this question is sensitive in differentiating bilingual children with SSD from typically developing bilingual children. In practice, if this question is reasonably sensitive in identifying KEB children with SSD, then parents could be asked during the case history. Secondly, whether parents are able to report different types of speech errors should be investigated. This will have significant implications, because certain types of speech errors could indicate atypical phonological development. Thirdly, we suggested that the language dominance of parents may influence their judgment of their bilingual child's speech accuracy. Systematic investigations are needed, because we did not directly measure the parents' language dominance or English proficiency. As we suggested in Chapter 6, there is little argument over whether a universal speech screen should be implemented. Future studies should consider how it can be done.

Having put this forward, however, it should not be taken to mean that addressing the issue of under-representation of bilingual children in speech-language therapy services is solely the responsibility of the researchers. As speech-language therapists, we should all take part in narrowing the gaps in our service provision and raising awareness of SSD. None of the parents who participated in the doctoral research had heard of SSD, with some believing SSD to be stuttering. A universal speech screen can bring attention to SSD and their adverse long-term consequences and encourage parents to monitor their child's phonological development (Nelson et al., 2006). However, we are a long way away from

implementing a universal speech screen. There is a need for speech-language therapists to be actively engaged in raising awareness of SSD within bilingual and migrant communities.

7.4 Closing Remarks

This doctoral thesis provided clinically relevant information about phonological development in KEB children. The findings in this doctoral thesis have clinical implications for identifying KEB children with SSD and have made significant contributions to the field of bilingual phonological development currently dominated by studies with Spanish-English bilingual children. With our world becoming more culturally and linguistically diverse, speech-language therapists will encounter an increasing number of bilingual children in their clinical practice. This doctoral thesis is a significant step towards enabling speech-language therapists to accurately identify KEB children with SSD.

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APPENDICES

APPENDIX 1: QUESTIONNAIRE

Division of Speech Science
Department of Psychology
The University of Auckland
CNR Morrin Road & Merton Road
Glen Innes, Auckland
Private Bag 92019

Questionnaire

Project Title:	Phonological Development in Korean-English Bilingual Children
Researchers:	Elaine Ballard, Clare McCann & Jae Hyun Kim

These questions will help us understand your child's development. If you have any questions or concerns about a question, please feel free to ask for clarifications or not to answer those questions. Some questions may be similar and this is so that we can collect a wide range of data.

Participant number: _____

Your relationship to the child: _____

***** *You* refers to the person completing this questionnaire, unless otherwise stated.
* *Your child* refers to the child who is participating in this research.

About you and your family

Mother

Date of birth: ___/___/___

Marital status: _____

Level of education completed:

_____

Years of education:

_____

Employment (tick one)
- □ Not employed
- □ Employed full-time
- □ Employed part-time

Occupation:

_____

Father

Date of birth: ___/___/___

Marital status: _____

Level of education completed:

_____

Years of education:

_____

Employment (tick one)
- □ Not employed
- □ Employed full-time
- □ Employed part-time

Occupation:

_____

1. How old were you (mother) when the child was born?

   _____ years _____ months

About your child – Developmental History

re: **the child** who is participating in the research.

1. What is your child's birthday? _____/_____/_____
2. Sex of your child: BOY / GIRL (circle one)
3. Is this your FIRST / SECOND / THIRD / FOURTH child? or other:_____
4. How many siblings does your child have? _____

   How old are they?

   _____

   _____

   _____
5. At home, how many people does your child live with? _____
6. Was the birth normal? YES / NO

   If answered "NO", why?

   _____

   _____

   _____
7. Did your child have issues with feeding in the past?

   Never Rarely Sometimes Frequently All the time
8. Does your child have issues with feeding at present?

   Never Rarely Sometimes Frequently All the time
9. Which hand does your child use? LEFT / RIGHT (circle one)
10. Where was your child born? _____
11. If your child was not born in New Zealand, at what age did he/she move to New Zealand?

    When he/she was _____years_____months old.

    Before moving to New Zealand, did he/she live in Korea? YES/NO
    If the answer is NO, where did he/she live and for how long?

    _____

    _____
12. Is your immigration to New Zealand permanent or temporary? _____

    If temporary, do you plan to move back to Korea? YES / NO

If YES, when? _____

13. What would you say your child's first language is? (circle one)

    Korean English Both Other:_____

14. At what age did your child begin to get second language input? (0 if from birth)

    When he/she was _____years_____months old.

    How was this done? (e.g. moved to NZ, started kindergarten)

    _____

    _____

15. When did your child first begin to walk?

    _____ months

16. How old was your child when he/she first babbled? (e.g. say 'bababa' or 'dadada')

    _____ months

17. When your child babbled, how much did he/she babble? (circle one)

    Almost never Rarely Sometimes Frequently All the time

18. When your child babbled, how much did you respond to your child's babbling?

    Almost never Rarely Sometimes Frequently All the time

19. How old was your child when he/she spoke a first word?

    _____ months

20. What were some of his/her first words? (in the languages spoken)

    _____

    _____

21. How old was your child when he/she began to put words together to make short sentences? [*short sentences are two words put together such as* "*more milk*"]

    _____ months

22. Please provide some examples of the short sentences (in the languages spoken)

    _____

    _____

    _____

23. When you think about other children you know at that age, do you think your child was different about when he/she started to use language? (if yes, how was he/she different?)

    _____

_____

_____

_____

24. Does or did your child use a dummy? YES / NO (circle one)

    If answered "YES", until when? _____

    How often?

    Never Rarely Sometimes Frequently All the time

25. Does or did you child use a bottle (excluding feeding times)? YES / NO

    If answered "YES", until when? _____

    How often?

    Never Rarely Sometimes Frequently All the time

26. Does or did you child suck his/her thumb? YES / NO

    If answered "YES", until when? _____

    How often?

    Never Rarely Sometimes Frequently All the time

27. Has your child ever received input from occupational therapy, physiotherapy or clinical psychology?

    YES / NO

    If answered "YES", please explain (for what reasons, for how long etc.)

    _____

    _____

28. Has your child ever received input from speech-language therapy? YES / NO

    If answered "YES", please explain (for what reasons, for how long etc.)

    _____

    _____

29. Has your child ever had his/her hearing checked? If yes, what were the results?

    _____

    _____

30. Has your child ever been treated for ear infections (e.g. otitis media)? If yes, how many times? When were they? Did or does your child often suffer from other ENT-related illnesses?

31. Has your child ever had a serious illness or been hospitalised? If yes, please explain.

32. Does your child have any diagnosed medical conditions? If so, please explain.

33. Are there any other conditions you can think of, for instance twins, allergies, operations, or unusual illnesses?

34. Thinking back at your pregnancy, was everything normal? – before, during and after?
[Prenatal: psychological stress, maternal infections, foetus damaging medications
Perinatal: forceps or ventouse delivery, delivered because the infant was overdue, complications such as umbilical cord prolapse, infections, preterm birth, and post-partum resuscitation]

35. Do you have any concerns about your child's general development? If so, what are they?

About your child – Current environment

1. Who's home? [i.e. Who does the child live with/interact with at home?]

2. Who does your child interact with the most? In what language?

   How often do you (i.e. primary caregiver) speak to the child in Korean?

   Never Rarely Sometimes Frequently All the time

   How often do you (i.e. primary caregiver) speak to your child in English?

   Never Rarely Sometimes Frequently All the time

   Do you code-switch (i.e. mix languages) when you speak to your child?

   Never Rarely Sometimes Frequently All the time

3. Think about all relatives of the child. Is there anyone who did not finish high school?
   Is there anyone who had difficulties learning to read and write, in speaking and pronunciation, slow to learn to talk? Can you explain? [includes dyslexia, autism spectrum disorder]

Only complete the following questions if the participating child is currently attending school or kindergarten.

1. Educational history [kindergartens/schools he has attended – both in Korean and NZ]

2. How long has your child been in NZ education system (i.e. NZ kindergarten/school)

   _____years_____months

3. Is your child in the age appropriate grade? YES/NO

   If not, how many years behind? _____years

4. In your opinion, compared to his classmates how is your child doing at school/kindergarten in general?

Not well Could do better Okay Well Very well

Why so?

5. Is English (speaking or understanding) is an issue at school? If so, please explain.

6. Other educational institutes/activities the child is currently attending [e.g. after school piano lessons, Taekwondo].

APPENDIX 2: ETHICS APPROVAL

UNIVERSITY OF AUCKLAND HUMAN PARTICIPANTS ETHICS COMMITTEE

13-Jul-2012

MEMORANDUM TO:

Dr Elaine Ballard
Psychology

Re: Application for Ethics Approval (Our Ref. 8357)

The Committee considered your application for ethics approval for your project entitled **Phonological Development in Korean-English Bilingual Children** .

Ethics approval was given for a period of three years with the following comment(s):

The Committee acknowledges the thought and care you have put into your application, including your very careful consideration of the various ethical issues.

1 Informed Consent – PIS (Parents/Caregivers)

(a) To avoid parents being taken aback by the length and detail of the questionnaire and interview, including for some very personal information, the Committee suggests that you give them a better indication of this in their PIS. For example, "The questionnaire consists of some background questions about you and your family, and about your child's developmental history ...." "... I will ask you several questions about your child's medical and developmental history ....". "Some of the questions in the questionnaire and interview are quite personal but you can choose whether or not you answer any or all of them."

(b) As the questionnaire consists of 69 questions, some of which require written responses, the Committee suggests that it will take longer than the 15 – 20 minutes you have indicated to parents that it will take to complete. Likewise, as your interview schedule has 26 questions and a spreadsheet to be completed of the child's daily activities and the language used for each, it might take longer than 10 – 20 minutes to complete. The Committee suggests you review if the time commitment you have signalled to parents is realistic.

(c) As the PIS is quite long, the Committee suggests that if you wish to shorten it, you could do this by summarising the section "About this research".

2 Voluntary Participation – For the avoidance of doubt and where it is relevant, please replace in the CF (Parents/Caregivers) the word "should" with "will" and replace the 3rd person with the 1st e.g. "I understand that my p/non-p in this research will have no impact on the relationship my child and I have with the school/kindergarten ..."; "I understand that my child's responses ..."; " ... be the case, I will be provided ..."; "...no information about me or my child ...". Likewise,

where this is relevant in other CFs e.g. CF (Principal) and CF(Teacher), "I agree that p/non-p ... will have no impact ...".

The expiry date for this approval is 13-Jul-2015.

If the project changes significantly you are required to resubmit a new application to UAHPEC for further consideration.

In order that an up-to-date record can be maintained, you are requested to notify UAHPEC once your project is completed.

The Chair and the members of UAHPEC would be happy to discuss general matters relating to ethics approvals if you wish to do so. Contact should be made through the UAHPEC ethics adminisatrators at humanethics@auckland.ac.nz in the first instance.

All communication with the UAHPEC regarding this application should include this reference number: **8357**.

(This is a computer generated letter. No signature required.)
Secretary
University of Auckland Human Participants Ethics Committee

c.c. Head of Department / School, Psychology
Clare McCann
Dr Helena Cooper Thomas
Mr Jae-Hyun Kim
Assoc Prof Douglas Elliffe

Additional information:

1. Should you need to make any changes to the project, write to the Committee giving full details including revised documentation.
2. Should you require an extension, write to the Committee before the expiry date giving full details along with revised documentation. An extension can be granted for up to three years, after which time you must make a new application.
3. At the end of three years, or if the project is completed before the expiry, you are requested to advise the Committee of its completion.
4. Do not forget to fill in the 'approval wording' on the Participant Information Sheets and Consent Forms, giving the dates of approval and the reference number, before you send them out to your participants.
5. Send a copy of this approval letter to the Manager - Funding Processes, Research Office if you have obtained funding other than from UniServices. For UniServices contract, send a copy of the approval letter to: Contract Manager, UniServices.
6. Please note that the Committee may from time to time conduct audits of approved projects to ensure that the research has been carried out according to the approval that was given.

APPENDIX 3: PARTICIPANT INFORMATION SHEET – PRINCIPAL

Division of Speech Science
School of Psychology
The University of Auckland
CNR Morrin Road & Merton Road
Glen Innes, Auckland
Private Bag 92019

Participant Information Sheet – Principal

Project Title:	Phonological Development in Korean-English Bilingual Children
Researchers:	Elaine Ballard, Clare McCann & Jae-Hyun Kim

My name is Jae-Hyun Kim and I am a PhD student in Speech Science at the University of Auckland. I am undertaking a research project on phonological development in Korean-English bilingual children, under the supervision of Dr Elaine Ballard and Dr Clare McCann (Speech Science, The University of Auckland). We would like to invite your school/early childhood education centre to take part in our research. Please read on for more information about this research.

Research background

Phonological disorders (a type of speech sound disorders) are of the most common developmental disorders. Phonological disorders relate to the underlying language system that governs speech sounds of the language(s) children are acquiring and can have long-term adverse consequences such as literacy and academic difficulties later at school. To accurately diagnose phonological disorders, we must first understand what typical phonological development is. While such data for monolingual English-speaking children can be obtained easily, there is a significant lack of research done on bilingual children. Research on bilingual children have significance in that the rates and patterns of phonological development in bilingual children are different from those of monolingual children.

My research aims to identify the typical rates and patterns of phonological development in Korean-English bilingual children. The database established from this study can be used by clinicians (e.g. speech-language therapists) to identify Korean-English bilingual children with phonological disorders and thus to determine the need for intervention.

Your participation

We are seeking your permission to officially approach the teachers at your school/early childhood education centre for their assistance in identifying and recruiting children for this research project. We are looking for children:

- aged between three and eight years **AND** who are typically developing (that is, the child should not have any conditions known to impact on communication, such as hearing loss or Autism Spectrum Disorder
- who are known to speak Korean and English **OR** whose parents/caregivers speak Korean and English – thus receiving language input in both Korean and English at home, even if they may not speak both languages

We would like such children and their parents/caregivers to take part in our research. We will ask the teachers to distribute an information sheet and consent form describing this research to invite these families to take part in our research.

If families decide to participate in the research, I will arrange to meet with them. I am a fluent Korean-English bilingual speaker and will be involved in the whole process. Their research participation involves the following:

1. Phonological assessments in English and/or Korean for the participating children during which their responses will be audio-recorded.

2. Questionnaire for the participating child's parent/caregiver on linguistic, developmental and family backgrounds.

This can be done over one session. However, in some cases, this may need to be completed over two sessions, if a child becomes distracted. I am a qualified speech-language therapist and I will administer the phonological assessments. They are entitled to withdraw from involvement in this research at any stage without explanation and to withdraw any or all of the data they provide before 31 March 2014.

The audio-recordings of the phonological assessments will be used to phonetically transcribe the participating child's responses. The transcriptions will be used for phonological analyses to investigate the children's phonological skills accordingly to their biographical factors, including age, age of second language acquisition, and age of arrival in New Zealand.

The research can take place either at their home or at The University of Auckland Tamaki Campus. A room *may* be requested at your school/early childhood centre, if the participating child's parent/caregiver should prefer to take part at the school/early childhood centre. I will liaise with your manager about a room at your school/early childhood centre.

If the parents/caregivers do not wish to take part in this research, please assure the parents/caregivers that this will not have any impact or influence on their relationship with the school/early childhood centre.

To participate, please send the signed consent form (enclosed) to Mr. Jae-Hyun Kim.

Confidentiality

All personal information will remain strictly confidential and no material that could personally identify the participants will be used in any report or publication of this study. The data will be given a unique code and stored separately from any personally identifiable material in a locked cabinet under the supervision of the Principal Investigator (Dr Elaine Ballard) at The University of Auckland Tamaki Campus. The data will be destroyed (audio recordings erased, electronic files deleted and paper records shredded) six years after completion of the project. If you have any queries or concerns regarding your rights as a participant in this research, you may wish to contact the principal investigator, Dr Elaine Ballard.

Thank you for considering this invitation. We look forward to hearing back from you. Please, contact Jae Hyun Kim, if you require further information.

Mr. Jae-Hyun Kim (PhD Student)
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Dr. Clare McCann (Lecturer/Co-Investigator)
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Associate Professor Douglas Elliffe (Head of Department)
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Address: Private Bag 92019,
Auckland Mail Centre 1142, Auckland

For any queries regarding ethical concerns please contact:
The University of Auckland Human Participants Ethics Committee
Research office-Office of the Vice Chancellor, The University of Auckland, Private Bag 92019, Auckland
373 7599 ext 83711

Approved by The University of Auckland Human Participants Ethics Committee on 13/July/2012 for 3 years (Reference Number 8357)

APPENDIX 4: PARTICIPANT INFORMATION SHEET – TEACHER

Division of Speech Science
Department of Psychology
The University of Auckland
CNR Morrin Road & Merton Road
Glen Innes, Auckland
Private Bag 92019

Participant Information Sheet – Teacher

Project Title:	Phonological Development in Korean-English Bilingual Children
Researchers:	Elaine Ballard, Clare McCann & Jae Kim

My name is Jae-Hyun Kim and I am a PhD student in Speech Science at the University of Auckland. I am undertaking a research project on phonological development in Korean-English bilingual children, under the supervision of Dr Elaine Ballard and Dr Clare McCann (Speech Science, The University of Auckland). We would like to invite your school/early childhood centre to take part in our research. Please read on for more information about this research.

Research background

We are undertaking this research to obtain normative data on phonological development in Korean-English bilingual children. The Korean ethnic group is one of the largest and fastest growing ethnic groups in New Zealand. Currently, there is no normative data for Korean-English bilingual children anywhere in the world. Establishing norms for typical development patterns of phonology in Korean-English bilingual children is important, because bilingual children follow qualitatively different developmental patterns from monolingual children.

The importance of understanding typical phonological development in Korean-English bilingual children goes beyond contributing to our knowledge about bilingual development. Phonological disorders are of the most common developmental communication disorders. Speech-language therapists in New Zealand are increasingly encountering Korean-English bilingual children with suspected phonological disorders in their caseloads. Without the knowledge of typical phonological development in Korean-English bilingual children, speech-language therapists cannot effectively and accurately assess and treat Korean-English bilingual children with phonological disorders.

Your participation

We are seeking your assistance to identify and recruit children for this research project. We are looking for children:

- aged between three and eight years **AND** who are typically developing (that is, the child should not have any conditions known to impact on communication, such as hearing loss or Autism Spectrum Disorder
- who are known to speak Korean and English **OR** whose parents/caregivers speak Korean and English – thus receiving language input in both Korean and English at home, even if they may not speak both languages

We would like to invite such children and their parents/caregivers to take part in our research. If families decide to participate in the research, I will arrange to meet with them. I am a fluent Korean-English bilingual speaker and will be involved in the whole process. Their research participation involves the following:

3. Phonological assessments in English and/or Korean for the participating children during which their responses will be audio-recorded.
4. Questionnaire for the participating child's parent/caregiver on linguistic, developmental and family backgrounds.

This can be done over one session. However, in some cases, this may need to be completed over two sessions, if a child becomes distracted. I am a qualified speech-language therapist and I will administer the phonological assessments. They are entitled to withdraw from involvement in this research at any stage without explanation and to withdraw any or all of the data they provide before 31 March 2014.

The audio-recordings of the phonological assessments will be used to phonetically transcribe the participating child's responses. The transcriptions will be used for phonological analyses to investigate the children's phonological skills accordingly to their biographical factors, including age, age of second language acquisition, and age of arrival in New Zealand. The audio-recordings of the interview, along with the questionnaire, will be used to identify themes and factors influencing the phonological development.

The research can take place either at their home or at The University of Auckland Tamaki Campus. A room *may* be requested at your school/early childhood centre, if the participating child's parent/caregiver should prefer to take part at the school/early childhood centre. I will liaise with your manager about a room at your school/early childhood centre.

If the parents/caregivers do not wish to take part in this research, please assure the parents/caregivers that this will not have any impact or influence on their relationship with the school/early childhood centre.

To participate, please send the signed consent form (enclosed) to me (Jae-Hyun Kim). I will then send you an information sheet and consent form describing this research in both English and Korean to invite these families to take part in our research for you to distribute to families who meet the participation criteria.

Confidentiality

All personal information will remain strictly confidential and no material that could personally identify the participants will be used in any report or publication of this study.Tthe data will be given a unique code and stored separately from any personally identifiable material in a locked cabinet under the supervision of the Principal Investigator (Dr Elaine Ballard) at The University of Auckland Tamaki Campus. The data will be destroyed (audio recordings erased, electronic files deleted and paper records shredded) six years after completion of the project. If you have any queries or concerns regarding your rights as a participant in this research, you may wish to contact the principal investigator, Dr Elaine Ballard.

Thank you for considering this invitation. We look forward to hearing back from you. Please, contact Jae Kim, if you require further information.

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Dr. Clare McCann (Lecturer/Co-Investigator)
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Associate Professor Douglas Elliffe (Head of Department)
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Auckland Mail Centre 1142, Auckland

For any queries regarding ethical concerns please contact:
The University of Auckland Human Participants Ethics Committee
Research office-Office of the Vice Chancellor, The University of Auckland, Private Bag 92019, Auckland
373 7599 ext 83711

Approved by The University of Auckland Human Participants Ethics Committee on 13/July/2012 for 3 years (Reference Number 8357)

APPENDIX 5A: PARTICIPANT INFORMATION SHEET – PARENTS (ENGLISH)

Division of Speech Science
Department of Psychology
The University of Auckland
CNR Morrin Road & Merton Road
Glen Innes, Auckland
Private Bag 92019

Participant Information Sheet – Parents

Project Title:	Phonological Development in Korean-English Bilingual Children
Researchers:	Elaine Ballard, Clare McCann & Jae Hyun Kim

My name is Jae Kim and I am a PhD student in Speech Science at the University of Auckland. I am undertaking a research project on speech sound development in Korean-English bilingual children, under the supervision of Dr Elaine Ballard and Dr Clare McCann (Speech Science, The University of Auckland). We would like to invite you and your child to take part in our research. Please read on for more information about this research.

About this research

We are undertaking this research to obtain normative data on speech sound development in Korean-English bilingual children. The Korean ethnic group is one of the largest and fastest growing ethnic groups in New Zealand. Currently, there is no normative data for Korean-English bilingual children anywhere in the world. Establishing norms for typical development patterns of phonology in Korean-English bilingual children is important, because bilingual children follow qualitatively different developmental patterns from monolingual children. Your participation in this research will contribute to establishing speech sound development norms for Korean-English bilingual children for the first time in the world.

We are looking for children:

- aged between three and eight years **AND** who are typically developing (that is, your child does not have any conditions known to impact on communication, such as hearing loss or Autism Spectrum Disorder
- who speak Korean and English **OR** whose parents/caregivers speak Korean and English – thus receiving language input in both Korean and English at home, even if they may not speak both languages

Your participation

We would like to invite you and your child to take part in this research. If you decide to take part in this research, after reading this information sheet, **please return the signed consent form** using the enclosed envelope. If you have any questions or concerns about this research, please contact me, Jae Hyun Kim. My contact details can be found at the end of this information sheet. I am a Korean-English bilingual speaker and will be able provide further information and answer your questions in either Korean or English. Once I have received the signed consent form, I will contact you to arrange a session with you and your child. There are three options as to where this session can take place.

1. The University of Auckland Tamaki Campus (Glen Innes)
2. Your home
3. Your child's school/kindergarten (this may depend on the availability of the room at your child's school/kindergarten)

If you agree to participate**,** research participation for you and your child involves the following:

1. Speech assessments for your child [approximately 40 minutes] – I am a qualified speech-language therapist and I will administer the speech assessments in Korean and/or English. In the assessments, I am going to show your child pictures and ask your child to tell me what each picture shows – "*What's this called?*" I will be transcribing what your child tells me using the International Phonetic Alphabet symbols. I will also audio-record your child's responses, so that I can make sure that the transcriptions are correct later on. This audio-recording will only be used for the purposes of this research. Your child's responses will be analysed to obtain a profile of your child's speech skills.
2. I will also collect connected speech samples from your child. For older children, I may ask the child to describe a picture. For younger children, a speech sample may be collected during a play activity. The speech samples will be collected in English and/or Korean. [10 minutes]
3. Questionnaire [30 minutes] – While your child is completing the assessments, you will be asked to complete a questionnaire. The questionnaire is prepared in Korean and English. You may choose to complete the questionnaire in the language you feel most comfortable using. The questionnaire consists of some background questions about you and your family, and about your child's medical and developmental history, and linguistic abilities, including speech intelligibility.

Some of the questions in the questionnaire and interview are quite personal but you can choose whether or not you answer any or all of them.

In total, it will take up to two hours of your time. This can be done over one session. However, in some cases, this may need to be completed over two sessions if your child becomes distracted.

Additionally, you are also invited to take part in six monthly follow-up sessions. If you indicate your interest in follow-up sessions on the consent form, I will contact you six monthly to arrange follow-up sessions. I will re-administer the same speech assessments for your child and the same questionnaire for you, which will take about 1 hour. You have no obligations to take part in the follow-up sessions. Even if you indicate your interest in follow-up sessions, you can opt out of this research at any time you wish.

Your child will receive stickers/stamps and you will receive a **$10.00 grocery voucher** for participating in the research as a token of appreciation. If you take part in follow-up sessions, you will receive a $10.00 grocery voucher for every time you participate.

Your rights

Your participation is entirely voluntary. If you do not wish to participate, this will not have any impact on your relationship with the school/kindergarten. You are entitled to withdraw from involvement in this research at any stage without explanation and to withdraw any data you and your child provide before 31 March 2014. You can also request a copy of the research summary. If you have any queries or concerns regarding your rights as a participant in this research, you may wish to contact the principal investigator, Dr Elaine Ballard.

Despite your consent for your child to participate in this research, your child may be reluctant to participate. We will also seek your child's assent to participate. If your child remains reluctant, the session will not proceed.

The information you and your child provides by participating in this research may reveal aspects of your child's speech sound development which may indicate possible delay or disorder. If I suspect this to be the case, I will provide with you contact details of appropriate speech-language therapy service providers.

Confidentiality

All personal information will remain strictly confidential and no material that could personally identify you and your child will be used in any report or publication of this study. Only the named researchers, Jae Hyun Kim, Dr Elaine Ballard and Dr Clare McCann, will have access to the data pertaining to you and your child. In addition, the data will be given a unique code and stored separately from any personally identifiable material in a locked cabinet under the supervision of the Principal Investigator (Dr Elaine Ballard) at The

University of Auckland Tamaki Campus. The data will be destroyed (audio recordings erased, electronic files deleted and paper records shredded) six years after completion of the project. No findings from this research will be reported back to the school/kindergarten. No information will be obtained from or shared with a third party.

Thank you for considering this invitation. We look forward to hearing back from you. Please, contact Jae Hyun Kim, if you require further information.

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Dr. Clare McCann (Lecturer/Co-Investigator)
Speech Science, Department of Psychology,
The University of Auckland
Phone: 09 373 7599 ext 85221
Email: c.mccann@auckland.ac.nz
Address: Private Bag 92019,
Auckland Mail Centre 1142, Auckland

Dr. Elaine Ballard (Lecturer/Principal Investigator)
Speech Science, Department of Psychology,
The University of Auckland
Phone: 09 373 7599 ext 87502
Email: e.ballard@auckland.ac.nz
Address: Private Bag 92019,
Auckland Mail Centre 1142, Auckland

Associate Professor Douglas Elliffe (Head of Department)
Department of Psychology,
The University of Auckland
Phone: 09 373 7599 ext 85262
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Research office-Office of the Vice Chancellor, The University of Auckland, Private Bag 92019, Auckland
373 7599 ext 83711

Approved by The University of Auckland Human Participants Ethics Committee on 13/July/2012 for 3 years (Reference Number 8357)

APPENDIX 5B: PARTICIPANT INFORMATION SHEET – PARENTS (KOREAN)

Division of Speech Science
Department of Psychology
The University of Auckland
CNR Morrin Road & Merton Road
Glen Innes, Auckland
Private Bag 92019

참가자 정보서 – 부모님

연구 제목:	한국어-영어 이중 언어 사용 아동의 조음음운 발달
연구자:	일레인 발라드, 클레어 맥캔 & 김재현

저는 현재 오클랜드 대학교 대학원에서 박사학위를 하고 있는 김재현 입니다. 오클랜드 대학교 언어 과학부에 일레인 발라드 박사님, 클레어 맥캔 박사님과 저는 한국어와 영어 이중 언어를 사용하는 아동을 대상으로 조음음운(말 소리) 발달에 관한 연구를 하고 있습니다. 부모님과 자녀분을 이 연구에 초대하고자 참가자 정보서를 보내드립니다.

이 연구에 관하여

현 연구진은 한국어와 영어 이중 언어 사용을 하는 아동을 대상으로 조음음운발달 과정에 관한 자료를 수집하고 있습니다. 뉴질랜드에서 한국인 커뮤니티는 가장 크고 가장 빠르게 성장하는 커뮤니티 중 하나입니다. 현재 한국어와 영어 이중 언어 사용을 하는 아동을 대상으로 한 조음음운발달 과정에 관한 자료는 전혀 없습니다. 이중 언어를 사용하는 아동의 언어 발달 과정은 한 언어만 사용하는 아동과 다르기 때문에, 한국어와 영어 이중 언어 사용하는 아동의 조음음운발달 과정 연구의 중요성은 아주 큽니다. 부모님과 자녀분의 본 연구 참여는 세계에서 처음으로 한국어와 영어 이중 언어를 사용하는 아동의 조음음운발달 과정 규범 수립에 큰 기여를 할 것입니다.

현 연구진은 다음과 같은 어린이를 찾고 있습니다.

- 3 살과 8 살 사이의 어린이 **중** 청각 장애 또는 자폐증과 같은 언어 발달에 장애를 줄 수 있는 발달 장애가 없이 정상적으로 자라고 있는 어린이들
- 한국어와 영어를 사용하는 어린이 **또는** 두 언어를 같이 사용하지 않아도 부모님/보호자님이 한국어와 영어를 사용하여 한국어와 영어 이중 언어 환경에서 자라고 있는 어린이들

이 연구 참여에 관하여

현 연구진들은 이와 같은 어린이들과 부모님/보호자님을 이 연구에 초대합니다. 이 연구에 참여를 원하시면, 이 참가자 정보서와 참가 동의서를 읽으신 후 **사인하신 참가 동의서를 동봉된 봉투를 사용하여 보내 주십시요**. 만약 질문이 있으시면, 이 참가자 정보서 마지막에 있는 저의 연락처를 사용하여 연락 주십시요 (김재현). 한국어나 영어 중 편한 언어를 사용하여 연락하여 주십시요. 제가 사인이 된 참가 동의서를 받은 후, 부모님과 자녀님을 만나기 위하여 연락 드리겠습니다. 연구 참가는 다음 중 한 곳에서 하실 수 있습니다.

1. 오클랜드 대학교 타마키 캠퍼스 (Glen Innes)
2. 부모님 댁
3. 자녀님의 학교/유치원 (이는 학교/유치원 측과 상의가 필요합니다)

연구 참여 절차는 다음과 같습니다.

1. 아동용 조음음운(말 소리) 평가가 있습니다. [40 분 정도 예상됨] – 임상언어 치료사인 제가 직접 한국어와 영어로 조음음운 평가를 하겠습니다. 평가중, 제가 자녀분에게 그림을 보여주고 그

그림들이 무엇을 보여주는지 물어 보겠습니다. 평가중 제가 자녀분의 답변을 국제 발음기호를 사용하여 기록 하겠습니다. 나중 기록 확인을 위하여 자녀분의 답변을 녹음하겠습니다. 녹음된 자료는 이 연구만을 위하야 사용될 것 입니다. 이 자료는 자녀분의 조음음운 능력을 얻기위해 분석 될 것 입니다.

2. 그림 묘사나 놀이를 통하여 자녀분이 연결된 이야기를 하여 답변을 녹음 하겠습니다. 자녀분의 나이에 맞는 방법이 사용될 것 입니다. 한국어와 영어로 답변이 수집됩니다. [10 분]
3. 참고자료 질문사항[30 분] – 자녀분이 조음음운 평가를 하는 동안, 부모님/보호자님은 설문지를 작성하실 수 있습니다. 이 설문지는 한국어와 영어로 준비되어 있어 부모님/보호자님이 편한 언어로 작성하실 수 있습니다. 이 설문지는 부모님과 참가 아동의 관한 질문들로 구성되어 있습니다. 설문지는 참가 아동의 의료적과 전체적인 발달, 언어 발달 과정 그리고 자녀분의 발음 명료를 표함한 언어 능력에 관한 질문을 포함합니다.
4. 인터뷰 [30 분] – 자녀님의 조음음운 평가 전 혹은 후에 제가 자녀님의 의료적 배경과 발달 과정, 가정과 학교 환경, 이중 언어 아이를 기르는 것에 관한 부모님/보호자님의 의견을 수집하겠습니다. 답변은 나중 기록과 번역을 위하여 녹음됩니다.

설문지와 인터뷰의 질문 중 개인적인 질문들이 있습니다. 설문지와 인터뷰 질문 중 대답을 원하시는 질문만 대답하여 주셔도 됩니다.

연구 절차는 최대 두시간 정도 걸릴것으로 예측됩니다. 주로 한번 만남이 충분하나, 어린이가 연구 절차가 너무 길다고 느끼는 경우 두번을 만나야 하는 경우가 있을 수 있습니다.

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보모님/보호자님의 참가 동의에도 불구하고, 참가 아동이 이 연구에 참가를 원하지 않을 경우가 있습니다. 참가 절차 시작 전에 어린이의 참가 동의를 구하겠습니다. 어린이의 참가 동의에도 불구하고 어린이가 이 연구 참가를 원하지 않는 경우 연구 절차를 중지하겠습니다.

이 연구 절차 중 수집된 자료가 참가 아동의 조음음운 발달 지연 또는 장애를 나타내는 증거가 있다고 의심이 될 때는 부모님/보호자분께 임상언어치료를 제공하는 클리닉의 연락처 정보가 제공될 것입니다.

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모든 개인 정보는 엄격하게 기밀로 유지되며 본 연구의 보고서나 학술 잡지 출판 시에 참가자를 식별할 수 없도록 기록 됩니다. 본 참가자 정보서에 이름이 포함된 김재현, 일레인 발라드 박사님 그리고 클레어 맥칸 박사님만이 부모님/보호자분과 참가 아동에 관한 자료를 볼 수 있습니다. 모든 자료들은 고유 코드가 주어져 참가자 식별이 가능한 문서들과 따로 개인적으로 저장되어 주 연구원 일레인 발라드 박사님 보호아래 오클랜드 대학교 타마키 켐퍼스에 보관됩니다. 자료들은 이 연구 종료 6 년후 제거됩니다. 녹음된 참가 아동의 말소리 자료가 현 연구진이 아닌 다른 사람이 신뢰성과 정확성을 위하여 다시 분석을 할 수도 있습니다. 녹음된 자료와 컴퓨터 자료들은 지워지며 기록지들은 찢어질 것 입니다. 다른 사람이나 단체로 부터 자녀분과 부모님/보호자님의 관한 자료가 수집되지 않습니다. 모든 연구 자료는 현 연구진만 이용이 가능하며 다른 사람이나 단체가 이용 또는 접급할 수 없습니다.

만약 부가적인 질문이 있으시면 아래의 연락처를 이용하여 김재현 학생에게 연락하여 주십시요. 이 연구 참여 초대를 고려하여 주셔서 감사합니다.

감사합니다.

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윤리적인 문제에 관하여는, 아래로 연락하십시요
The University of Auckland Human Participants Ethics Committee
Research office-Office of the Vice Chancellor, The University of Auckland, Private Bag 92019, Auckland
09 373 7599 ext 83711

이 연구는 2012 년 7 월 13 일 오클랜드 대학교 윤리 위원회로 부터 3 년 동안 승인을 받았습니다 (참조 번호 8357)

APPENDIX 6A: PARTICIPANT INFORMATION SHEET – CHILDREN (ENGLISH)

Division of Speech Science
Department of Psychology
The University of Auckland
CNR Morrin Road & Merton Road
Glen Innes, Auckland
Private Bag 92019

Participant Information Sheet – Children

To be read aloud to the participating child

Project Title:	Phonological Development in Korean-English Bilingual Children
Researchers:	Elaine Ballard, Clare McCann & Jae Hyun Kim

Hello. My name is Jae and I am from the University of Auckland. I am doing some work into how children like you say Korean and English words. So, I want to find out how you talk in Korean and English. I have two picture books and we'll have a look at the pictures together. When we look at one picture book, I'll ask you what's in the pictures and I'll ask you to tell me in Korean. When we look at the other picture book, I'll ask you what's in the pictures and I'll ask you to tell me in English.

When we look at the picture books together, we can take breaks or stop at any time if you want. I am also going to bring a little voice recorder and put close to you when we look at the pictures. It will record what you say, because I want to listen to you later on. But if you want me to stop recording you can tell me at any time and we can turn it off. I have a couple of cool stickers for you after we've finished!

Only you, me and your mum or dad will know about this. And when I go away, I am going to put everything in a box so no one else can see what we've done. I'll keep those for a long time (6 years) in a safe place. I may also go away and write something about what you've done but no one will know that it's you because I won't use your name.

If you don't want to do it, it is okay with me, your mum and dad. If you start and don't want to do it anymore, we can stop at any time. Does this sound okay?

Do you have any questions?

Mr. Jae Hyun Kim (PhD Student)
Speech Science, Department of Psychology,
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Address: Private Bag 92019,
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Dr. Elaine Ballard (Lecturer/Principal Investigator)
Speech Science, Department of Psychology,
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Phone: 09 373 7599 ext 87502
Email: e.ballard@auckland.ac.nz
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Dr. Clare McCann (Lecturer)
Speech Science, Department of Psychology,
The University of Auckland
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Email: c.mccann@auckland.ac.nz
Address: Private Bag 92019,
Auckland Mail Centre 1142, Auckland

Associate Professor Douglas Elliffe
(Head of Department)
Department of Psychology, The University of Auckland
Phone: 09 373 7599 ext 85262
Email: d.elliffe@auckland.ac.nz
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For any queries regarding ethical concerns please contact:
The University of Auckland Human Participants Ethics Committee
Research office-Office of the Vice Chancellor, The University of Auckland, Private Bag 92019, Auckland
09 373 7599 ext 83711
Approved by The University of Auckland Human Participants Ethics Committee on 13/July/2012 for 3 years (Reference Number 8357)

APPENDIX 6B: PARTICIPANT INFORMATION SHEET – CHILDREN (KOREAN)

Division of Speech Science
Department of Psychology
The University of Auckland
CNR Morrin Road & Merton Road
Glen Innes, Auckland
Private Bag 92019

참가자 정보서 – 참가 아동

연구자가 참가 아동에게 읽어 줌

연구 제목:	한국어-영어 이중 언어 사용 아동의 조음음운 발달
연구자:	일레인 발라드, 클레어 맥캔 & 김재현

안녕. 나는 오클랜드 대학교에 있는 김재현이라고해. 나는 너와 같은 아이들이 한국어와 영어를 말하는지 보는 중이야. 그래서 나는 너가 한국어와 영어로 어떻게 말을 하는지 보고 싶어. 내가 가지고 있는 그림책 두개를 같이 보고, 한 그림책을 볼 때, 내가 그림책에 뭐가 있는지 물어 볼꺼야. 한 그림책을 볼 때는 내가 한국어로 물어보고 다른 그림책을 볼 때는 영어로 물어 볼꺼야.

우리가 그림책을 볼 때, 너가 원하면, 쉬면서 하거나 그만 할 수 도있어. 내가 올 때, 목소리를 녹음하는 작은 녹음기를 가지고 와서 너 옆에 놓아 둘께. 너가 말하는 걸 녹음해서 나중에 다시 들어 보고 싶어서 그래. 너가 녹음을 잠깐 중지하고 싶으면, 나 한테 말하면, 녹음 중지할 수 있어. 끝나면 너 줄 스티커도 가지고 올께!

너, 나 그리고 엄마, 아빠만 너가 참가한 것을 알고 있을 꺼야. 또 우리가 다 끝나면 아무도 못 보게 전부다 상자 안에 넣어 놓을꺼야. 그리고는 우리가 오랫동안 (육 년) 안전하게 모아 놓을께. 우리가 다 끝나면, 내가 너가 해준 말들에 대해서 몇 가지 적을지도 몰라. 그러면, 아무도 너거 한 말이라는 것을 모르게 너 이름을 쓰지 않을께.

만약 하고 싶지 않아도 괜찮아. 너가 하기 시작하고도 하기 싫다고 생각돼면, 그만 할 수 도 있어. 괞찮겠니?

질문 있니?

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윤리적인 문제에 관하여는, 아래로 연락하십시요

The University of Auckland Human Participants Ethics Committee

Research office-Office of the Vice Chancellor, The University of Auckland, Private Bag 92019, Auckland

09 373 7599 ext 83711

이 연구는 2012 년 7 월 13 일 오클랜드 대학교 윤리 위원회로 부터 3 년 동안 승인을 받았습니다 (참조 번호 8357)

APPENDIX 7: CONSENT FORM – PRINCIPAL

Division of Speech Science
School of Psychology
The University of Auckland
CNR Morrin Road & Merton Road
Glen Innes, Auckland
Private Bag 92019

Consent Form – Principal

Project title: Phonological Development in Korean-English Bilingual Children
Researchers: Elaine Ballard, Clare McCann & Jae Hyun Kim

THIS CONSENT FORM WILL BE HELD FOR A PERIOD OF SIX YEARS

- I understand the aims and procedures of the research project and have had the opportunity to ask questions about the research project and have them answered.
- I agree that the researchers may approach teachers at the school/early childhood education centre for assistance in identifying and recruiting potential participants for this research.
- I understand that participation in this research is entirely voluntary and that the participants are entitled to withdraw any of or all of their data before 31 March 2014.
- I agree that participation or non-participation of the children identified through the school/early childhood education centre will have no impact on the relationship between the children and the school/early childhood education centre.
- I understand that the children's responses during the phonological assessments and connected speech samples are audio-recorded and phonetically transcribed.
- I understand that the participating children's parents/caregivers will be asked to complete a questionnaire.
- I understand that all data collected from the participants for this research, including audio-recordings, transcribed and translated data, will only be used for the purposes of this research.
- I understand that all personal information of the participants will remain strictly confidential and no material that could potentially identify the participants will be used in any report of this research.
- I understand that the translated and transcribed data (i.e. phonological assessment results, questionnaire and interview data) will be codified and stored separately from any personally identifiable material.
- I understand that all data including the consent form are stored six years after the completion of the research in a locked cabinet under the supervision of the principal investigator, Elaine Ballard at the University of Auckland Tamaki Campus, and that after a period of six years, all audio-files and any electronic data will be deleted and all paper records will be shredded.

Signed:

Name: (*please print clearly*) _____ **Date:** _____

Name of the school/early childhood education centre _____

Address: _____

How may I contact you? (*please tick one and provide the information below*)

- o **Phone:** _____
- o **Email:** _____

Approved by The University of Auckland Human Participants Ethics Committee on 13/July/2012 for 3 years (Reference Number 8357)

APPENDIX 8: CONSENT FORM – TEACHER

Division of Speech Science
Department of Psychology
The University of Auckland
CNR Morrin Road & Merton Road
Glen Innes, Auckland
Private Bag 92019

Consent Form - Teacher

Project title: Phonological Development in Korean-English Bilingual Children
Researchers: Elaine Ballard, Clare McCann & Jae Hyun Kim

THIS CONSENT FORM WILL BE HELD FOR A PERIOD OF SIX YEARS

- I understand the aims and procedures of the research project and have had an opportunity to ask questions about the research project and have them answered.
- I agree that I can assist the research team in identifying families who meet the participant criteria and that I can distribute an information sheet and consent form, provided by the researcher team, to invite such families to participate in this research.
- I understand that participation in this research is entirely voluntary and that the participants are entitled to withdraw any of or all of their data before 31 March 2014.
- I understand that a room may be requested for the phonological assessments and interview if the parents/caregivers would like to participate in this research at the school/early childhood centre.
- I agree that participation or non-participation of the children identified through the school/kindergarten will have no impact on the relationship between the children and the school/early childhood centre.
- I understand that the children's responses during the phonological assessments and connected speech samples are audio-recorded and phonetically transcribed.
- I understand that the participating children's parents/caregivers will be asked to complete a questionnaire and will be interviewed, and that the interview will be audio-recorded.
- I understand that all data collected from the participants for this research, including audio-recordings, transcribed and translated data, will be accessed only by the named researchers and will only be used for the purposes of this research.
- I understand that all personal information from the participants will remain strictly confidential and no material that could potentially identify the participants will be used in any report of this research.
- I understand that the translated and transcribed data (i.e. phonological assessment results, questionnaire and interview data) will be codified and stored separately from any personally identifiable material.
- I understand that all data including the consent form are stored for six in a locked cabinet under the supervision of the principal investigator, Elaine Ballard at the University of Auckland Tamaki Campus, and that after this period, all audio-files and any electronic data are deleted and all paper records are shredded.

Signed:

Name: (*please print clearly*) _____ **Date:** _____

Name of the school/early childhood education centre _____

Address: _____

How may I contact you? (*please tick one and provide the information below*)

- o **Phone:** _____
- o **Email:** _____

Approved by The University of Auckland Human Participants Ethics Committee on 13/July/2012 for 3 years (Reference Number 8357)

APPENDIX 9A: CONSENT FORM – PARENTS (ENGLISH)

Division of Speech Science
Department of Psychology
The University of Auckland
CNR Morrin Road & Merton Road
Glen Innes, Auckland
Private Bag 92019

Consent Form – Parents

Project title: Phonological Development in Korean-English Bilingual Children
Researchers: Elaine Ballard, Clare McCann & Jae Hyun Kim

THIS CONSENT FORM WILL BE HELD FOR A PERIOD OF SIX YEARS

- I understand the aims and procedures of the research project and have had the opportunity to ask questions about the research project and have them answered.
- I understand that participation is entirely voluntary and that I am entitled to withdraw any of or all of my own and my child's data before 31 March 2014.
- I understand that my participation or non-participation in this research will have no impact on the relationship my child and I have with the school/kindergarten and that the school/kindergarten has signed a consent form agreeing to this.
- I have been given an opportunity to take part in six monthly follow-up sessions and I understand that I can opt out of the research at any time I wish, even if I indicate my interest to be followed up on this consent form.
- I understand that my child's responses during the phonological assessments and connected speech samples will be audio-recorded and phonetically transcribed.
- I understand that I will be asked to complete a questionnaire and will be interviewed, and that the interview will be audio-recorded.
- I understand that all data collected from me and my child for this research will be accessed only by the named researchers and will only be used for the purposes of this research.
- I understand that my child will give assent as well as my consent for my child to participate in this research and that if my child does not wish to participate in this research, data collection will not proceed.
- I understand that the data collected for the purpose of this research may reveal aspects of my child's speech sound development which may indicate possible delay or disorder. I also understand that, if this should be the case, I will be provided with contact details of appropriate speech-language therapy service providers from the researcher.
- I understand that no information about me or my child will be obtained from a third party.
- I understand that all personal information from me and my child will remain strictly confidential and no material that could potentially identify us will be used in any report of this research.
- I understand that all data including the consent form are stored six years after the completion of the research in a locked cabinet under the supervision of the principal investigator, Elaine Ballard at the University of Auckland Tamaki Campus, and that after a period of six years, all audio-files and any electronic data will be deleted and all paper records will be shredded.

I, _____, (your name) agree to take part in this research.

I agree that _____ (child's name), who is under my guardianship, may participate in this research.

Where would you like to take part in this research? (tick one)

- o I would like to take come to The University of Auckland to participate in this research.
- o I would like the researcher to arrange a home visit and would like to do it at home.

- o I would like the researcher to arrange a room at the child's school/kindergarten.

I would like to receive the research summary (circle one) YES / NO

I would like to take part in six monthly follow-up sessions (circle one) YES / NO

Signed: **Date:** _____

How may I contact you? (*please tick one and provide the information below*)

- o **Phone:** _____
- o **Email:** _____

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APPENDIX 9B: CONSENT FORM – PARENTS (KOREAN)

Division of Speech Science
Department of Psychology
The University of Auckland
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Glen Innes, Auckland
Private Bag 92019

참가자 동의서 – 부모님

연구 제목:	한국어-영어 이중 언어 사용 아동의 조음음운 발달
연구자:	일레인 발라드, 클레어 맥캔 & 김재현

이 참가자 동의서는 6 년동안 보관됩니다

- 나는 이 연구의 목적과 절차를 이해한며 이 연구에 관한 질문에 대한 답을 구했다.
- 나는 이 연구의 참가가 자발적이며 2014 년 3 월 31 일전에 제공한 자료의 일부 혹은 전부를 철회 할 수 있음을 이해한다.
- 나는 이 연구에 내가 참가하고 또는 참가하지 않음이 나와 학교/유치원과의 관계가 전혀 없음을 이해하고, 학교/유치원 측 또한 이를 동의하는 동의서를 사인하였음을 이해한다.
- 나는 6 개월 마다 이 연구에 다시 참가 할 수 있는 기회를 받았으며, 이 동의서에 6 개월 마다 다시 연구 참가에 동의하여도 내가 이 연구에서 내가 원하는 언제든 참가를 중단할 수 있음을 이해한다.
- 나는 참가 아동의 조음음운 평가 답변과 발화연결 검사의 답변이 녹음이 되어 나중 참가 아동의 조음음운 능력에 관한 자료를 얻기위해 분석이 됨을 이해한다.
- 나는 설문지 작성과 인터뷰를 해야함을 이해하며 인터뷰의 답변이 녹음이 되어 나중 참가 아동의 조음음운 발달에 미치는 요인을 검사하기 위하여 사용 됨을 이해한다.
- 나는 이 연구 절차 중 녹음, 기록 또는 번역이 된 모든 자료들이 이 연구에 관하여만 사용이 됨을 이해하며 현 연구진만이 이용이 가능함을 이해한다.
- 나는 나의 동의와 별도로 현 연구원이 참가 아동으로 부터 참가 동의서를 구할 것을 이해하며, 참가 아동이 이 연구에 참가 동의를 한 후에도 참가를 원하지 않을 경우 연구 절차가 중지 될것을 이해한다.
- 나는 이 연구 절차 중 수집된 자료가 참가 아동의 조음음운 발달 지연 또는 장애를 나타내는 증거가 있다고 의심이 되는 경우 임상언어치료를 제공하는 클리닉의 연락처 정보를 제공받을 것을 이해한다.
- 나는 나와 참가 아동에 관한 정보가 현 연구진이 아닌 다른 사람 혹은 다른 단체로 부터 수집되지 않음을 이해한다.
- 나는 개인 정보가 엄격하게 기밀로 유지되며 이 연구의 보고서에 참가자를 식별할 수 없도록 기록이 됨을 이해한다.
- 나는 이 참가자 동의서를 포함한 모은 자료가 이 연구 종결 후 6 년 동안 주 연구원 일레인 발라드 보호아래 오클랜드 대학교 타마키 캠퍼스에 잠긴 캐비넷에 보관이 됨을 이해한다. 나는 그 후 녹음 자료를 포함한 모든 컴퓨터 파일이 지워지며 기록지들은 찢어질 것을 이해한다.

나, _____, (참가자 이름)는 이 연구에 참가함을 동의한다.

나는_____ (참가 아동 이름)이 이 연구에 참가함을 동의한다.

원하시는 참가 장소를 선택하여 주십시요.

- o 나는 오클랜드 대학교 타마키 캠퍼스에서 이 연구를 참가하기를 원한다.
- o 나는 연구자가 집으로 찾아와 나의 집에서 이 연구를 참가하기를 원한다.

o 나는 참가 아동의 학교 또는 유치원에서 이 연구를 참가하기를 원한다.

요약 결과를 받기를 원하 십니까? 네 / 아니오

나는 6 개월 마다 다시 이 연구에 참가하기를 원한다. 네 / 아니오

서명: _____/_____/_____

_____

연구자가 연락을 할 수 있도록 아래 전화번호 혹은 이메일을를 적어 주십시요

- **Phone:** _____
- **Email:** _____

이 연구는 2012 년 7 월 13 일 오클랜드 대학교 윤리 위원회로 부터 3 년 동안 승인을 받았습니다 (참조 번호 8357)

APPENDIX 10A: ASSENT FORM – CHILDREN (ENGLISH)

Division of Speech Science
Department of Psychology
The University of Auckland
CNR Morrin Road & Merton Road
Glen Innes, Auckland
Private Bag 92019

Assent Form – Children

Project title: Phonological Development in Korean-English Bilingual Children
Researchers: Elaine Ballard, Clare McCann & Jae Hyun Kim

THIS CONSENT FORM WILL BE HELD FOR A PERIOD OF SIX YEARS

- I have had the information sheet read to me.
- I understand what we are doing.
- Jae has answered my questions.
- I understand that I will look at pictures books and tell Jae what's in the pictures in Korean and in English.
- I understand that Jae will look at my talking later.
- I understand that Jae will use a voice recorder so he can listen to me talking later.
- I understand that I can ask Jae to stop the recording without saying why.
- I understand that I can ask Jae to stop looking at the picture books when I am tired or I want to take a break.
- I understand that Jae will keep everything in a safe box so no one will know what I told Jae.
- I understand that Jae may write something about what I said but will do it without using my name, so no one will know that it is me.
- I understand that my recordings will be kept for a long time/six years in a safe place.

If you want to do this with me, write your name here: _____

Date: _____

Approved by The University of Auckland Human Participants Ethics Committee on 13/July/2012 for 3 years (Reference Number 8357)

APPENDIX 10B: ASSENT FORM – CHILDREN (KOREAN)

Division of Speech Science
Department of Psychology
The University of Auckland
CNR Morrin Road & Merton Road
Glen Innes, Auckland
Private Bag 92019

참가자 동의서 – 참가 아동

연구 제목:	한국어-영어 이중 언어 사용 아동의 조음음운 발달
연구자:	일레인 발라드, 클레어 맥캔 & 김재현

이 참가자 동의서는 6 년동안 보관됩니다

- 나는 참가자 정보에 관한 내용을 들었다.
- 나는 우리가 무엇을 하는지 이해한다.
- 나는 나의 질문의 대답을 구했다.
- 나는 우리가 그림책을 보고 김재현 선생님께 그림에 무엇이 있는지 한국어와 영어로 말함을 이해한다.
- 나는 김재현 선생님이 나중에 내가 말한 것을 볼것을 이해한다.
- 나는 김재현 선생님이 내가 말한것을 나중에 듣기 위해 녹음함을 이해한다.
- 나는 김재현 선생님께 이유를 말하지 않고 녹음 중지를 구할 수 있다.
- 나는 내가 피곤하고 쉬고 싶을 때, 그림책 보는 것을 그만 할 수 있다.
- 나는 김재현 선생님이 내가 말한 모든 것을 안전한 상자에 보관하여 내가 말한 것을 아무도 알지 못하게 됨을 이해한다.
- 나는 김재현 선생님이 내가 말한 것에 관하여 적을 때 나라는 것을 모르도록 내 이름을 밝히지 않음을 이해한다.
- 나는 나의 녹음 내용이 안전한 곳에 오랫동안/육 년동안 보관됨을 이해한다.

참가를 원하면, 이름을 적어 주세요: _____

_____/_____/_____

이 연구는 2012 년 7 월 13 일 오클랜드 대학교 윤리 위원회로 부터 3 년 동안 승인을 받았습니다 (참조 번호 8357)