The Phonological Abilities of Bilingual Children with Specific Language Impairment: A Descriptive Analysis

Les habiletés phonologiques des enfants bilingues présentant un trouble spécifique de développement du langage : un analyse descriptive.

Andrea A. N. M^{ac}Leod
Rebecca J. M^{c}Cauley

Abstract

The purpose of this comparative study was to provide basic information about the phonological abilities of Canadian French-English bilingual children with specific language impairment (SLI). Thus five bilingual children with SLI (6;11 to 7;11) were compared to four French monolingual children with SLI (7;0-8;1) as well as with four normally developing monolingual children (2;5 to 3;10). The phonology of the three groups was compared using standard methods of phonological description as well as measures recently proposed (Ingram & Ingram 2001; Ingram, 2002). The seven sets of phonological measures were made from conversational samples conducted in French between the child and an adult, taken from previously collected experimental data. The group comparison examined the relationship between differences in sound use that may be motivated by the complexities posed by the bilingual environment and those secondary to identified developmental language learning difficulties (i.e., SLI).

Abrégé

Cette étude comparative avait pour objectif d'obtenir de l'information de base sur les habiletés phonologiques des enfants canadien français présentant des troubles spécifiques de développement du langage (TSDL). Cinq enfants bilingues présentant un TSDL (âgés entre 6;11 et 7;11) ont été comparés à quatre autres enfants unilingues français présentant aussi un TSDL (âgés entre 7;0 et 8;1) de même qu'avec quatre autres enfants unilingues présentant un développement normal du langage (âgés entre 2;5 et 3;10). La phonologie des trois groupes a été comparée en utilisant des méthodes de description phonologique standards de même qu'à l'aide de méthodes de mesure récemment proposée (Ingram & Ingram, 2001; Ingram, 2002). Les sept ensembles de mesures phonologiques ont été effectuées à partir d'échantillons de conversation conduites en français, entre un enfant et un adulte. Ces échantillons provenaient de cueillettes de données expérimentales effectuées dans le passé. Les comparaisons entre les groupes portaient sur la relation entre les différences au niveau de la production des sons qui aurait pu être attribuables à la complexité de l'environnement bilingue et celles secondaires aux difficultés d'apprentissage du langage (p. ex., TSDL).

Key words: bilingualism, phonology, specific language impairment, French, Canadian French, dialect

Andrea A. N. M^{ac}Leod, MS
University of Washington
Seattle, Washington

Rebecca J. M^{c}Cauley, PhD
University of Vermont
Burlington, Vermont

Currently, a lack of research on the topic of bilingual phonological development has led to an underdiagnosis of bilingual children with phonological disorders because of the difficulty identifying normal bilingual development and deviant bilingual development (Anderson,

1996; Crutchle, Botting, & Conti-Ramsden, 1997; Goldstein & Iglesias, 1996; Holm & Dodd, 1999; Holm, Dodd, & Ozanne, 1997). In addition, bilingual children are often only diagnosed with a language problem once it has become more complex and severe, adversely impacting their success in school (Crutchle et al., 1997). Many children with moderate to severe phonological disorders are reported to have poor phonological awareness skills and greater difficulty learning to read (Bernthal & Bankson, 1998).

The description of a bilingual individual must consider a number of different factors to best understand the nature of his or her language use. Broadly, the factor to consider is the ease with which a person uses each of his or her languages in speaking, reading, writing, and listening. Factors which contribute to this ease in production and comprehension include the age when the languages were acquired, linguistic relationships between the languages being acquired, the social contexts of language acquisition, and the social status of the languages (Genesee, 1994). Before addressing the specifics of this study, a brief review is needed of bilingualism, the Canadian French sound system, and the phonological development and abilities of children who are monolingual and bilingual, as well as those with SLI.

Bilingualism

According to Grosjean (1982), psychosocial factors such as the use of language in the family, in school, or in the community will determine the degree of bilingualism attained by a child, not whether the languages were learned simultaneously or successively. However, it is important to identify the nature of language acquisition and exposure when examining the phonology of young children because these factors will be reflected in their degree of bilingualism. Thus, simultaneous bilingual acquisition will be used herein to refer to the acquisition of two languages before the age of three, whereas successive bilingual acquisition will refer to the acquisition of a second language after the age of three (McLaughlin, 1978 in Grosjean, 1982).

The second and third factors contributing to ease of production and comprehension is the social context of language acquisition and the social status of the two languages (Genesee, 1994). The region targeted for this study includes urban and rural areas between Ottawa, Ontario and Montreal, Quebec, wherein approximately 70% to 90% of inhabitants speak French as their first language (Mougeon, Beniak, & Valois, 1985). These regions provide fertile grounds for investigating individual bilingualism because of the numerous contexts for using both English and French, thus, strengthening the linguistic skills of bilingual residents. An understanding of the nature of bilingualism and related factors guided the selection of participants for this study.

Canadian French

Dumas (1987) and Walker (1984) have provided insightful descriptions of Canadian French based largely on the variety spoken in Montreal, Quebec. Work by Walker also highlights departures Canadian French has made and continues to make from European French. The phonetic inventories of Canadian and European French are the same when a broad transcription is undertaken, but differences arise in the phonetic realization of these sounds (Walker, 1984). A caveat must be included, however, since the speakers of Canadian French vary in their use of Canadian French features according to both linguistic and social context, a process common among speakers of all nonstandard language variants (Romaine, 1991).

The key characteristics of the production of consonants in Canadian French as identified by Walker (1984) and Dumas (1987) include the processes of affrication of apical stops /t, d/, final consonant deletion, final consonant retention or insertion, and nasal assimilation. This study does not require discussion of vowels because of the focus on consonant errors which are dominant in most descriptions of phonological disorders (Pollack, 2002). However, the number and complexity of phonological processes which vowels undergo make them a fascinating focus of future study.

Perhaps the most notable characteristic of Canadian French consonant production is the process of affrication which applies to the apical stops /t, d/ making them /ts, dz/ respectively, when followed by a high front vowel or glide (e.g., "petit" /pətsi/; "tube" /tsyb/; Dumas, 1987; Walker, 1984). The process of affrication takes place within word boundaries where it is a pervasive process, and it can occur across separate morphemes in the case of clitics and compound words (e.g., " parle-t-il" /paʁltsıl/; "Sept-Îles" /sɛtsıl/; Dumas, Walker).

Final consonant deletion occurs in both European French and Canadian French; however, Walker (1984) notes it occurs to a much greater extent in Canadian French. In European French the deletion occurs dominantly with final consonant-liquid clusters, as well as the deletion of two stops in certain masculine-feminine adjective pairs or derived forms. Canadian French simplifies most final consonant clusters, except for liquid-consonant and consonant+/s/ clusters (e.g., "cercle" /sɛʁk/; "ministre" /minıs/; "correct" /cʌʁɛk/). The retention of final consonants occurs in both European French and Canadian French, but occurs in a greater number of words in the latter (Dumas, 1987; Walker

1984). Walker notes that the consonant retained or inserted is almost always /t/ (e.g., "bout" /but/; "adroit" /adʁɛt/; "ici" /ɪsɪt/).

Nasal assimilation is also observed in both varieties of French but is more lexically widespread in Canadian French (Walker, 1984). Nasal assimilation describes the tendency for voiced stops to assimilate to a preceding or a following nasal vowel or consonant (Walker). This process results in the production of a homorganic nasal consonant: /b-m, d-n, g-N/ (e.g., "ensemble" /ãsãm/; "lendemain" /lãnmɪ̃n/; "jungle" /ʒœ̃ŋ/; Dumas, 1987; Walker).

The velar nasal /N/ has been marginal in European French because of its infrequent presence in all but loan-words such as "parki*ng*" and "smoki*ng*," and in the process of nasal assimilation described previously (Walker, 1984). This phoneme has become less marginal in Canadian French due to the process of velarization of the palatal nasal /œ/ when in syllable final position (e.g., palatal /ɲ/ in "baigne" /bɛɕ/ contrasted with velar /ŋ/ in "baigne" /bɛŋ/).

A brief note on the prosodic nature of Canadian French, specifically stress, is necessary to provide a fuller understanding of the production of this variant of French. The term *stress* in phonology describes the degree of prominence a syllable is given in contrast to other syllables (Dobrovolsky, 1996). At the word level, Canadian French is a quantity-sensitive, or *iambic* language with word-level stress placed on the final syllable unless the final syllable ends with a schwa (Paradis, 2001; Walker, 1984). This word-level distinction may affect the truncation patterns expected in the present study.

Monolingual Phonological Development

Phonological development is most frequently seen through the lens of English phonological development. A number of studies have provided critical information necessary to distinguishing between normal, delayed, and deviant phonological development. Unfortunately, corresponding data on the phonological development of bilingual three-year-old children is not available at this time. In order to better understand the phonological abilities of the children in the present study, a review of available data from younger French children, and children from the same age groups who speak English, Spanish, or Italian will be reviewed.

Recently, Vinter (2001) has reported on the phonological development of 13 two-year-old French children from France. Further developmental data from Vinter are expected and should provide considerable insight into the expected acquisition patterns of children speaking Canadian French. Her data revealed that by age 24 months the intelligibility of these children was 69.3%; the phonetic inventory of over 70% of the 13 children had a phonetic inventory that involved /p, b, t, d, k, m, n, s, l, w, j/ in initial position, and a reduced inventory of /p, t, k, m, f, v, s, w, j/ in final position; and they used a variety of syllable structures, including consonant-vowel (CV), CVCV, VCV, CVC, and CVCVC items. The following phonological processes were observed: final consonant deletion, consonant cluster reduction, stopping, fronting, gliding, and consonant harmony.

English speaking children by the age of three have most difficulty with the production of liquids and stridents (/f, v, s, z, ʃ, ʒ, tʃ, dʒ/) and consonant clusters. They are no longer applying the majority of simplifying phonological processes (Vihman & Greenlee, 1998). This decrease in phonetic and phonological errors made by children at this age leads to an increases in intelligibility (Vihman & Greenlee), although increases in MLU and sentence length can act to decrease overall intelligibility for some children (Vihman & Greenlee).

Normative data from Spanish indicate that by the age of three years most children will have acquired the dialect features of the community and the vowel system and the consonant systems (Anderson & Smith, 1987; Pandolfi & Herrera, 1990 in Iglesias & Goldstein, 1998). These children will exhibit some difficulty with a few phones, mainly fricatives and liquids (i.e. / ð, x, s, ŋ, tʃ, ɾ, r, l /; Acevedo, 1991; Jimenez, 1987 as cited in Iglesias & Goldstein, 1998). In addition, a limited number of phonological processes will still be present, specifically cluster reduction, unstressed syllable deletion, stridency deletion, and tap/trill and /r/ deviation (Goldstein & Igleisas, 1996).

Lastly, normative data indicate that Italian children between the ages of 26 and 35 months have acquired most of the vowel and consonant systems of Italian (Bortolini & Leonard, 1991). As with Spanish speaking children, the children in Bortolini and Leonard's study evidenced a number of phonological processes including assimilation of place, consonant cluster reduction, unstressed syllable deletion, tap/trill deviation, and epenthesis of both consonants and vowels.

Some error patterns are reported across all four languages studied, and others seem language specific (see Table 1). The data available from English, Spanish, Italian, and younger French children allow the tentative creation of hypotheses regarding the developmental patterns that should be expected in the phonology of French speaking children. Specific phonemes which continue to be challenging for the French-speaking children who are approximately three years old are predicted to be from the classes of fricatives and liquids.

Table 1
Developmental patterns observed in normally developing children from English, French, Spanish, and Italian data sets

Developmental Patterns	Observed in English Stoel-Gammon, 1991	Observed in French at 24 months (Vinter, 2001)	Observed in Spanish Goldstein & Iglesias, 1996	Observed in Italian Bortolini & Leonard, 1991
Age of Children	**36 months**	**24 months**	**36 months**	**26 to 35 months**
Phones in error	f, v, s, z, ʃ, ʒ, tʃ, dʒ	g, s, z, w, ʃ, ʒ, l,ɲ,ʀ	ð, χ, s, ŋ, tʃ, ɾ, r, l	Not reported
(phone classes)	(fricatives, liquids)	(voiced velar stops, fricatives, liquids)	(fricatives, nasals, liquids)	(fricatives, nasals, liquids)
Consonant Cluster Reduction	Yes	Yes	Yes	Yes
Unstressed syllable deletion	Not reported	Yes	Yes	Yes
Stridency deletion	Not reported	Yes	Yes	Not reported
Tap/trill deviation	Not reported	Yes	Yes	Yes
Gliding	Yes	Yes	Not reported	Not reported
Assimilation of Place	Not reported	Yes	Not reported	Yes
Stopping	Not reported	Yes	Not reported	Not reported
Fronting	Not reported	Yes	Not reported	Not reported
Devoicing	Not reported	Yes	Not reported	Not reported

The phonological processes of consonant cluster reduction, unstressed syllable deletion and /"/ deviation are also expected.

Bilingual Phonological Development

McLaughlin (1984) observed that studies of bilingual development are varied with regards to the languages being acquired, focus of the study, and the methodology used by the researchers and, unfortunately, this continues to be the case. Despite this methodological variation, data suggest that bilingual children may not follow the same developmental patterns as monolingual children with regards to phonology, but the exact nature of the difference is not clear. In part, this is due to a lack of information about developmental milestones in languages other than English and a general paucity of information regarding bilingual acquisition. Current research has been mainly concerned with two broad questions: (a) is bilingual phonological development different from monolingual development, and (b) do bilingual children have separate, language specific linguistic systems? The present study concerns itself with the first of these two questions by contrasting the phonological abilities of bilingual children with SLI to monolingual peers.

The hypothesis that phonological development is different from monolingual development is supported by a small body of research regarding normal and disordered bilingual phonological acquisition. The research on normally developing bilingual children supports the hypothesis of a separate (but nonautonomous) phonological system within the bilingual child by the age of three, rather than a separate, autonomous phonological system in which one would observe the two languages operating independently of each other without cross-linguistic errors (Genesee, 1989; Holm & Dodd, 1999; Paradis, 2001). Nevertheless, the extent to which the two phonological systems influence each other, or lack autonomy, is not clear.

Bilingual children's phonologies have been found to differ from typically developing monolingual children in three ways. Based on his work and studies he has reviewed, Watson (1991) proposes that bilingual children acquire their phonological systems differently from monolingual children. Bilingual children may employ strategies that remain undeveloped or

underdeveloped in monolingual children in order to differentiate between two languages. This is done to avoid interference of one language when using the other, and to learn to categorize phonetic input in two contrasting ways (Watson). Thus, there is a proposed tension between the need to sound sufficiently like a native speaker so as to participate in two different language communities and the need to reduce the processing load of having to master these two different phonetic systems. English-French bilingual speakers studied by Watson sometimes appeared to achieve phonetic compromises between the two target languages, in this case changes in voice onset times that reduced the difficulties created by their need to use two systems, without this difference being perceived by other native speakers (Watson). Thus, this group was able to reach a balance between matching monolingual norms and reducing the processing load while remaining within the limits of acceptability of their language communities (Watson).

Second, bilingual children tend to produce a higher number of phonological processes which are unusual or unexpected relative to those seen in monolinguals (Dodd, So, & Li, 1996 as cited in Dodd, So, & Wei , 1997). Dodd and her colleagues examined the productions of 16 children (25-41 months old) who learned Cantonese at home, were then exposed to English at preschool, and therefore were sequential bilinguals (Dodd et al., 1996). The children's error patterns were found to be different from one language to another and included a number of error patterns atypical for either English or Cantonese (Dodd et al., 1996). The reason for these unusual speech error patterns may be attributed to the difference in the phonology of English and Cantonese (Dodd et al., 1996).

The third way in which bilingual children's development was found to differ from that of monolinguals is most evident in research on disordered bilingual phonological acquisition (Dodd et al., 1996; Dodd & Ozanne, 1997; Ingram, 1981). This body of work indicates that within individual children there are both uni- and bidirectional influences on bilingual children's phonology. Unidirectional influences are characterized by phonological errors where only one of the child's phonological systems appears to affect the other (Dodd et al., 1996). Bidirectional influences are errors which can be explained based on the input phonology of each language on the child's speech, rather than unusual or idiosyncratic errors and simplification strategies (Dodd et al., 1996; Dodd & Ozanne, 1997; Ingram, 1981). In addition, findings indicate that the deficits underlying phonological disorders are rarely, if ever, language specific; rather, they are the product of a general inability to abstract the phonological rules of languages (Holm & Dodd, 1999; Holm et al., 1997). This inability results in different error profiles across two languages. Thus, the resulting errors may be of the same type but they are not necessarily the same errors (Holm & Dodd, 1999; Holm et al., 1997).

In summary, a number of patterns are seen specifically in the phonological development of bilingual children, thereby differentiating their development from their monolingual peers. These patterns include strategies to reduce the processing load caused by processing of two languages (Watson, 1991), the higher incidence of unusual phonological processes and errors (Dodd et al., 1996), and influence of uni- and bidirectional influences of the two languages on each other. Further research is needed to determine the adequacy of the dominant theories of phonological development and disorders in explaining the phonological development and disorders of bilingual children (Crutchle et al., 1997; Goldstein & Iglesias, 1996; Holm & Dodd, 1999; Holm et al., 1997).

Phonological Development and SLI

In general terms, children with specific language impairment (SLI) exhibit significant limitations in language ability without the presence of factors such as hearing impairment, low nonverbal intelligence test scores, and neurological damage (Leonard, 1998). Much of the research on children with SLI concerns itself with exploring the characteristics of the language impairment (Leonard, 1998). In his review of SLI, Leonard stated that generally morphosyntactic skills were most deficient followed by argument structure and phonology. Least deficient were lexical and pragmatic skills (Leonard). Paul and Jennings (1992) have also reported that children with SLI demonstrated similar phoneme production to that of younger, language matched children.

The phonological development of children with SLI has been described as delayed with reference to their acquisition and mastery of phonemes when compared to age matched peers (Leonard, 1998). Leonard highlights three specific differences between the phonological development of younger monolingual English-speaking children and that of monolingual English-speaking children with SLI. First, he refers to studies that have found that children with SLI retain the strident feature less often, resulting in a higher frequency of substituting a stop for a strident than in normally developing age matched children (Leonard, 1973; McReynolds & Houston, 1971). Second, he cites work by Catts and Jensen (1983), Ingram (1981), and Schwartz, Leonard, Folger, and Wilcox (1980) which found that children with SLI apply voicing to word initial consonants or consonants in prevocalic position. Finally, he cites the

work of Ingram (1981) which found that children with SLI deleted word-initial weak syllables more frequently.

Roberts, Rescorla, Giroux, and Stevens (1998) investigated the phonological skills of three-year-olds diagnosed with a type of SLI that primarily affects expressive skills: Specific Expressive Language Impairment (SLI-E). Children with this disorder exhibit similar difficulties and strengths to children with SLI, with the exception that their receptive skills are developing in an age appropriate manner. These children lagged behind their normally developing peers with regards to their syntax, morphology, and their ability to produce consonants correctly. They also employed phonetic processes similar to the normally developing, younger children but applied the processes to a greater number of phonemes.

Bilingual Phonological Development and SLI

The investigation of the phonological abilities of bilingual children with SLI is necessarily complex. A preliminary investigation such as that to be reported subsequently must attempt to distinguish between patterns attributable to bilingual language development and patterns attributable to impaired language development. Thus, to better understand the effects of bilingual language development, the bilingual children were contrasted with monolingual children. The monolingual children were further subdivided into children with SLI and language matched, normally developing younger children. The comparison of bilingual children with SLI (BIL-SLI) to monolingual children with SLI (MON-SLI) will permit investigation of how bilingual children differ in their phonological abilities when compared to their monolingual peers. The comparison of these two groups, BIL-SLI and MON-SLI, to the language matched younger children (MON-NORM) will allow the investigation of whether the SLI groups are phonologically delayed or deviant. Unfortunately, data are not available from a younger bilingual, normally developing, language-matched group to investigate the bilingual phonologic development of the BIL-SLI group. Figure 1 provides an illustration of the manner in which groups were compared.

As described above, the literature regarding phonological abilities of English children with SLI indicated that these children will exhibit abilities similar to younger, language matched children (Paul & Jennings, 1992). The children with SLI in this study were also expected to exhibit phonological abilities similar to younger, language-matched peers. Examination of the type of phonological errors allowed for preliminary contrast of language specific error types between English and French.

Based on available literature, it was expected that the BIL-SLI children would not only exhibit phonological abilities similar to younger, language matched children (Paul & Jennings, 1992), but that they would also differ from their monolingual peers in a number of parameters. The bilingual children were expected to exhibit patterns which differ from monolingual children because of strategies needed to differentiate between the two languages, to avoid interference of one language when using the other, and to learn to categorize phonetic input in two contrasting ways (Watson, 1991). Expected differences included a higher number of phonological errors and phonological processes, because of the additional processing load of managing the input from two languages in addition to their language impairment. However, it was thought that the bilingual group's exposure to two phonetic inventories may lead to a mastery of a greater number of phonemes than the two monolingual groups.

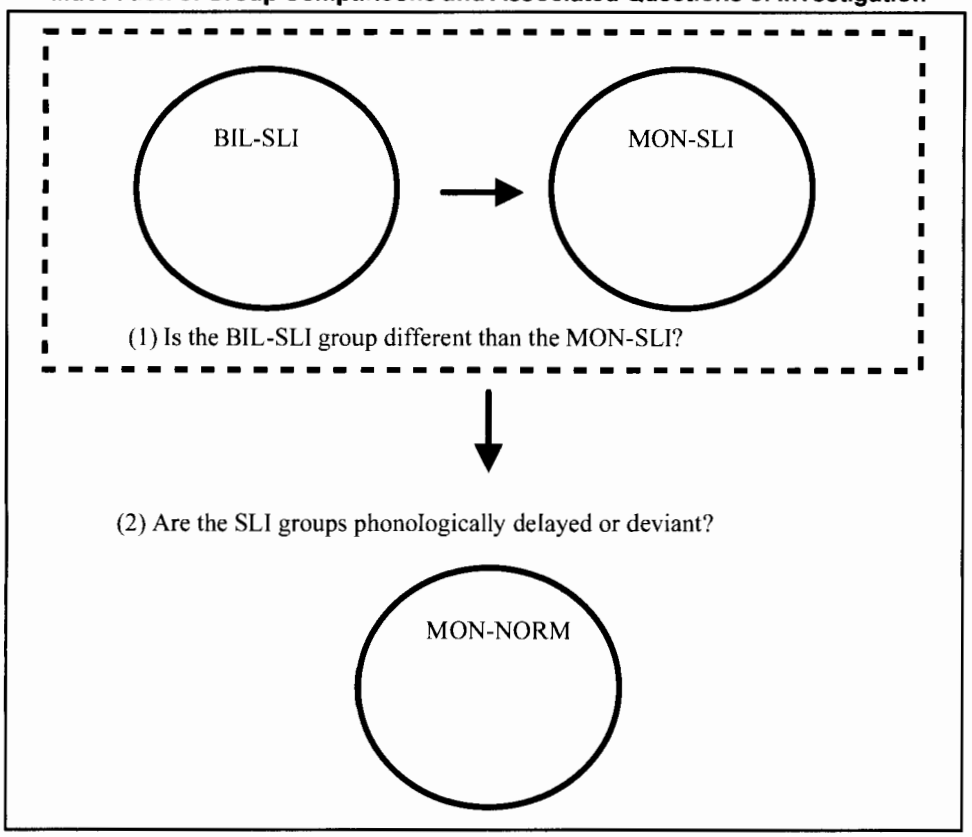
The present study investigated the French expressive phonological abilities of bilingual children with specific language impairment (SLI) as compared to their age-matched monolingual peers with SLI and younger, language-matched monolingual peers without language impairment (Figure 1). The study of the phonological abilities of children with SLI allows investigation of the question of whether the abilities of bilingual children with SLI are different or delayed compared to their monolingual language matched peers without SLI. The investigation of bilingual children builds toward a better understanding how their phonological development is similar or different to monolingual development.

Methods

Participants

The data set consisted of three groups of previously collected spontaneous language samples that are described in detail in Table 2. All data used in this study were drawn from a larger set of previously collected spontaneous language samples from research conducted on the morphological and syntactic abilities of bilingual children with SLI by Martha Crago, Joanne Paradis, and Fred Genesee at McGill University, Montreal, Quebec (Paradis & Crago, 2000). From the larger data set, a total of 13 children were selected for this study based on their comparable mean length of utterance and sufficient audio quality for broad phonetic transcription. The first group, BIL-SLI, consisted of five children (6;11 to 7;11) who met the criteria of having both SLI without concomitant cognitive deficits, as identified by their

Figure 1
Illustration of Group Comparisons and Associated Questions of Investigation



school speech-language pathologist, as well as having acquired English and Canadian French concurrently from birth as reported by their family and educators. The first comparison group, MON-SLI, was comprised of four children (7;0 to 8;1) who met the criteria of having both SLI without concomitant cognitive skills as identified by their school speech-language pathologist, and being monolingual speakers of Canadian French. The second comparison group, MON-NORM, consisted of four children (2;5 to 3;1) who were normally developing, monolingual Canadian French speakers, and who were language matched, as determined by mean length of utterance to both groups with SLI: MON-SLI and BIL-SLI. In each group, one of the participants was a girl and the remainder were boys. The children were selected to diminish variation within the data contributed by independent variables of age and language ability. Thus, the two impaired groups, BIL-SLI and MON-SLI, were matched on both age and language ability, and the control group, MON-NORM, was matched to both SLI groups only on language ability alone.

Procedures

Each of the children was visited in his or her home except for children in the MON-SLI group (monolingual SLI), who were visited at school. The sessions included one hour of free play between the child and the parent and/or the research assistant. In the case of the bilingual children, the free play was with the parent who spoke French as his/her dominant language as determined by self-report of the parent and questionnaire. All sessions were videotaped with audio input provided by an external microphone.

An orthographic, nonphonetic transcription of all the children's spontaneous utterances during the free-play sessions was created. The nonphonetic transcriptions excluded the first five minutes of free-play and ended after the child's four-hundredth successive spontaneous utterance. This transcription was completed by research assistants at McGill University (all of whom were Canadian French-English bilingual speakers, including the first author) according to the conventions of the Child Data Exchange System (CHILDES) format (MacWhinney, 2000). One third of the free-play sessions was retranscribed by a second research assistant and compared to the originals, resulting in 80% or greater interrater reliability.

A broad phonetic transcription of the first 100-130 of each child's spontaneous utterances was then added to the previously created orthographic transcriptions (according to the conventions of the CHILDES format) by the first author who acquired both English and Canadian French concurrently and speaks both languages fluently. To obtain 100-130 utterances for all children, the portion of free play that underwent broad phonetic transcription ranged from 10 minutes to 22 minutes, and the number of words transcribed ranged from 140 to 492. Onomatopoeia and utterances of poor audio quality were excluded from the 100 to 130 utterances. Any English utterances within the sample were also been excluded. Reliability was conducted by a graduate student whose first language was Canadian French. One third of each child's 100-130 spontaneous utterances were independently broadly transcribed by this graduate student. On all transcripts, independent point-by-point agreement obtained on the transcription of consonants exceeded 80%, and overall reliability for vowels exceeded 75%. A point-by-point review of the words which were not agreed upon by the first author

Table 2
Detailed description of individual members of each group, BIL-SLI, MON-SLI, and MON-NORM.

Group	Partici-pant No./	Age	Sex	Home Language(s)	SLI: Y/N	No. Utterances	No. of Words	No. of Word Types	Token Ratio	Mean Length of Utterance
BIL-SLI	1	7;11	M	French, English	Y	122	545	220	0.404	4.63
BIL-SLI	2	6;11	F	French, English	Y	118	313	190	0.607	3.24
BIL-SLI	3	7;9	M	French, English	Y	113	279	166	0.595	3.29
BIL-SLI	4	7;9	M	French, English	Y	118	323	151	0.468	3.04
BIL-SLI	5	7;1	M	French, English	Y	130	320	162	0.506	2.47
MON-SLI	6	7;10	M	French	Y	103	492	121	0.246	2.71
MON-SLI	7	7;0	M	French	Y	103	309	135	0.437	2.54
MON-SLI	8	8;1	M	French	Y	103	351	153	0.436	5.39
MON-SLI	9	8;1	F	French	Y	107	373	222	0.595	3.49
MON-NORM	10	3;3	F	French	N	106	283	123	0.435	2.70
MON-NORM	11	2;5	M	French	N	106	313	128	0.409	2.98
MON-NORM	12	2;8	M	French	N	127	203	82	0.404	2.08
MON-NORM	13	3;10	M	French	N	106	286	145	0.507	3.94

and the graduate student was performed and consensus achieved.

Independent Variables

Each child was originally recruited based on his or her language status (i.e., SLI or normal language development), the child's linguistic background (i.e., bilingual or monolingual), and the possession of language abilities that were comparable to the other group's as measured by mean length of utterance and type-token ratios. This resulted in three groups: (a) BIL-SLI, a bilingual group with SLI (aged 6;11-7;11); (b) MON-SLI, a French monolingual group with SLI (7;00-8;01); and (c) MON-NORM, a French monolingual normally developing group (2;05-3;10). Group membership was treated as the main independent variable because of the lack of a bilingual normally developing group. All participants were from Eastern Ontario and Western Quebec and were from families classified as lower to middle socio-economic status based on parent education and current employment. The adequacy of group matching was assessed using a multivariate analysis of variance based on two indicators of language ability: type token ratios and mean length of variance. This analysis revealed no significant group differences: ($F = 0.794$ [4, 20], $p = 0.543$), suggesting adequate group matching.

Dependent Variables

A number of phonological measures were used to investigate the phonological skills of these experimental groups. Measures include *percentage consonants correct*, *productive phonetic inventory*, use of *phonological processes*, and *intelligibility of utterances* (Shriberg & Kwiatkowski, 1982). In addition, three measurements recently proposed by Ingram and Ingram (2000), and Ingram (2002) were applied to the transcribed samples. These additional dependent measurements were *whole word correct*, *phonological mean length of utterance*, and *proportion of whole word proximity*. The phonological measures were conducted on a sample of 100 to 130 consecutive Quebec French utterances from each child in each group. The rationale for each of these dependent variables is provided below.

Productive Phonetic Inventory

A summary of each participant's *productive phonetic inventory* independent of an adult model was created using the criteria proposed by Stoel-Gammon (1987). This analysis investigates the phonetic structures used by the child without focusing on "errors" of production relative to adult forms (Stoel-Gammon, 1991). A *productive phonetic inventory* is a list of stable phones, defined as a phone occurring three or more times in more than one phonetic context (in syllable initial, medial, final, or cluster positions). Sounds that do not fulfill these requirements are considered "unstable" and are not included in the final count. A *productive phonetic inventory* provides developmental information with regard to the child's acquisition of sounds compared to other children of the same age. In addition, two allophones for standard phonemes (/dz, ts/ for /d, t/, in front of high front vowels) were included in coding in order to provide preliminary information on dialect features.

Phonological Processes

A summary of productive *phonological processes* for each participant was created again using the criteria proposed by Stoel-Gammon (1987). A *productive phonological process* is any process that occurs upward of three times within the sample. Phonological processes are the phonological rules that describe the relationship between the child's production and the expected, adult version of the word (Bernthal & Bankson, 1998). An example of the phonological process of final consonant deletion is /dɥ/ ("do") for /dɥg/ ("dog"). A number of *productive phonological processes* have been reported for children of approximately three years of age in English, as well as Spanish and Italian, and are considered part of the normal course of phonological development at this age. These productive processes include cluster reduction, unstressed syllable deletion, stridency deletion, tap/trill and /r/ deviation, assimilation of place, and epenthesis of both consonants and vowels (Bortolini & Leonard, 1991; Goldstein & Igleisas, 1996; Stoel-Gammon, 1991). As previously reviewed, *productive phonological processes* have been found to provide considerable insight into the differences in simplification strategies employed by bilingual and monolingual children.

Whole Word Correct

The procedure for assessing whole word correct as described by Ingram and Ingram (2001) involves a comparison of the child's production of a word to the production of the adult standard pronunciation. If the child's production matches the adult standard, the word is marked correct. A *proportion of whole-words correct* is calculated by dividing the number of whole words produced correctly by the total sample size. This measure provides a very broad overview of each child's overall accuracy of production. It is expected that although children within a group may have different error types, the *proportion of whole-words correct* should be less variable within a group and provide a basis for cross-group comparisons.

Phonological Mean Length of Utterance

An analysis of whole word complexity has been suggested as a way to enrich the description of a child's attempted productions, such as phonological mean length of utterance (Ingram & Ingram 2001, Ingram 2002). *Phonological mean length of utterance* focuses on both the number of segments in the child's words and the number of correct consonants to better capture the fact that as children's words get longer they become more complex (Ingram & Ingram, 2001). *Phonological mean length of utterance* is calculated as the total number of points assigned for a selected set of words divided by the total number of words. The detailed procedure as outlined in Ingram and Ingram (2001) was applied. This measure was expected to supplement the *proportion of whole-words correct* measurement by reflecting the complexity of the words in the sample from which the *proportion of whole-words correct* was derived. Thus, a child may have a high *proportion of whole-words correct* but a low *phonological mean length of utterance score* (i.e., higher number of accurate productions of phonologically simple words) or vice versa (i.e., a lower number of accurate productions of phonologically complex words).

Proportion of Whole-Word Proximity

The *proportion of whole-word proximity* is designed to capture the relative accuracy of the child's productions when compared to the adult standard target (Ingram & Ingram, 2001). The *proportion of whole-word proximity* is calculated by first determining the *phonological mean length of utterance* of a the adult standard target word, then dividing the product into the *phonological mean length of utterance.* Ingram and Ingram's preliminary data indicate that children have high *proportions of whole-word proximity* even early in their phonological acquisition (Ingram & Ingram, 2001). Thus, an effort to maintain high proximity to the adult targets may be a driving force behind phonological acquisition (Ingram & Ingram, 2001). This measure also supplements the *proportion of whole-words correct* measurement by reflecting the accuracy of the words in the sample from which the proportion of whole-words correct as compared to the adult target was derived.

Percentage Consonants Correct

Percentage consonants correct is an index developed by Shriberg and Kwiatkowski (1982) to quantify the severity of involvement of children with a developmental phonological disorder by comparing the child's production of consonants to the adult target consonants, providing a percentage of accurate production. The *percentage consonants correct* has been shown to correlate strongly with listeners' perception of the severity of the phonological disorder (Shriberg & Kwiatkowski, 1982). In this study, this standard measure was contrasted with the recently proposed *phonological mean length of utterance* to discuss the relative sensitivity of this measure to children's production errors within the data.

Percentage Vowels Correct

This measure is similar to *percentage consonants correct* but is applied to vowels instead of consonants to determine the degree of accuracy of vowel production. The *percentage vowels correct* is calculated by dividing the number of vowels correctly produced by the number of vowels attempted. This measure provides an overview of possible errors in vowels relating to the parallel acquisition of two different vowel inventories in the bilingual children as compared to their monolingual peers. In addition, this standard measure will also be used to compare the relative sensitivity of the recently proposed *phonological mean length of utterance* to children's production errors.

(All statistical analysis were computed using SPSS, version 10.0 statistical data analysis software (SPSS, 1990), except where noted. A significance level of .05 was used throughout.)

Results

The following results are based on broad phonetic transcriptions extracted from 100-130 consecutive words drawn from the videotapes of the 13 children participating in this study. The dependent variables for each individual in each group were computed for the following measures: *fully intelligible utterances, proportion of whole words correct, phonological mean length of utterance, proximity of word production, percentage consonants correct, percent vowels correct,* and *phonetic inventory.* In order to compare the three groups, a multivariate test of variance (MANOVA) was performed to determine whether the differences between the groups' means across measures were statistically significant. A summary of the group means and standard deviations for each dependent measure are presented in Table 3.

The SPSS statistical data analysis software performs a number of test statistics to evaluate multivariate differences (i.e., Pillai's Trace, Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root). The Pillai's Trace was selected for use in this study because it is the most powerful and robust multivariate criterion. The results from the Pillai's Trace indicated a significant group difference ($F = 4.928$ [14, 10], $p = 0.008$). However, when a one-way analysis of variance (ANOVA) was conducted, it appeared that only two measures contributed to producing the overall group difference: i.e. *phonological mean length of utterance* ($F = 6.633$ [2], $p = 0.015$) and *percent consonant correct* ($F = 7.197$ [2], $p = 0.012$). The results from the analysis of variance for each dependent measure are provided in Table 4.

Table 3
Group means and standard deviations for BIL-SLI, MON-SLI and MON-NORM

Dependent Variables	BIL-SLI	MON-SLI	MON-NORM
Phonetic Inventory	0.81 (0.05)	0.81 (0.04)	0.81 (0.05)
Fully Intelligible Utterance	0.93 (0.05)	0.99 (0.01)	0.94 (0.04)
Whole Word Correct	0.87 (0.06)	0.93 (0.03)	0.93 (0.05)
Phonological Mean Length of Utterance	4.95 (0.31)	4.18 (0.18)	4.67 (0.27)
Proximity Word Production	0.96 (0.02)	0.96 (0.02)	0.98 (0.01)
Percent Consonants Correct	0.90 (0.06)	0.97 (0.01)	0.98 (0.01)
Percent Vowels Correct	0.99 (0.01)	1.00 (0.00)	1.00 (0.00)

Table 4
Summary form ANOVA for mean length of utterance, type-token ratio and the dependent variables (i.e., phonetic inventory, fully intelligible utterance, whole word correct, phonological mean length of utterance, proximity word production, percent consonant correct, and percent vowels correct) for BIL-SLI, MON-SLI and MON-NORM

Source	df	F-value	P-value
Between participants			
Group	14	3.684	.022*
Within participants			
Mean length of utterance	2	0.409	0.0675
Type-token ratio	2	1.079	0.377
Fully intelligible utterance	2	3.543	0.069
Whole words correct	2	2.322	0.149
Phonological mean length of utterance	2	9.442	0.005**
Proportion of whole-word proximity	2	1.119	0.364
Percentage consonants correct	2	7.197	0.012**
Percentage vowels correct	2	5.238	0.028*
Phonetic invetory	2	0.004	0.996

Notes. *$p < .05$; **$p < .01$

Phonological Mean Length of Utterance

A *phonological mean length of utterance score* was calculated for each child to investigate possible differences due to phonetic complexity as well as correct production. As noted earlier, this measurement revealed significant group differences based on an ANOVA: (p = 0.015). Based on a Bonferroni adjusted t-test, the MON-SLI children had phonological mean length of utterance scores that were significantly lower than those of BIL-SLI (p = 0.004) and approached significance when compared to the MON-NORM (p = 0.079). This suggests that the MON-SLI group was attempting somewhat simpler words than the two other groups.

Percent Consonants Correct

The *percentage consonants correct* scores were also analyzed and produced significant group differences based on an ANOVA: (F = 7.197 [2], p = 0.012). In contrast to the results from the phonological mean length of utterance scores, the BIL-SLI children had the lowest score on this measure and showed the most variation across participants. In contrast, both the MON-SLI and MON-NORM groups performed similarly and exhibited little variation across participants. Based on a Bonferroni adjusted t-test the BIL-SLI children had percent consonant correct scores that were significantly lower than those of MON-SLI (p = 0.043) and MON-NORM (p = 0.019). This suggests that although the BIL-SLI group was attempting more complex words, they were less accurate in their productions than the other groups.

Phonological Processes

Data were also coded for cluster reduction, unstressed syllable deletion, stridency deletion, /"/ deviation, assimilation of place, and epenthesis of both consonants and vowels. They were considered productive *phonological processes* when the process occurred more than three times within the one child's sample (Stoel-Gammon, 1987). Statistical analysis was not conducted on this measure due to the low percentage of occurrence of each process by each child. The children across the three groups demonstrated the following productive *phonological processes*: final consonant deletion, initial consonant deletion, and consonant cluster reduction.

Other Dependent Variables

Group performance for the remaining measures were compared, but resulted in no statistically significant group differences, despite some interesting trends. Specifically, the BIL-SLI group lagged slightly behind the other groups on the *proportion of whole words correct* ($M_{SLI\text{-}BIL}$ = 0.87[SD = 0.06]; $M_{SLI\text{-}MON}$ = 0.93[SD = 0.03]; $M_{MON\text{-}NORM}$ = 0.93[SD = 0.05]). However, scores greatly varied within all groups. As expected since all are based on accurate productions relative to the adult model, one-tailed Pearson Correlation revealed that this measure was significant and positively correlated to *percentage consonants correct* (r = 0.856, p = .01) and *proportion of whole-word proximity* (r = 0.740, p = .01). The overall level of the variable *proportion of whole-word proximity* was very similar and high for all three groups, demonstrating their generally successful approximation of the adult standard target ($M_{SLI\text{-}BIL}$ = 0.96[SD = 0.02]; $M_{SLI\text{-}MON}$ = 0.96[SD = 0.02]; $M_{MON\text{-}NORM}$ = 0.98[SD = 0.01]). Proportions for all groups ranged from between 0.94 and 0.99. This concurs with preliminary suggestions by Ingram and Ingram (2001) that children work to maintain high proximity to the adult target. Finally, the percentage vowels correct revealed that all children had very accurate vowel production with little variation across groups ($M_{SLI\text{-}BIL}$ = 99% [SD = 1]; $M_{SLI\text{-}MON}$ = 100% [SD = 0]; $M_{MON\text{-}NORM}$ = 100% [SD = 0]).

Table 5
Stable and Attempted Phonemes That Comprise the Phonetic Inventories of Children From all Three Groups

Group	Partici-pant	Manner	Stop				Nasal	Fricative		Liquid	Glide
		Place	Bilabial	Alveolar	Velar	Glottal	All	Interdental	Alveolar	All	All
BIL-SLI	1	stable	p,b	t,d	k,g		m,n	f,v	s, z, ʒ, ts	l, ʁ	w
		attempted									j
BIL-SLI	2	stable	p,b	t,d	k,g	h, /	m,n	f,v	s,z,ʃ,ʃ,ts,	l, ʁ	j,w
		attempted							dz		
BIL-SLI	3	stable	p,b	t,d,	k		m,n	f,v	s,z,ʃ,ʒ,ts	l, ʁ	j,w
		attempted			g				z,		
BIL-SLI	4	stable	p,b	t,d	k		m,n,ŋ	v	s,z,ʃ,ʒ	l, ʁ	j,w
		attempted			g	h		f	ts		
BIL-SLI	5	stable	p,b	t,d	k,g,		m,n,ŋ	f,v	s,z,ʃ,ts	l, ʁ	j,w
		attempted				h			ʒ,		
MON-SLI	6	stable	p,b	t,d	k,g		m,n	f,v	s,ʃ,ʒ,ts,dz	l, ʁ	j,w
		attempted							dz,z		
MON-SLI	7	stable	p,b	t,d	k,g		m,n	f,v	s,z,ʃ,ʒ,dz	l, ʁ	j,w
		attempted							ts		
MON-SLI	8	stable	p,b	t,d	k,g		m,n,	f,v	s,ʃ,ʒ,ts,dz	l	w
		attempted									
MON-SLI	9	stable	p,b	t,d	k,g		m,n	f,v	s,ʃ,ʒ,ts	l, ʁ	j,w
		attempted					ŋ,ɲ				
MON-NO-RM	10	stable	p,b	t,d	k,g		m,n	v	s, ʃ, ʒ, ts	l, ʁ	j,w
		attempted							z,		
MON-NO-RM	11	stable	p,b	t,d	k,g	h, /	m,n	f,v	s, ʃ, ʒ	l, ʁ	j,w
		attempted							z,		
MON-NO-RM	12	stable	p,b	t,d,	k		m,n	f,v	s,ʃ,ʒ,	l, ʁ	w
		attempted			g				z,		j
MON-NO-RM	13	stable	p,b	t,d	k,g,	h	m,n,ŋ	f,v	s,z,ʃ,ʒ	l, ʁ	j,w
		attempted									

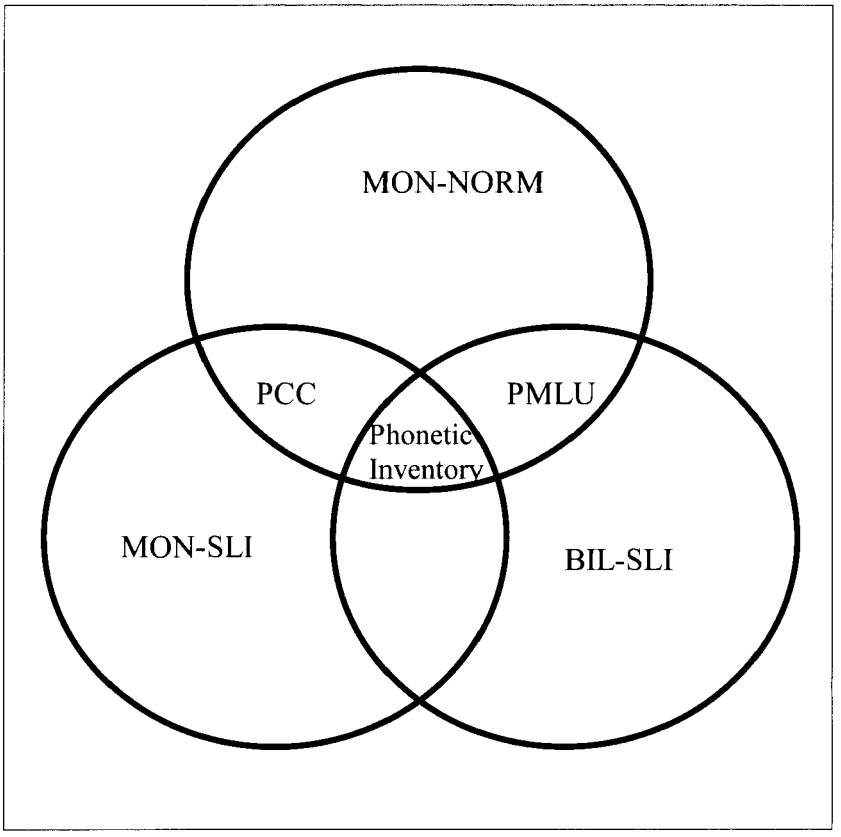
Phonetic Inventory

The phonetic inventory provided information regarding the children's production of sounds independent of an adult model, thus without focussing on "errors" of production (Stoel-Gammon, 1991). This analysis revealed great similarity across the three groups in terms of productive phonetic inventory means ($M_{SLI-BIL}$ = 0.81[SD = 0.05]; $M_{SLI-FRA}$ = 0.81[SD = 0.04]; $M_{MON-NORM}$ = 0.81[SD = 0.05]). Based on normal developmental data for English, it is expected that children above the ages of 6-years-old have productive inventories that include all phonemes in their language (Bernthal & Bankson, 1998). As described in the methods, the coding of consonant productivity consisted of identifying stable phones, those which occurred three or more times in more than one phonetic context. A one-way ANOVA revealed no significant difference between the groups based on number of stable, productive consonants in their inventory (F = 0.004 (2), p = 0.996). The productive inventory of all children included 17 to 19 stable consonants of a possible 22 found in Canadian French (Table 5).

The phonetic inventories of the children with SLI suggest a pattern of delayed, rather than deviant phonological development. This pattern of delay is evident in the similarity of consonants that were present in the inventories of the older, language impaired groups, as well as to the younger, normally developing group. Deviant phonological development is characterized in part by a productive inventory that is missing a number of developmentally appropriate phones but has a number of unusual error patterns, a pattern not evident in the data obtained from these present participants (Bankson & Bernthal, 1998). Thus, the phonology of children with SLI is developing in a manner analogous to the phonological development of their younger, language matched peers, a pattern that is confirmed in the current results.

The two allophones characteristic of this Canadian French dialect and described above (i.e. /ts/ and /dz/) were most productive in the two SLI groups, but not among their younger normally developing peers. Three of the four members of the MON-SLI group, an older group, consistently applied affrication to [d] (i.e., [dz] in front of high front vowels) and [t] (i.e., [ts] in front of high front vowels). None of the members of the BIL-SLI group, also an older group, produced [d] allophone, while four of the five members consistently produced the [t] allophone, /ts/. However, none of the MON-NORM group, which was also the younger group, productively produced [dz] as an allophone of /d/; only one participant productively produced the [ts] as an allophone of /t/.

Figure 2
Illustration of Independent Variables are Shared Between Groups



These data suggest that dialect features, such as these allophones, are being acquired by children at the age of three, which is somewhat later than the acquisition of most nondialect features. The productive *phonetic inventories* for each child are identified in Table 5.

Discussion

The purpose of this comparative study was to examine the relationship between differences in sound use motivated by the complexities posed by the bilingual environment, as well as those motivated by identified developmental language learning difficulties. In particular, this study sought to address the following questions: how are the phonological abilities of the bilingual children with SLI (BIL-SLI) different from their age matched, language impaired (MON-SLI) peers? and are the phonological abilities of the older, impaired groups similar to those of the younger, language matched (MON-NORM) peers indicating phonological delay rather than phonological deviance? An additional goal of this study was to provide preliminary data on Canadian French phonological development, including the distinctive dialect feature of affrication. The relationship between the abilities of each group graphically represented in Figure 2.

Phonological Delay or Deviance?

The results from the analysis of the children's phonological productions independent of the adult standard revealed that the three groups' abilities were very similar. The productive phonetic inventories of both language-impaired groups, the BIL-SLI and the MON-SLI, indicated abilities similar to their younger, language matched peers, the MON-NORM group. This delay is evident in that the two SLI groups had not yet mastered all the phonemes of Canadian French. This result is consistent with available data from the study on the phonological abilities of English speaking children with SLI (Paul & Jennings, 1992).

Despite the evident overall delay, the MON-SLI group was the most advanced in their mastery of the dialect feature of Canadian French investigated in this study as indicated by their productive use of affrication of the /t/ and /d/ to become /ts/ and /dz/, respectively, when these consonants occurred in front of high, front vowels. The BIL-SLI group members were less consistent in their mastery of this feature and productively applied affrication to /d/ in the appropriate phonetic environments, whereas the younger MON-NORM rarely applied this feature. These results are similar to those described by Roberts (1997b) in her study of the acquisition of dialect features by children from Philadelphia. In her data set, the two children who had inconsistent production of the dialect features were a child whose mother was not a native of Philadelphia and a child whose parents spoke English as their second language (Roberts, 1997b). The younger, normally developing monolingual French group in this study appear to be acquiring the dialect features at a similar age to those in Roberts (1997a, b) studies, where children as young as three years and three months were making productive use of the dialect features. However, given the likelihood that dialect features will vary in their age of acquisition even within a single dialect, further investigation of the dialect features of the Canadian French spoken in this area is needed to better understand the variation in production and mastery.

Bilingual versus Monolingual Phonological Abilities

The bilingual children in this study exhibited phonological abilities which were both similar and different from those of their monolingual peers. The newly proposed measures for analyzing the phonological productions of children (Ingram & Ingram, 2001; Ingram, 2002) provided insight into the phonological abilities of the bilingual children. As described above, the BIL-SLI group had a *productive phonetic inventory* comparable to the MON-SLI and MON-NORM groups, and they had inconsistent productions of the investigated dialect feature of Canadian French. Despite these similarities, they differed from the MON-SLI group in their choice of word composition and accuracy production of consonants. The BIL-SLI children tended to exhibit less accurate consonant productions, yet attempted more complex words than the MON-SLI groups. However, the bilingual children did not exhibit a higher number of *phonological processes* when compared to the other groups. Without the use of the *phonological mean length of utterance* measure proposed (Ingram & Ingram, 2001; Ingram, 2002), the bilingual group would simply have seemed delayed in their ability to accurately produce target consonants than the MON-SLI group and MON-NORM. However, the *phonological mean length of utterance measure* provided insight into a possible alternative strategy employed by the bilingual group, namely attempting more complex words. This strategy may have developed in response to processing capacity constraints associated with the need to increase intelligibility, differentiate between the two languages, to avoid interference of one language when using the other, and to learn to categorize phonetic input in two contrasting ways (Watson, 1991). The impact of language impairment on a bilingual child may have lead to the allocation of resources into the production of phonologically more complex words at the expense of

accurate consonant production. In contrast, the monolingual children with SLI in this study had more accurate consonant production and phonologically simpler words. The addition of data from age-matched normally developing peers and from language matched, younger, normally developing bilingual children would help clarify patterns attributable specifically to bilingual language development independent of SLI.

Overall, the two groups of children with SLI performances were similar to the MON-NORM group, but different from each other. The use of both the *percent consonant correct* measure and the *phonological mean length of utterance* allowed for a better understanding of how these two groups differed. The advantages of attempting phonetically simpler words with a accurate consonant production seems to be preferred by the MON-SLI group. In contrast, the BIL-SLI group seems to favour phonetically complex words while sacrificing accurate consonant production. The extent to which these patterns are a result of bilingual versus monolingual language exposure is unclear and further data from normally developing bilingual groups would be needed to clarify this issue.

This comparative study provides preliminary information about the phonological abilities of bilingual children with SLI. The BIL-SLI children have a phonetic inventory and phonological skills that are similar to MON-SLI children and to the younger MON-NOR children. This study did not clearly differentiate effects on sound use that were motivated by the bilingual environment versus from those motivated by the language learning difficulties. This differentiation could be aided by investigating the phonological abilities of bilingual, normally developing children and by comparing the phonological abilities in both English and French. An additional area of interest that arose from the data in this study is the acquisition of the dialect features of Canadian French by both bilingual and monolingual children in this area.

Acknowledgements

I extend my thanks to the researchers at McGill University, Dr. Martha Crago, Dr. Fred Genesee and, from the University of Alberta, Dr. Joanne Paradis, for generously allowing me to use previously gathered data for the investigation of the questions at hand, and to the children and families who participated. Thanks are extended to Dr. Julie Roberts, Dr. Andre Senecal, and Alan Howard at the University of Vermont who provided insight and support in the completion of this project. Thanks to the Graduate College and the Department Communication Science at the University of Vermont for the grants who helped make this possible. I'd like to thank Julie Ouellette for her work as a research assistant on this project. Finally, I give my thanks to my family for their unfailing support. Please address all correspondence to Andrea A.N. M[ac]Leod, Department of Speech and Hearing Sciences, University of Washington, 1417 N.E. 42nd St., Box 354875, Seattle, WA 98105-6246; email: amacleod@u.washington.edu

References

Acevedo, M. (1991, November). *Spanish consonants among two groups of Head Start children*. Paper presented at the annual convention of the American Speech-Language-Hearing Association, Atlanta, GA.

Anderson, R. T. (1996). Assessing the grammar of Spanish-speaking children: A comparison of two procedures. *Language, Speech, and Hearing Services in Schools, 27*, 333-344.

Anderson, R., & Smith, B. (1987). Phonological development of two-year-old monolingual Puerto Rican Spanish-speaking children. *Journal of Child Language, 14*, 57-78.

Bankson, N. W., & Bernthal, J. E. (1998). Analysis and interpretation of assessment data. In J. E. Bernthal & N. W. Bankson (Eds.), *Articulation and phonological disorders* (4th ed., pp. 233-269). Boston: Allyn and Bacon.

Bortolini, U., & Leonard, L. B. (1991). The speech of phonologically disordered children acquiring Italian. *Clinical Linguistics & Phonetics, 5*(1), 1-12.

Catts, W. H., & Jensen, J. P. (1983). Speech timing of phonologically disordered children: Voicing contrast of initial and final stop consonants. *Journal of Speech and Hearing Research, 26*, 501-510.

Dobrovolsky, M. (1996). Phonetics: The sounds of language. In W. O'Grady & M. Dobrovolsky (Eds.), *Contemporary linguistic analysis: An introduction* (pp. 18-67). Toronto: Copp Clark Pitman.

Dodd, B., Holm, A., & Wei, L. (1997). Speech disorder in preschool children exposed to Cantonese and English. *Clinical Linguistics and Phonetics, 11*(5), 229-243.

Dodd, B., So, L. K. H., & Wei, L. (1996) Symptoms of disorder without impairment. In B. Dodd, R. Campbell & L. Worrall (Eds.), *Evaluating theories of language evidence from disorder* (pp. 137-161). London: Whurr.

Dumas, D. (1987). *Nos façons de parler* [Our ways of talking]. Sillery, QC: Presses de l'Université de Québec.

Genesee, F. (1989). Early bilingual development: One language or two? *Journal of Child Language, 16*, 161-179.

Genesee, F. (1994). Bilingualism. In D. Ramachandra (Ed.), *Encyclopedia of human behavior* (pp. 383-393). San Diego, CA: Academic Press.

Goldstein, B. A., & Iglesias, A. (1996). Phonological patterns in normally developing Spanish-speaking 3- and 4-year-olds of Puerto Rican descent. *Language, Speech, and Hearing Services in Schools, 27*, 82-89.

Grosjean, F. (1982). *Life with two languages: An introduction to bilingualism*. Cambridge: Cambridge University Press.

Holm, A., & Dodd, B. (1999). Differential diagnosis of phonological disorder in two bilingual children acquiring Italian and English. *Clinical, Linguistics & Phonetics, 13*(2), 113-129.

Holm, A., Ozanne, A., & Dodd, B. J. (1997). Efficacy of intervention for a bilingual child making articulation and phonological errors. *International Journal of Bilingualism, 1*, 55-69.

Ingram, D. (1981). *Procedures for the phonological analysis of children's language*. Baltimore, MD: University Park Press.

Ingram, D. (2002). The measurement of whole word productions. *Journal of Child Language, 29*(4), 713-733.

Ingram, D., & Ingram, K. D. (2001). A whole-word approach to phonological analysis and intervention. *Language, Speech, and Hearing Services in Schools, 32*, 271-283.

Iglesias, A., & Goldstein, B. (1998). Language and dialectal variation. In J. E. Bernthal & N. W. Bankson (Eds.), *Articulation and*

phonological disorders (4th ed., pp. 148-171). Boston, MD: Allyn and Bacon.

Leonard, L. B. (1973). The nature of deviant articulation. *Journal of Speech and Hearing Disorders, 2*, 156-161.

Leonard, L. B. (1998). *Children with specific language impairment*. Cambridge, MA: Massachusetts Institute of Technology Press.

MacWhinney, B. (2000). *The CHILDES project tools for analyzing talk* (3rd ed.). Mahwah, NJ: Lawrence Erlbaum Associates.

McLaughlin, B. (1984) *Second-language acquisition in childhood: Volume 1. Preschool children* (2nd ed.). Hillsdale, NJ: Erlbaum.

McReynolds, L. V., & Huston, K. (1971). A distinctive feature analysis of children's misarticulation. *Journal of Speech and Hearing Disorders, 2*, 155-166.

Mougeon, R., Beniak, E., & Valois, D. (1985). A sociolinguistic study of language contact, shift and change. *Linguistics, 23*, 455-487.

Paradis, J. (2001). Do bilingual two-year-olds have separate phonological systems? *International Journal of Bilingualism, 5*(1), 19-38.

Paradis, J., & Crago, M., Genesee, F., & Rice, M. (2003). French-English bilingual children with SLI: How do they compare with their monolingual peers? *Journal of Speech, Language, and Hearing Research, 46*, 113-127.

Paul, R., & Jennings, P. (1992). Phonological behaviors in toddlers with slow expressive language development. *Journal of Speech and Hearing Research, 35*, 99-107.

Roberts, J. (1997a). Acquisition of variable rules: A study of (-t, d) deletion in preschool children. *Journal of Child Language, 24*, 351-372.

Roberts, J. (1997b). Hitting a moving target: Acquisition of sound change in progress by Philadelphia children. *Language Variation and Change, 9*, 249-266.

Roberts, J., Rescorla, L., Giroux, J., & Stevens, L. (1998). Phonological skills of children with specific expressive language impairment (SLI-E): Outcome at age 3. *Journal of Speech, Language, and Hearing Research, 41*, 374-384

Romaine, S. (1991). *Language in society: An introduction to sociolinguistics*. Oxford: Oxford University Press.

Schwartz, R., Leonard, L., Folger, M. K., & Wilcox, M. J. (1980). Early phonological behavior in normal speaking and language disordered children: Evidence for a synergistic view of linguistic disorders. *Journal of Speech and Hearing Disorders, 45*, 357-377.

SPSS 10.0 for Windows, Standard Version. (release 1999). Copyright © SPSSS Inc. 1989-1999. Chicago, IL.

Stoel-Gammon, C. (1987). The phonological skills of two-year-olds. *Language, Speech, and Hearing Services in Schools, 18*, 323-329.

Stoel-Gammon, C. (1991). Normal and disordered phonology in two-year-olds. *Topics in Language Disorders, 11*, 21-32.

Walker, D. C. (1984) *The pronunciation of Canadian French*. Ottawa, ON: University of Ottawa Press.

Watson, I. (1991). Phonological processing in two languages. In E. Bialystok (Ed.), *Language Processing in Bilingual Children* (pp. 25-48). Cambridge: Cambridge University Press.

Vihman, M. M., & Greenlee, M. (1998). Individual differences in phonological development: Ages one and three years. *Journal of Speech and Hearing Research, 30*, 503-521.

Vinter, S. (2001). Les habiletés phonologiques chez l'enfant de deux ans [Phonological skills of two years-old children]. *Glossa, 77*, 4-19.

Manuscript received: September 7, 2002

Accepted: January 8, 2003