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Speech Assessment of Chinese-English Bilingual Children: Accent versus Developmental Level

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Abstract

The study aimed to evaluate the phonological profiles of Chinese-English bilingual children in primary grades relative to those of English monolinguals, and to compare these profiles with speech-language pathologists' (SLPs') ratings of children's speech in terms of accent or developmental level. Participants were 29 Chinese-English bilinguals and 25 English-monolingual children. Speech samples were collected using the *Goldman-Fristoe Test of Articulation – 2*, either a Cantonese or Mandarin phonology test, and three sentences in a delayed repetition task. In addition, ten SLPs rated each of the randomized sentences on either an accent or developmental level scale. Bilingual children with identified accents had significantly lower standard scores than monolingual children on the GFTA-2, but on the Chinese phonological assessments the same children showed age-expected speech. The differences in the bilingual children's scores on phonology tests in English versus Chinese highlight the need for phonological assessment in both languages. The SLP listener results further suggest that perceptual judgment may be a useful complement in phonological assessment of bilingual children but not a replacement for more formal testing.

Speech-language pathologists (SLPs) are increasingly expected to address the needs of bilingual children (Crago & Westernoff, 1997). However, few studies exist on the development of bilingual phonology (Holm & Dodd, 1999) and most SLPs have access to a battery of speech assessments only for first-language English speakers (Goldstein, 2001). Furthermore, commonly used speech assessment tools do not help an SLP differentiate developmental versus accented mismatches with adult targets (e.g., Goldman & Fristoe, 2002). In recent years, guidelines such as those from the Canadian Association of Speech and Language Pathologists and Audiologists have stated that accent needs to be taken into account when assessing children speaking English or French as a second language (Crago & Westernoff, 1997). Children learning a second language may speak it with an accent, at least in the early stages of the second language learning process, i.e., characteristics of their first language may influence pronunciation of their second (Flege, 1995). Accented speech can be best described as “non-pathological speech produced by L2 learners that differs in partially systematic ways from the speech characteristic of native speakers of a given dialect” (Munro, 1998, p. 139).

Little is known about the reliability of SLPs’ perceptual judgments of accent and the relationship of such judgments to formal speech assessment. As a consequence of a lack of appropriate tools and developmental data, bilingual children may be mislabelled as having protracted phonological development (PPD: speech sound disorders[1]). Conversely, SLPs may attribute developmental differences to accent, and fail to identify children who might benefit from speech therapy. The current study was therefore designed as an exploratory investigation in this topic area. The following section provides background on English and Chinese phonologies and their acquisition (monolingual and bilingual) and issues in bilingual assessment of phonology, including the evaluation of accent.

Phonology of English, Cantonese and Mandarin

English has a variety of word lengths and shapes in terms of CV sequences, including frequent syllable-final consonants (codas) and consonant sequences in all word positions. The primary stress pattern in disyllabic words is trochaic (stressed-unstressed). Before the age of 3 years, children tend to produce monosyllabic and disyllabic words with open syllables (without codas), singleton consonants and disyllabic words with trochaic stress; consonant sequences, multisyllabic words and other stress patterns generally emerge after the age of three. Multisyllabic words continue to develop in early primary grades (James, van Doorn, McLeod, & Esterman, 2008).

The English consonant inventory includes nasals and stops at the labial /m, p, b/, coronal /n, t, d/ and dorsal (velar) places of articulation /ŋ, k, g/.[3] The stops contrast in voicing ([+voiced]/[-voiced]), with allophonic aspiration of stops before a stressed vowel. Fricatives include voiced and voiceless cognates at the labiodental /f, v/ and coronal places of articulation /s, z, θ, ð, ʃ, ʒ/. The coronal fricatives contrast in grooving/stridency (/θ/ and /ð/ being [-grooved]), and in anteriority (all but /ʃ, ʒ/ being [+anterior]). Affricates /tʃ, dʒ/ are also coronal [-anterior] and [+grooved] with a voicing contrast. Sonorants include the nasals mentioned above, labial /w/, coronal /j/ and glottal glides /h/, and coronal liquids /ɹ, l/.

Stops, nasals, and glides are typically acquired by age 3 years (although dorsals may be later), with fricatives, affricates, and liquids acquired later and gradually (up to age 7 or 8 years for coronals: Porter & Hodson, 2001; Smit, 1993). Common substitution patterns for consonants include use of stops for fricatives, glides or stops for liquids, coronals for dorsals, unaspirated stops for aspirated word initially, and voiceless segments for voiced stops/fricatives syllable finally (Bernhardt & Stemberger, 1998). However, in general, most typically developing children have few phonological mismatches with adult targets after the age of four (e.g., Hodson & Paden, 1981, Roberts, Burchinal & Footo, 1990).

For English-speaking children with PPD, Shriberg and Kwiatkowski (1994) found mismatches on segments that typically develop early (e.g., nasals and glides) in addition to those that typically develop later. Dodd and Iacano (1989) (in a study of seven children) and Smit (1993) noted common phonological patterns[2] for children with PPD to include final consonant deletion, cluster reduction, weak syllable deletion, reduplication, gliding, stopping, voicing, fronting, and deaffrication; less common patterns included backing, initial consonant deletion, pervasive glottal replacement, affrication, and denasalization.

Turning to the Chinese languages, Cantonese is primarily monosyllabic but does have compounds of two to four (or more) syllables. Many syllables are open, but unreleased stops /p, t, k/ and nasals can occur in coda. Consonant sequences are rare but can occur across syllable boundaries if the first syllable has an unreleased stop or nasal, and the next one begins with a consonant. In terms of the vowel system, Cantonese has nine lexical tones (six contrastive and three stopped tones; So, 2007). The consonant inventory of Cantonese includes labial nasals and stops at the labial /m, p, p^h/, coronal /n, t, t^h/ and dorsal /ŋ, k, k^h/ places of articulation, plus labialized dorsal stops /k^w, k^{wh}/ (So, 2007). Cantonese stops and the coronal [+anterior] affricates /ts, ts^h/ contrast in laryngeal features but in terms of aspiration rather than voicing. There are two voiceless fricatives: labiodental /f/ and coronal [+anterior] /s/. Sonorants include the nasals noted above plus labial /w/, coronal /j/ and glottal /h/ glides plus the liquid /l/.

For a sample of 268 typically developing Cantonese-speaking children, So and Dodd (1995) reported that unaspirated stops /p, t, k/, nasals /m, n/, liquid /l/, glides /w, j, h/ and word-final /m, n, p/ were generally acquired before age 3 years. Aspirated stops, fricatives, affricates, labialized dorsal stops /k^{h}w, kw/, and word-final /t, k, ŋ/ were acquired later, up to age 5. Assimilation was relatively common as was simplification of the labialized dorsals. Up to age 4;3, the following patterns were also observed: substitution of stops for fricatives/affricates, affricates for stops/fricatives, coronals for dorsals or vice versa, or unaspirated for aspirated stops (So & Dodd, 1995).

Mandarin (in which we also include Putonghua) is also primarily monosyllabic with some compounds of two to four syllables. Only /n/ and /ŋ/ can occur in syllable-final position. Consonant sequences can occur across syllable boundaries if the first syllable ends in a nasal and the next begins with a consonant. Mandarin also has lexical tone (four in Mandarin compared with six or nine in Cantonese). Like Cantonese, the Mandarin consonant inventory includes nasals and stops at the labial /m, p, p^h/, coronal /n, t, t^h/ and dorsal /ŋ, k, k^h/ places of articulation, with stops contrasting in terms of aspiration. However, Mandarin has more fricatives and affricates. Fricatives (all voiceless) include the labiodental /f/, [+anterior, +grooved] coronals /s, ʂ/ (contrasting in retroflexion), the alveopalatal /ɕ/ ([-anterior], [-grooved]) and the dorsal /x/. Affricates contrast in aspiration, retroflexion /tʂ vs. tʂ^h/ and anteriority and grooving (/ts vs. ts$^{h/}$/ and /tɕ vs. ɕ^h/). Similar to Cantonese, Mandarin sonorants include nasals, the labial /w/ and coronal /j/ glides and the liquid /l/, but also the retroflexed rhotic /ɻ/.

Zhu Hua and Dodd's (2000a) study of 126 Mandarin-speaking children showed mastery of nasals /m/ and /n/, stops /p, t, t^h/, and fricatives /f, ç, x/ before age 3 years. The stops /p^h, k^h/, affricates /tɕ, tɕ^{h}/, liquids /ɻ, l/, and fricative /s/ were acquired by age 4;6, with /tʂ, tʂ^{h}, ts, ts^{h}, ʂ/ acquired after 4;6. Common substitution patterns up to age 4;6 included use of glides for liquids, aspirated for unaspirated stops and affricates, stops for fricatives/affricates, affricates for fricatives/stops and assimilation. Place differences (fronting/backing) and deaspiration continued past age 4;6.

In terms of children with PPD, uncommon patterns observed for Cantonese (So & Dodd, 1994, sample of 17 children) included initial consonant deletion, backing, and gliding. For Mandarin (Zhu Hua & Dodd, 2000b, sample of 33 children), less common patterns included final consonant addition, syllable-initial addition and backing ([k]) of coronal affricates.

Bilingualism, Phonological Development and "Accent"

Bilingual children can, but may not necessarily follow patterns of monolingual development as sketched above. Studies focusing on bilingual phonological acquisition are relatively rare, however (e.g., Goldstein & Washington, 2001). For Mandarin-English, Lin and Johnson (2010) examined the phonetic inventories and phonological patterns of 10 simultaneous Mandarin-English bilinguals in Taiwan. The children showed similar inventories in the two languages, with some influence of Mandarin on their English output (e.g., patterns affecting word stress, vowels, final devoicing of consonants). For Cantonese-English, a study of 16 sequential bilinguals aged 25-51 months (Dodd, So & Li, 1996) found occurrence of patterns in one language that are more often reported for the other (e.g., initial consonant deletion and backing in the bilinguals' English, patterns more commonly found in Cantonese-learning children). In another study (Holm & Dodd, 1999), two Cantonese-English bilinguals (aged 2;3 to 3;1 and 2;6 to 3;5) showed consonant inventory acquisition similar to that of monolinguals for each language. However, the authors' perspective was that some of the children's phonological patterns resembled those of English monolinguals with PPD, i.e., stopping, fronting, and final consonant deletion; again, less common patterns in English (aspiration, backing) suggested influence of more typically Cantonese learning patterns. Dodd, Holm and Wei (1997) noted that two Cantonese-English bilingual children with speech delay showed the uncommon patterns noted in the previous section for Cantonese, but also consonant addition and nasalization. Their English samples included all of the uncommon English patterns noted by Dodd and Iacano (1989) along with deaffrication and addition of initial consonants.

In considering this topic further, the notion of accent becomes relevant; the influence of L1 on L2 pronunciation (creating *accent*) is often called *transfer* or *interference* (Chan & Li, 2000; Gass & Selinker, 1983). A comparison of Cantonese and Mandarin phonologies with the phonology of English suggests potential sites of transfer between the languages. Cheng (1991) describes consonant substitution patterns commonly observed in Mandarin and Cantonese adult learners of English, i.e., /θ/ > [s]; /f/, /v/ > [f] or [w]. In terms of word structure, Chinese first-language speakers also tend to show deletion of final consonants and reduction of syllable-initial clusters in their English (or epenthesis of [ə] between the cluster elements). Cheng (1991) notes some possible language-specific patterns: for Mandarin speakers of English, /ð/ > [z], and for Cantonese speakers of English, /z/ > [s], /ɹ/ > [l], /ʃ/ > [s], and /ð/ > [d] word initially or medially. In addition, Cantonese speakers may show a tendency to produce coda stops as unreleased when speaking English, and Mandarin speakers may produce the post-alveolar grooved (strident) fricative /ʃ/ and affricate /tʃ/ as ungrooved alveopalatals ([ɕ], [tɕ]), the closest phones in Mandarin to the English palatoalveolars). Comparing these potential areas of language transfer with the types of developmental mismatches seen in monolingual English-learning children, we see both overlap and differences. In terms of commonalities, monolingual English learners as late as age 8 may show similar developmental substitutions patterns for late-developing fricatives, e.g., /v/, /z/, /ʃ/, /θ/ and /ð/, making it difficult to determine what is *accent* and what is *typical development* for those particular targets. However, most English-learning children would have acquired /f/ by primary grades, and thus difficulty with /f/ might lead to designation of a category of protracted development. Monolinguals in primary grades are less likely to produce stops as unreleased (whether they have typical or protracted development), or to produce consonant sequences with epenthetic vowels (these patterns may occur in children with protracted development but are relatively uncommon). Thus, some aspects of pronunciation might be easier to designate as accent than developmental, but the language differences at least do show potential for the distinction between the designations of accent/developmental level.

Phonological Assessment in the Bilingual Context

The above discussion concerning language differences suggests potential challenges for assessment of bilingual speech. Commonly, in SLP practice, a speech assessment involves the use of a standardized assessment tool (often a single word elicitation) and other evaluations (language testing/sampling, hearing screenings, oral mechanism evaluations, etc.). Age-related "errors" are noted and speech patterns described, often using phonological pattern terminology (Shriberg, Austin, Lewis, McSweeny & Wilson, 1997, although see more recent work by Bernhardt & Stemberger, 2000; Gierut, 2007). However, the majority of articulation/phonology tests in English are based on normative samples that do not include bilingual children. A bilingual child with accented speech in English might show more "errors" on such tests, receiving a below-average score and inaccurate designation as speech-impaired. Furthermore, access to or use of tests for other languages may be impossible or very challenging.

The SLP does have the option of making informal perceptual judgments about a child's speech. For monolingual children, researchers (Garrett & Moran, 1992; Rafaat, Russell, & Rvachew, 1995) have shown that judgments of severity for monolingual children may relate to scores on standardized measures: for example, children ranked as more severe were observed to have lower percentile ranks on the *Goldman-Fristoe Test of Articulation* (Goldman & Fristoe, 1986). No studies to date have compared test scores with SLP ratings of bilingual children's speech, however. For bilingual speech, SLPs could rate accent and/or designate a child's developmental speech level (defined here as the child's skill level in articulation relative to others of the same age range).

The current study was designed to address gaps in the literature concerning bilingual speech development and SLPs' judgments of accent and developmental level in relation to standardized assessments of English phonology. A number of predictions were made:

1) In comparing bilingual children's English and Chinese consonant development with that of their monolingual peers, mismatch patterns were expected to occur similar to those reported in previous studies (e.g. Holm & Dodd, 1999; Lin & Johnson, 2010).
2) Bilingual children with accents were expected to have lower scores than their monolingual peers on a standard test such as the *Goldman-Fristoe Test of Articulation – Second edition* (GFTA-2), because such assessments do not factor out the effect of mismatches due to accent.
3) For bilinguals, SLPs' perceptual ratings of accent level were expected to be associated with standard scores on the GFTA-2 (greater accent with lower standard scores and vice versa). Similarly, for monolingual children SLPs' perceptual ratings

of “lower developmental level” were predicted to be associated with lower standard scores on the GFTA-2.

Method

Participants

Speakers

The study included a bilingual Chinese-English group and a monolingual English group. The bilingual group of children consisted of 16 native Cantonese speakers and 13 native Mandarin speakers in Grades 1 through 3, who spoke only Mandarin or Cantonese at home (according to parent report on a language use questionnaire). It was considered appropriate to include children from both Chinese languages in the study, because the two languages come from the same language family, have similar word structure, and “Cantonese has 19 consonants and is most closely related to Putonghua” (So, 2007: 314). The language use questionnaire consisted of some multiple choice questions and some short answers. Language exposure was established based on who spoke which language to the child and in what context. Although we did not formally measure *oral language* proficiency of the children, the parents were asked to rate the child’s proficiency in each language on a 1 to 5 scale, with 1 being not satisfied and 5 being satisfied. More than 80% of the bilingual children’s parents who filled out the questionnaire indicated that they were satisfied with their child’s Chinese proficiency (checked 5 on the scale). Moreover, the parents of all children reported that their children spoke primarily their native language at home and English at school. The 18 boys (11 Cantonese and 7 Mandarin speakers) and 11 girls (5 Cantonese and 6 Mandarin speakers) had an age range of 5;6 to 9;8 (*M* = 7;4, *SD* = 0;11). Sixteen children were born in Canada (12 Cantonese and 4 Mandarin speakers), 11 in China, and two in Taiwan. The average length of residence in Canada for those born elsewhere was 2;2 years (*SD* = 1;10), and their average age of first exposure to English was 5;2 (*SD* = 1;10).

The English monolingual group consisted of 25 children born in Canada, with English as the only language spoken in their homes. The 16 boys and 9 girls were recruited from Grade 1 through 3 classrooms in the same school district and ranged in age from 6;8 to 9;4 (*M* = 7;8, *SD* = 0;11). All of the children in both groups were reported to have typical speech and language development by their parents and had not been referred for SLP services by their teachers. However, data from two boys in the monolingual group were removed from the analysis because they were rated consistently by the SLPs as having an accent. The two children used gliding in all positions and with clusters, and changed /ð/ to [d] initially and medially. These patterns were also associated with somewhat unusual voice quality. Taken together, we considered these features of the children' speech as indicative of possible protracted speech development, and the two children were taken out of the sample.

Raters

A group of 10 monolingual English-speaking SLPs were recruited as judges for the study. Their professional experience ranged from 1 to 40 years (*M*=19.9), and they reported moderate to frequent clinical experience with foreign accent.

Materials and Procedures

The research reported here was reviewed and approved by the Behavioural Research and Ethics Board at the university of the authors. The speech assessment consisted of both single word elicitation tasks (picture naming in the relevant language or languages for the group) and an English sentence elicitation task.

Speech materials: single word elicitation tasks

Speech samples were recorded on an Olympus VN-6200PC digital voice recorder with built-in microphone. English single words were elicited with the GFTA-2, targeting 39 consonants and clusters across word positions. For Cantonese, So's (1993) *Segmental Test of Cantonese* (CSPT) was used for elicitation of the 19 Cantonese consonants across word positions, So and Dodd (1995) serving as a developmental reference. Mandarin was assessed using a 40-item screening protocol sampling 23 consonants in Mandarin (Bernhardt & Zhao, 2009). Zhu Hua and Dodd (2000a) served as a general developmental reference for Mandarin.

Two trained English-speaking research assistants independently transcribed the GFTA-2 sessions of all children, with an agreement proportion of 93% for broad phonetic transcription. Two trained Cantonese- and Mandarin-speaking research assistants each phonetically transcribed the Chinese words with an agreement proportion for broad transcription of 99%. For analysis, in addition to standard scores, both consonant mismatches and phonological patterns were described for English (descriptions from Grunwell [1981] were used to define phonological patterns). The consonant mismatches from the standardized items on the GFTA-2 were grouped into common and uncommon categories based on reports by Dodd and Iacano (1989), Smit (1993) and Porter and Hodson (2001). In addition to calculating the number of occurrences of each consonant mismatch and phonological pattern, the mismatches and patterns were also calculated as a percentage of occurrence (the number of occurrences divided by the total number of opportunities on the GFTA-2).

Speech materials: Sentence repetition task

The sentence elicitation task was designed to evaluate SLP judgments of accent and developmental level. Three sentences were constructed to elicit speech targets presumed to be more challenging for both monolingual and bilingual children, i.e. fricatives, liquids, consonant clusters (/nt/, /pl/, /bl/, /tɹ/), and a variety of final consonants. The sentences were:

"The elephant ate a banana plant": [ði ˈɛləfə̃nt eɪɾ ə bənˈænə plæ̃nt]

"Two big mice chase one little black cat": [tʰu bɪg mʌɪs tʃeɪs wʌ̃n ˈlɪtḷ blæk kʰæt]

"Five sheep get on a long train": [faiv ʃip gɛɾ ɑ̃n ə lɑ̃ŋ tɹeĩn]

The sentences were elicited through delayed repetition, i.e., the investigator presented the target sentence (live voice), and then the children were asked to count to five orally before repeating the sentence. Delayed repetition tasks have been reported to reduce the likelihood of immediate (and more accurate) imitation of the experimenter's speech in studies of accent that use the same stimuli across participants (Flege, Munro, & Mackay, 1995).

Listening task for the SLP raters

The sentence responses (162 in total) were then randomized and played to 10 individual SLP raters, who did not know the results of the GFTA-2 assessments nor whether each response they heard was from a child who was bilingual or monolingual (but SLPs generally knew that the L1 of the bilingual children was either Cantonese or Mandarin). The SLPs were instructed to listen globally to each sentence (not to listen for specific sounds or patterns) only once but had control over the interval between sentence presentations. As a first step of decision-making, the SLPs were asked to decide for each sentence whether the speech was accented; if accented, then they were to choose the accent rating scale, if not, the other (developmental level) rating scale. For the developmental level scale, they were instructed to judge the child's developmental skill level in pronunciation. To aid in their judgement of the developmental level of the child, the SLPs were informed that the children were in primary grades at school. Typically-developing

English monolingual children reach 95% accuracy for consonants by the age of 5;6 according to Dodd, Holm, Hua and Crosbie (2003) and Pollock (2002), but some children do not finalize their acquisition of the fricatives or liquids until the end of the primary grades. The SLPs were very familiar with the primary grade population and thus could be expected to make a judgment about a particular sentence spoken by a particular child in terms of its developmental level within the primary grade context, i.e. sentences with no mismatches or very few mismatches would be expected, with typical mismatches perhaps noted for the coronal fricatives and liquids. No further information regarding the children's exact age was necessary for the SLPs to make judgements regarding the developmental level of a particular sentence. The result of this procedure was that some of the sentences produced by the bilingual children were not rated for accent because they were not perceived as accented; these sentences were therefore rated on the developmental level scale. Both scales were nine-point Likert scales, where 1 equalled low foreign accent or low developmental level and 9 equalled strong foreign accent or high developmental level, respectively. Southwood and Flege (1999) found ceiling effects using a 7-point scale of accent and thus recommend a 9-point scale.

Analysis of raters' scores and reliability

The results of each scale were averaged over the three sentences and across the ten judges to arrive at a separate mean perceptual score, one for accent and one for developmental level. For example, across the three sentences, a child with a mean rating of 3 (out of 9) on the developmental level scale and two mean ratings of 5 and 7 (out of 9) on the accent scale would then receive a developmental level score of 1 (3+0+0=3/3 sentences) and an accent score of 4 (0+5+7=12/3 sentences). This scoring scheme was considered to reflect the SLPs' judgments of the child's degree of accent or lack thereof. In the example above, the child was rated overall as accented on two of the three sentences, and the calculation above confirmed that the child received higher accent scores and a low developmental score (indicating a poorer speech ability relative to monolingual peers of the same age); thus, the average score on each scale accurately reflects the SLPs' assessment of the child's speech as more accented. For comparison purposes, consider another child, who had an average developmental level rating of 3 on all three sentences, and received a score of 3 on developmental level (3+3+3=9/3 sentences) but 0 on accent, since none of the SLPs scored on the accent scale (0+0+0=0/3 sentences). Therefore, this child was rated as not having a foreign accent, and therefore has only a developmental rating, which is on the higher end of the spectrum overall, comparing both scales together. It is acknowledged that accent and developmental level are relative terms and can overlap.

Each child had 30 ratings in total across judges. If a child had 20 or more ratings on the accent scale, they were designated post-hoc as being in the accented bilingual group (a conservative criterion, i.e., 2/3 of the total number of ratings were accented). Eleven of the 29 bilingual children did not meet this criterion and were therefore designated as a non-accented bilingual group.

In order to determine the interrater reliability of accent and developmental level ratings by the SLPs, an intraclass correlation coefficient (ICC) was used with a criterion of $r_1 = 0.8$, $p < 0.05$, which has been considered as good reliability in past research (Shrout & Fleiss, 1979). The ICC in the present study was $r_1 = 0.92$, $p < 0.01$, indicating high agreement between the judges. An additional ICC was calculated to determine the agreement on which children had an accent ($r_1 = 0.92$, $p < 0.01$), which was similarly high.

Results and Discussion

Both the Chinese and English speech data were evaluated, with the latter being compared with perceptual ratings of accent by the SLPs. Results are presented and discussed first for the children's L1 phonology, then for their English phonology, and finally for the accent evaluation.

Phonological profiles of Chinese-English bilingual children

Our first prediction was that the children's Chinese phonological productions might mirror those of previous studies. Reports for Chinese-learning monolinguals suggest an overall lack of observable phonological patterns after 5 years of age (So & Dodd, 1995; Zhu Hua & Dodd, 2000a), a younger age than that of the participants in the present study. In terms of their Chinese phonology, none of the Mandarin-speaking children had any mismatches on the Bernhardt and Zhao (2009) assessment. The only mismatch was for three Cantonese-speaking children, who replaced /ts/ with [dʒ] in Cantonese. This was similar to So and Dodd (1995), who reported later acquisition of /ts/. Thus, as expected, the consonant production of Cantonese and Mandarin by the bilingual children was developmentally similar to reports for monolingual Cantonese and Mandarin speakers.

These findings contrasted with the bilingual children's English, which included both common and uncommon consonant mismatch patterns. The phonological analysis of data from the GFTA-2 from both the bilingual and monolingual groups indicated that bilingual segmental development was similar to that of monolingual development, but with more mismatches overall. Table 1 presents segmental mismatch patterns in each group. The bilingual group had a total of 84 segmental mismatches on the GFTA-2 whereas the monolingual English group had 67 mismatches.

As expected, the segmental mismatches between the three languages were similar overall and in accordance with monolingual typical development; children had difficulty with late-developing fricatives, affricates, and liquids. Unexpectedly, there were three mismatches by children in the bilingual group for English, i.e., for /w/ (Mandarin), /m/ (Cantonese), and /n/ (Mandarin; one token of each) that would be uncommon for the children's age, according to monolingual developmental research (Shriberg, 1993). However, the dorsal [ŋ] substitution for /m/ and /n/ (once each) may reflect particular word items on the GFTA-2. The target word for word-medial /m/ was *swimming* /swɪmɪŋ/, making assimilation to the final dorsal a possibility, and the target word for word-final /n/ was *clown* /klaʊn/, with the [+back] feature of the diphthong spreading to the nasal, resulting in [ŋ]. As reported earlier, Cheng (1991) noted a /v/ to [w] pattern in Chinese-English speakers, the opposite mismatch of the present study. It may be, in general, difficult to differentiate the two sounds in Mandarin bilingual speech. Conversely, this was the only instance of this type of assimilation in the data and therefore may have been the result of transcription error.

Insert table 1 about here

Table 2 presents phonological patterns in English for both the bilingual and monolingual children. The total number of patterns, including those for clusters, was 173 for the bilinguals and 64 for the monolinguals. As predicted, the bilingual group used some different patterns in their English compared with the monolingual children. In the bilingual group, 61% of the patterns observed have been reported to be less common, while in the monolingual group, 34% were less common. Final consonant deletion was a common phonological pattern for the bilinguals only.

Insert table 2 about here

Relating phonological mismatch types and accent, the higher number of mismatch types in the bilingual group was probably due to the presence of foreign accent because the children performed at age level when assessed in Mandarin or Cantonese, but not when assessed in English. By design, the GFTA-2 does not differentiate mismatches due to accent from those of monolingual children. Therefore, bilingual children with accents would likely have lower standard scores on the GFTA-2 than monolingual children.

Contrastive analysis could explain the contribution of accent to mismatches, thus differentiating accent from impairment in the bilingual children. For example, fricatives and affricates /v, z, ʃ, ʧ, ʤ, θ, ð/ that do not occur in Mandarin or Cantonese present challenges for Chinese speakers of English and are potential loci for accented speech for speakers of those languages (Cheng, 1991). Cheng's (1991) predictions regarding segments account for the observed patterns of alveolarization (/θ/ > [s] in Cantonese speakers and /ð/ > [z] in Mandarin speakers), and devoicing (/z/ > [s] and /dʒ/ > [tʃ]) in the current sample. In terms of word structure, a contrastive analysis (as in Cheng [1991]) for English-learning native speakers of Chinese suggests potential for greater incidence of final consonant deletion, epenthesis and cluster reduction, also found in the sample.

Not all patterns noted in the current study were identified in Cheng's (1991) adult data, however. Phonological patterns left unexplained by the contrastive analysis of Cheng (1991) were affrication, initial and medial consonant deletion, assimilation and stopping of /v/. These might be considered less common patterns for the children's age in English (although /v/ and affricate-fricative contrasts can be later acquisitions), but the assimilations may have reflected specific words in the GFTA-2. Assimilation occurred exclusively for /θ/ in both the bilingual and monolingual groups. The targets for /θ/ on the GFTA-2 are *bath* /bæθ/, *bathtub* /bæθtʌb/, and *thumb* /θʌm/. All of these words include a labial consonant /b/ or /m/, which can potentially trigger assimilation with the interdental fricative, resulting in [f], also a common segmental mismatch pattern for English monolinguals. Overall, however, Cheng's (1991) predictions in contrastive analysis accounted for 92% of all phonological patterns observed. From these comparisons, it becomes clear that the speech patterns in the bilingual group were likely due to language interaction between their L1 and L2, and not due to a speech impairment.

Accent evaluation

Another study objective was to evaluate accent. First, we noted that some children in both the monolingual and bilingual groups received ratings on both scales. In the bilingual group, 55% of the children had accent scores only and no developmental scores (eight of these children were born outside of Canada, and the remaining five were born in Canada) whereas none of the children had developmental level scores only and no accent scores. The fact that five of the 13 children were born and raised in Canada and yet had accent ratings in the primary grades, may reflect the dominance of the Chinese language in the area where the study took place (where there is a high proportion of Chinese speakers). In the monolingual group, 75% of the children had developmental level scores only and no accent scores and two of the children had accent scores only and no developmental level scores; these two were thus eliminated (as noted previously).

In order to determine whether bilingual children had lower scores than their monolingual peers on a standardized test, comparisons were made between the two groups of children on the GFTA-2 with independent sample *t*-tests. Table 3 reports on the descriptive statistics of the

GFTA-2 standard scores, raw scores, the two perceptual (accent and developmental level) scores, and the number of accent ratings for all groups.

Insert table 3 about here

As expected, the bilingual group had a significantly higher accent score, t (50) = -4.87, $p < 0.001$ (d = 1.31), a significantly lower score on the developmental scale, t (50) = 5.88, $p <$ 0.001 (d = 1.68), and, on average, four times more accent ratings than the monolingual group. Moreover, although there was no significant difference between the mean standard scores on the GFTA-2 between the bilingual and monolingual groups, t (50) = -1.3, p = 0.19 (d = 0.37), there was a significant difference on the number of mismatches between the two groups, t (50) = 2.106, p = 0.04 (d = 0.59).

In order to evaluate the data more closely, the bilingual group was divided into two sub-groups. The first group, labelled *Accented* in table 3, included only bilingual children with perceived accents (20 or more accent ratings). The children with fewer than 20 accent ratings were designated as the second *Non-accented* group. While there was no difference on the GFTA-2 standard scores between the monolingual group and the non-accented bilingual group, t (32) = -0.47, p = 0.64 (d = 0.16), the accented bilingual group had significantly lower standard scores, t (39) = 2.20, p= 0.03 (d = 0.70), and a higher number of mismatches t (39) = 3.162, p = 0.003 (d = 1.01) than the monolingual group. The accented bilingual group also had more consonant mismatches with the adult targets than the monolingual group, t (39) = -3.17, p = 0.003 (d = 1.01), suggesting that the presence of detectable accent is related to the presence of more mismatches and lower standard scores on the GFTA-2. The results from the group comparisons confirmed the study's second prediction, i.e., only the bilingual children with detectable accents had lower standard scores and more consonant mismatches on the GFTA-2 than the monolingual children.

SLP perceptual ratings of accent

In order to address our third hypothesis, namely whether there was a relationship between scores on the GFTA-2 and SLPs' perceptual ratings of accent, Pearson product-moment correlations were calculated. Results indicated that standard scores on the GFTA-2 were not associated with either accent scores, r (21) = -0.24, p = 0.28, r (9) = -0.16, p = 0.64, or developmental level scores, r (21) = 0.31, p = 0.16, r (9) = 0.31, p = 0.35, for the monolingual and the non-accented bilingual groups respectively. Moreover, in the accented bilingual group, accent scores were not significantly correlated with the GFTA-2 standard scores, r (16) = 0.31, p = 0.22, but the developmental level scores were positively correlated with the GFTA-2 standard scores, r (16) = 0.68, p = 0.002.

Contrary to our expectations, the developmental level ratings were not significantly correlated with the standard scores on the GFTA-2 for the monolingual group and non-accented groups. This is possibly due the fact that none of the children in the study had a speech impairment according to the GFTA-2 criteria. Similarly to Goldstein and Washington (2001), on average, the standard scores of the bilingual children on the GFTA-2 were not in the impaired range for either the accented (standard score of 91) or the non-accented (standard score of 99) bilingual children. However, there was variance in the standard scores within the bilingual group that was not found in the non-accented group. Six of the bilingual children (24% of the bilingual sample) were in what would be designated as a speech-impaired range (i.e. they had a standard score less than 85 [1 SD below the mean]). These six children also had some of the highest mean accent ratings (6 and above on the scale), indicating a mid- to strong accent. Taken together, these findings suggest that bilingual children with accents will not necessarily fall in the impaired range, but those with stronger accents are at a greater risk of doing so.

Contrary to our third prediction, *overall* accent ratings were not correlated with standard scores on the GFTA-2. Similar to the correlation results for the monolinguals and the non-accented bilingual group, the accent ratings for the bilingual children designated as accented were not correlated with the GFTA-2 standard scores. This may reflect the fact that the GFTA-2 is a test of developmental level rather than accent, and the children did not have PPD. However, tokens rated on the developmental level scale for the accented bilingual group did show positive correlations between the SLP ratings and the GFTA-2. In other words, when the SLPs were not aware of the bilingual status of the individual children, their exact age, or gender, they were more likely to assume lower developmental level on utterances that were not first judged to be accented. A potential implication of this finding is that a child with accented speech may be judged as having PPD by clinicians, especially if speech test standard scores are slightly lower than expected. Therefore, it is important to highlight that when assessing culturally and linguistically diverse children, SLPs should have prior knowledge about the dominant language of their client, as well as solid understanding of the typical speech development paths of these children. The determination of accent versus impairment necessarily relies on a number of different procedures, with sufficient data for each procedure (three sentences being a low number for this determination). Clearly, further research is needed in this area concerning the relationship between accent, judgment of developmental level, and determination of speech impairment.

Clinical implications

The phonological pattern analysis in the present study revealed unique patterns in bilingual phonology, whereas the phoneme-based analysis, for the most part, revealed similarities between the two groups. This contrast suggests a pattern-based analysis may be preferable for future studies on bilingual speech development. Compared with the prevalence of speech delay in the general population (9%; Shriberg, Tomblin, & McSweeney, 1999), the proportion of bilingual children in our sample categorized as accented was almost three times as great. Therefore, there is a great need for the development of assessments in English that are standardized on bilingual populations of various language backgrounds. Ideally, a bilingual SLP of the same L1 as the child should administer a normative test of phonology in the child's L1 (Crago & Westernoff, 1997; Goldstein, 2001). If this is not possible, an interpreter or a family member can help with the elicitation, with the SLP using phonetic transcription skills to judge the productions as matching or not matching adult targets. Caregivers or interpreters may also provide assistance during the transcription process, although previous literature advises caution in this process (Langdon & Cheng, 2002).

The current study revealed that the bilingual children's developmental level in L1 phonology was similar to that of monolingual children learning the same language. Moreover, the bilingual group had a larger total number of patterns in their English production and a larger proportion of these patterns were less common when compared with the monolingual children. If a larger number of mismatches had been noted on the L1 phonological assessments, a speech impairment may then have been suspected. This underlines the importance of assessment within L1, both to identify children with PPD and to differentiate accent from PPD. SLPs therefore need training in both monolingual and bilingual phonological development and tools for a variety of languages[4]. In addition, knowledge of bilingual phonological development may help determine which mismatches might be expected due to development versus transference and which might indicate a possible speech impairment.

The present study has demonstrated that a group of SLPs can agree reliably overall on the determination and degree of accent and developmental level. However, the judgments were not completely reliable for each child in the sample; some children in both groups were not consistently rated on one or the other scale only. Thus, judgments for individual children remain informal and open to error. This situation could be ameliorated by SLPs learning more (during university training and afterwards) about the individual languages that are common in their community and the potential for language transfer between their L1 and L2.

When the SLPs were asked what contributed to their judgment of developmental level they verbally reported “intelligibility”. Past research has similar reports from SLPs judging impairment (Rafaat et al., 1995; Shriberg & Kwiatkowski, 1982). It is possible then that SLPs in the current study were judging developmental level through intelligibility, which may not be optimal because intelligibility is a factor that could affect judgments of foreign accent as well (Rafaat et al., 1995) and therefore may have been a confounding factor in the present study. Although we separated the two scales and analyzed them separately, even more could be done to avoid a potential overlap in the two scales. For future research, it is recommended, for example, that only one perceptual rating be used at a time. Moreover, for a more complete picture of the children’s abilities in their two languages, future studies should formally measure other aspects of language proficiency (e.g. vocabulary and/or morphosyntactic knowledge) in both the L1 and L2 and should aim to control the exact age of exposure to English in the bilingual group. Finally, an important next step in this line of research is to explore how accent is reduced over time in this population, which could be best examined through a longitudinal research design.

In conclusion, the study evaluated the phonological profiles of Chinese-English bilingual children in primary grades relative to those of English monolinguals, and compared the children's profiles with SLP ratings of children's speech in terms of accent or developmental level. The children had near-perfect phonology in Chinese, but a range of speech sound differences in English. This finding strongly suggests a need for formal phonological assessment in both languages of bilingual children. The results from the SLP listeners further suggest that perceptual judgment may be a useful complement in phonological assessment of bilingual children provided that the SLPs receive further training on expected areas of transference between languages and the notion of "accent."

Notes

[1]The term *speech sound disorders* is prevalent in the field, but a more current and neutral term *protracted phonological development* is used in this paper (first appearing in Bernhardt & Stemberger, 1998). However, when studies by other authors are discussed, we have used the term employed by the original authors.

[2]For consistency purposes, we use the more current term *phonological patterns* instead of *phonological processes*.

[3]The features for English are based on Bernhardt and Stemberger (1998; 2000). The glottal stop also is part of the phonology, but is generally only inserted before vowel-initial words occurring after a pause.

[4]Please contact the third author for free tools that are currently being developed for a number of languages.

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Table 1

Consonants with Mismatches (Tokens and Proportion of Mismatches) for English on the Goldman-Fristoe Test of Articulation - Second Edition

Monolingual Group	Bilingual Group
Common for age[a]	Common for age[a]
/θ/ (9: 13%), /s/ (14: 20%), /ɹ/ (12: 18%)	/θ/ (17: 20%), /s/ (3: 4%)[c], /ɹ/ (2: 2%)[c]
/z/ (10: 15%), /tʃ/ (7: 10%), /dʒ/ (5: 7%)	/z/ (11: 13%), /tʃ/ (2: 2%), /dʒ/[m] (1: 1%)
/ð/ (4: 9%), /ʃ/ (4: 6%), /v/ (1: 1%)	/ð/ (32: 38%), /ʃ/ (3: 4%), /v/ (9: 11%)
/l/ (1: 1%)	/l/ (1: 1%)[m]
	Uncommon for age[b]
	/w/[m] (1: 1%), /m/[c] (1: 1%)
	/n/[m] (1: 1%)

[a]Expectations based on Smit (1993) and Porter and Hodson (2001)

[b]Expectations based on Shriberg (1993)

Note. The number of mismatches per segment and the percentage of the number per segment over the total number of mismatches in the sample are presented in parentheses, separated by a colon; [c] indicates a Cantonese only mismatch, [m] indicates a Mandarin only mismatch.

Table 2

Phonological Patterns (tokens and proportion of patterns) observed on the Goldman-Fristoe Test of Articulation - Second Edition for English

Monolingual Group	Bilingual Group
Common for age[a]	Common for age[a]
Depalatalization (5: 8%), Gliding (33: 52%), Stopping of /θ/ or /ð/ (5: 8%)	Depalatalization (16: 9%), Gliding (6: 3%), Stopping of /θ/ or /ð/ (33: 19%)
Less common for age[a]	Less common for age[a]
Assimilation (10: 16%)	Assimilation (35: 20%)
Cluster reduction (1: 2%)	Cluster reduction (10: 6%)
Alveolarization (7: 11%)	Alveolarization (17: 10%)
Deaffrication (3: 5%)	Deaffrication (2: 1%)
	Stopping of /v/ (3: 2%), Epenthesis (4: 2%)
	Final Consonant Deletion (34: 20%)
	Uncommon pattern types[b]
	Affrication (3: 2%), Initial Devoicing (7: 4%), Spirantization (1: 1%)[m], Deletion of initial and medial consonants (2: 1%)[c]

[a]Expectations based on Grunwell (1981) and Stoel-Gammon and Dunn (1985)

[b]According to Dodd and Iacono (1989)

Note. The number of occurrences of patterns and the patterns as a percentage of the total number of patterns in the sample are in parentheses and separated by a colon; [c] is a Cantonese only mismatch, [m] is Mandarin.

Table 3

Means and standard deviations (SD) for the Goldman-Fristoe Test of Articulation - Second Edition standard scores (SS), raw scores and the accent/developmental level ratings for the bilinguals and monolinguals, as well as the two subgroups of bilingual children.

	Variables				
Group	GFTA-2 SS M (SD)	GFTA-2 Raw score M (SD)	Accent Rating M (SD)	Developmental level Rating M (SD)	# of Accent Ratings M (SD)
Bilingual (N=29)	93.8 (10.9)	7.1 (5.4)	3.2 (1.1)	1.84 (1.6)	19.4 (8.2)
Accented (N=18)	90.7 (10.3)	9.1 (5.3)	3.8 (0.5)	0.9 (0.8)	24.5 (3.5)
Non-Accented (N=11)	99.0 (10.2)	3.8 (4.2)	2.3 (1.1)	3.5 (1.1)	10.8 (5.1)
Monolingual (N=23)	97.5 (9.0)	4.2 (4.4)	1.4 (1.6)	4.4 (1.5)	4.82 (5.3)