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Language variation in teacher speech in a dual immersion preschool

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Abstract. This study investigates the language input provided for English-Mandarin emergent bilingual children in a California English-Mandarin dual immersion preschool. As illustrated in previous studies, teacher speech in foreign language classrooms often serves as the native standard of the target language, thus necessarily limiting students' exposure to stylistic variation. The current research focused on the language input for emergent bilingual preschoolers who were Chinese heritage language learners and the use of sociolinguistic variables, including Mandarin lexical tones and word-initial sibilants, by their teachers. Results show that although the teachers perceived their classroom roles differently, they tried to provide clear and rich Mandarin input with tonal and sibilant variables that were used in consistent patterns. Except for the constraints of the linguistic environment, standard variables were preferred in classroom discourse. This implies that the particular needs of the English-dominant children to acquire Mandarin have been acknowledged and addressed by teachers. This type of modification in language input may affect children's development of phonetic categories and their sociolinguistic competence.

Keywords. language input; language variation; early childhood; teacher speech; dual immersion; heritage language

1. Introduction. In hyper and hypo-articulation theory, Lindblom (1990) proposed that "speech production is adaptive" (p. 403) and speakers can have their own choices "to vary their output along a continuum of hyper- and hypospeech" (p. 404) according to the context. Child-Directed Speech (CDS) is such a fine-tuned register that is modified phonetically, phonologically, morphologically, and syntactically (Snow 1995). Studies (e.g., Foulkes, Docherty, & Watt 2005; Grieser & Kuhl 1988; Han, de Jong, & Kager 2018; Kuhl et al. 1997; Tang et al. 2017) have identified some universal characteristics in CDS, such as shorter utterances, slower speaking rate, longer durations, a large number of repetitions, higher pitch, larger pitch range, and simplified vocabulary and syntactic structures across tested languages. Two possibilities are proposed to explain the observed modifications: the hyperarticulation hypothesis claims that the contrasts between different phonetic categories will be enhanced for learnability (Kempe, Brooks, & Pirott 2001; Kuhl et al. 1997; Tare, Shatz, & Gilbertson 2008) while the prosodic hypothesis states that the observed modifications are just due to the emotional expressions in CDS and adults expect to facilitate adult-child interaction by attracting the child's attention (Dominey & Dodane 2004; Gauthier & Shi 2011; Matychuk 2005; Papoušek & Hwang 1991; Trainor & Desjardins 2002; Wong 2018; Wong & Ng 2018).

However, most current CDS studies mainly focus on input provided by caregivers or mothers, most of the time at home, while input in other settings, such as preschool, is often understudied for its linguistic role. As a critical period during which a child intensively develops

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their linguistic, cognitive, and socio-emotional skills, preschool serves as the first transitional step from home to the broader social environment where the child starts independent socialization (Schwartz & Palviainen 2016). Through interaction with teachers, preschoolers learn the group norms and how they are expected to express their needs in different contexts. In addition, compared with the dominant language exposure, linguistic input in a heritage language for young children is limited, and the primary language resource often comes from core family members (Cychosz 2022; De Houwer 2018; Duff, Liu & Li 2017; Montrul 2010; Xiao 2006). Whether and how heritage language children learn and use their home language outside the family is still unknown. Viewing teacher speech as another crucial part of CDS, this study investigates the characteristics of language input in two English-Mandarin dual immersion preschools. Specifically, it examines the variation of lexical tones and syllable-initial sibilants in Mandarin classroom instruction for Chinese heritage language (CHL) children. In general, teachers tended to hyperarticulate their Mandarin lexical tones and use standard forms of sibilants in classroom instructions. Moreover, sibilant dentalization is constrained by other linguistic factors, including vowel, word class, initial sibilant, final consonant, tone, and sentence type. It seems that although the two teachers perceived their classroom roles differently, both were trying to provide clear and rich Mandarin input with tonal and sibilant variables that were used in consistent patterns. This implies that the needs of the English-dominant children to acquire Mandarin have been acknowledged and addressed in bilingual classroom speech. This type of Mandarin input may affect the development of phonetic categories and sociolinguistic competence for emergent bilingual children.

2. Literature review.

2.1. PRESCHOOL TEACHER SPEECH. As mentioned earlier, how preschool teachers use their language with young children in the class is relatively understudied. Previous research has mainly explored teachers' language use in different classroom activities (Cabell et al. 2013; Dickinson et al. 2014; Dickinson & Keebler 1989; Price, Bradley & Smith 2012). For example, Dickinson and Keebler (1989) demonstrated that by using different book-reading styles, daycare teachers constructed different speech events for 3- and 4-year-old children. Dickinson and colleagues (2014) further examined preschool teachers' language in Head Start programs in three settings: book reading, group content instruction, and small group instruction. Focusing on the use of vocabulary and syntactic complexity, the study revealed that (1) differences in teacher speech are primarily associated with settings; (2) book reading could foster an academic register by using analytical language; and (3) rich vocabulary input but not syntactic complexity was found to be significantly higher in narrative text (Dickinson et al. 2014). Similarly, Price et al. (2012) compared teacher talk during storybook and information book read-aloud. Results showed that teachers tended to use more extratextual utterances during information book reading and favored reading storybooks more. Teachers' educational backgrounds and the age of the children in the class were related to the language teachers used during the read-aloud (Price, Bradley, & Smith 2012). Lastly, the effectiveness of instructional interactions among different classroom settings was examined based on a large-scale data collection consisting of instructional interactions by 314 preschool teachers and children primarily from low-income families in eight states (Cabell et al. 2013). Statistical analysis showed that teachers demonstrated the most effective instruction in science activities and literacy-focused events during large group activities.

Language input in preschool may also function as a reliable predictor of various aspects of children's language development in the long term (Dickinson & Porche 2011; Hadley, Barnes &

Hwang 2022; Huttenlocher et al. 2002; Piasta et al. 2012). For example, based on teacher speech collected from 40 preschool classrooms, Huttenlocher et al. (2002) found that the syntactic complexity in the classroom linguistic input was positively associated with children's performance in the syntax comprehension text over a year. In a longitudinal study, Dickinson and Porche (2011) revealed that (1) the use of low-frequency words by preschool teachers significantly predicted the children's reading comprehension in fourth grade; and (2) teachers' correction in preschool classes was also associated with children's receptive vocabulary in the fourth grade. In addition, Piasta et al. (2012) investigated the relationship among professional development, preschool teachers' conversational responsivity, and children's language outcomes. Findings showed that trained teachers adopted significantly more communication-facilitating strategies to promote children's participation in class. Consequently, children with trained teachers demonstrated greater linguistic productivity and complexity in their language production (Piasta et al. 2012). In a recent systematic review, Hadley et al. (2022) interpreted 54 related studies to examine the relationship between teacher language use and children's oral language outcomes. The most typical methodology adopted to investigate teacher language is recording segments of classroom activities, transcribing the interactions between teachers and children in the class, and coding the utterances by teachers. Four critical strands of teacher language practice were identified: conceptual talk, interactive talk, linguistic features, and management and literal talk. Generally, preschool teachers can support children's oral language development by using various communicative strategies tailored to specific contexts. And children's oral language in early childhood can predict their later reading comprehension (Hadley, Barnes, & Hwang 2022).

2.2. CHILD-DIRECTED SPEECH. In contrast to language teachers use in class, caregivers' linguistic input at home is often explicitly modified according to the child's needs. This language genre is also known as parental speech, maternal speech, motherese, or child-directed speech (CDS) (Grieser & Kuhl 1988; Liu, Tsao & Kuhl 2009; Tare, Shatz & Gilbertson 2008; Zellou & Scarborough 2015). Universal characteristics of CDS have been identified across languages, including short utterances, longer duration, repetition, parental addition, phonetic clarification and enhancement, simplified structures, and salient prosodic patterns (e.g., Foulkes, Docherty, & Watt 2005; Grieser & Kuhl 1988; Han, de Jong & Kager 2018; Kempe, Brooks & Pirott 2001; Kuhl et al. 1997; Lahey & Ernestus 2014; Liu, Tsao, & Kuhl 2009; Tang et al. 2017). As a fine-tuned speech register, CDS has been examined in terms of its unique modifications compared with other registers (e.g., adult-directed speech or ADS, foreigner-directed-speech or FDS, and Lombard speech or speech in a noisy environment), the possible functions of these adjustments, and the effects on child language development (Snow 1995).

CDS can be modified for phonetic distinction. As one of the representative studies, Kuhl et al. (1997) compared the realization of three corner vowels /i, a, u/ in English, Russian, and Swedish infant-directed speech (IDS) and found that the vowels were hyperarticulated with stretching of the vowel space area. Studies also demonstrated that rich vocabulary input in CDS would contribute to children's later vocabulary knowledge (e.g., Rowe 2012). In addition, CDS may also be adjusted for the social meanings behind the linguistic variation. For example, in the use of British English /t/ in word-medial and word-final prevocalic contexts, adults tended to use more standard variants with girls and more vernacular versions with boys. This differentiation by gender was most apparent for the youngest children aged 2;0 (Foulkes, Docherty & Watt 2005). Moreover, the extent that CDS is modified relates to parents' socioeconomic status. Rowe (2008) reported that parents with better educational backgrounds and higher family income tended to

talk more, use more diverse vocabulary, and produce longer utterances with their young children. However, the differentiation caused by socioeconomic status could be mediated by parental knowledge of child development (Rowe 2008). Similarly, in Hebrew and English CDS, caregivers with high socioeconomic backgrounds provided more successive utterances with partial self-repetitions to support children's language learning in both languages (Tal & Arnon 2018). Schwab and Lew-Williams (2016) reviewed recent research on language input for children from different socioeconomic groups. Parental socioeconomic status was found to be a significant predictor of the quantity and quality of linguistic input in perspectives of vocabulary, grammar, and pragmatic functions. This is further associated with children's language development longitudinally. Differences in input and learning also exist within socioeconomic-status groups (Schwab & Lew-Williams 2016).

3. Present study. This study focused on the language input provided for CHL children in a dual English-Mandarin dual immersion preschool. Few studies have examined the variability of language input for young CHL children outside the family. To fill this gap, the current study investigated the variation of Mandarin lexical tones and sibilants in teacher speech. This research aims to answer the following questions: Do teachers change their ways of using these two sociolinguistic variables when talking to CHL children in class, and if so, how? Also, what kind of social and linguistic factors constrain the variables in the CHL input?

3.1. PARTICIPANTS AND DATA. Teacher speech data were collected in the 2021-2022 academic year from two teachers in an English-Mandarin dual immersion preschool in the San Francisco Bay Area. The preschool, Lily Valley (a pseudonym), is located in a coastal city next to San Francisco, where many early Chinese immigrants from the southern parts of China have resided for generations. As a family-based preschool, Lily Valley serves eight to ten children every academic year in a mixed-age classroom and adopts English and Mandarin at a 50/50 ratio for classroom instruction. Usually, teachers mixed English and Mandarin by saying one sentence in a language and the next one in another language. Although the eight children who enrolled in Lily Valley in the 2021-2022 school year can be identified as CHL learners or who have at least one parent or grandparent as a native speaker of one Chinese variety, most of them (seven out of eight) actually spoke English as the dominant language at home. Considering this, teachers usually included more English to facilitate their teaching and classroom management, despite their desire to use both languages equally. Data were collected via classroom observation and sociolinguistic interviews with a Sony ICD-UX570 digital voice recorder and a lavalier lapel microphone at a 44.1 kHz sampling rate.

3.2. TONAL VARIATION. A Mandarin syllable consists of two parts: a segmental unit and a suprasegmental unit (Chen et al. 2017). The suprasegmental unit refers to the lexical tone which is used to distinguish the meanings of /pā/ for "eight" and /pà/ for "dad" (Singh & Fu 2016). In modern Mandarin, there are four lexical tones, namely, Tone 1, Tone 2, Tone 3, and Tone 4. The primary phonetic cue of tonal contrast is the F0 contour (Singh & Fu 2016; Wong, Schwartz & Jenkins 2005; Yang & Liu 2012), but other acoustic parameters such as duration, amplitude, vocal range, and register may serve as the secondary cues (Singh & Fu 2016). According to the hyperarticulation hypothesis (e.g., Kuhl et al. 1997; Lindblom 1990; Liu, Tsao & Kuhl 2009), an adult who is talking to a young language learner will modify her speech to simplify the language input by enhancing the contrasts between different phonetic categories. For the acquisition of lexical tones in Mandarin, this will be reflected in higher mean F0, wider pitch range, and enhanced tonal contrasts in one or more lexical tones.

Mandarin tonal variation in three registers was compared: monolingual CDS in the corpus by McCabe and Chang (2013), bilingual CDS collected from the two teachers in class, ADS collected via sociolinguistic interviews between the two teachers and the researcher. Following the methodology of Tang et al. (2017), Han, de Jong, and Kager (2018), Wong (2018), and K.-Y. Tang, Hsiao, and Su (2020), this study examines the realization of four lexical tones in disyllabic words in declarative sentences. As shown in Table 1, the target disyllabic words are compound nouns where the first syllable only bears T1 to avoid the contextual impact on the pitch contour at the lexical level (Xu 1997; Han, de Jong, & Kager 2018; Wong 2018). Tokens that occurred in non-declarative sentences or with neutral tones in declarative sentences were excluded as the overall intonation in questions, and imperatives may cause contextual tonal variations (Han, de Jong, & Kager 2018). Data was transcribed in Praat (Boersma & Weenink 1992). Phoneme segmentation was completed via Montreal Forced Aligner (McAuliffe et al. 2017). Following the phonetic segmentation principles (Skarnitzl & Machač 2011), manual correction on phoneme segmentation was made for all tokens. Voiced consonants (i.e., nasals and approximants) in onsets were not excluded from the target tokens as they may convey tonal information as well (Howie 1974; Duanmu 2007).

Mandarin compounds	English meaning	Lexical tones	IPA for syllables	Pinyin
秋千	swing	T1 T1	/tɕʰjy tɕʰjan/	qiū qiān
蜗牛	snail	T1 T2	/wo njou̯/	wō niú
斑马	zebra	T1 T3	/pan ma/	bān mǎ
天气	weather	T1 T4	/tʰjan tɕʰj/	tiān qì

Table 1. Lexical tone target token

With a customized Praat script, F0 values were extracted with other contextual information such as individual speaker, token number, target word, and time-point. Tone tracks were verified by visual and audio checks during the manual correction. Data normalization and tonal contour plotting were conducted in R (Stanford & Pan 2013). Based on this, the following acoustic parameters were calculated: the duration of the syllable (ms), the mean pitch, the pitch range, and the pitch contour. Mixed-effects logistic regression was used to examine how the key parameters were affected by linguistic constraints and social factors. Linguistic constraints consist of onset, vowel, coda, and the rest parameters. Social factors are discourse contexts, and individuals were set as random intercepts.

3.3. SIBILANT VARIATION. In Mandarin, the post-alveolar sibilants /tʃ, tʃʰ, ʃ/ (or zh, ch, sh in Pinyin) and dental sibilants /ts, tsʰ, s/ (or z, c, s in Pinyin) are two distinctive phonemic categories but are often mixed in many dialects, such as Taiwan Mandarin (Chang & Shih 2015; Starr 2016). In the merger of /s/ and /ʃ/, it is more common to find sibilant dentalization in which retroflex sibilants such as /ʃ/ are realized as alveolar sibilants such as /s/, as shown in example (1), instead of the palatalization of /s/, as demonstrated in example (2). For linguistic constraints, Starr (2016) noted that preceding rounded vowels might lead to a retroflex realization. For social factors, Li (2017) revealed that female adult speakers' production of the palatal fricative x was more anterior than that of males. This resembles recent findings in the gender variation on /s/ and /ʃ/ in English (Stuart-Smith 2020).

(1) 原来 美国 有 那么 多 火***山***。
Yuán lái měi guó yǒu nà me duō huǒ ***sān***
It turns out the United States have so many volcano
'It turns out that there are so many volcanoes in the United States.'

(2) ***所***有 的 庄稼 都 被 烧焦 了。
Shuǒ yǒu de zhuāngjia dōu bèi shāo jiāo le
All de-NOM crop all BEI scorch le-CRS
'All the crops were scored.'

The realization of sibilants was measured by several acoustic parameters, including sibilant duration, F2 value at the onset of the following vowel, and spectral moments analysis of the target sibilant (Li 2009). Although /s/ and /ʃ/ can be identified as categorical phonetic contrasts, many previous acoustic studies have pointed out that the sibilant space or the space between the constriction points of /s/ and /ʃ/ is continuous in the same axis of front-back articulation (Gunter, Vaughn, & Kendall 2021; Li 2009; Li & Munson 2016). Recent studies showed that the phonetic distinction between /s/ and /ʃ/could be captured by spectral moments analysis which consists of the first spectral moment (M1) or the centroid frequency, the second spectral moment (M2) or the standard deviation of the fricative spectrum, the third spectral moment (M3) or the skewness of the spectral shape, and the fourth spectral moment (M4) or the kurtosis of the spectral shape (Li 2009; Reidy 2016). As M2 and M4 only distinguish sibilants from non-sibilant consonants, these two parameters were not involved in the analysis. In addition, F. Li (2009) pointed out that F2 frequency at the onset of the following vowel may better reflect the contracts among /ɕ/, /s/, and /ʃ/ in Mandarin.

Acoustic parameters, including duration, M1, M3, and Onset F2 were measured in Praat with a spectral moments analysis script with 15-ms window size, 6 window number, and high-pass filter at 300 Hz (Boersma & Weenink 1992; DiCanio 2021). The linguistic environment and contexts of the target sibilants were also coded. Linguistic constraints were measured as preceding sound, following vowel, lexical tone, word type, and sentence type. Multiple logistic regression and linear mixed-effect models were conducted in R to examine the functions of linguistic environment and context on sibilant variation (Bates et al. 2015; Kuznetsova, Brockhoff & Christensen 2017; Johnson 2009).

4. Findings.

4.1. TONAL VARIATION. Statistical analysis shows that both linguistic factors, such as consonant onset, vowel, tone, and discourse context, significantly affect the tonal variation in all tested samples. In general, speakers tended to produce the four lexical tones with longer duration, higher mean pitch, wider pitch range, steeper pitch slope in T1, T2, and T4, and an earlier turning point for T3 in bilingual CDS than in monolingual CDS. Besides the effect of discourse context, lexical tones were realized with longer duration when the syllables begin with unaspirated consonants, have triphthongs, diphthongs, or single front vowels in the middle, in T3, T2, and T1, and with larger pitch range and steeper slope. For the variation of the mean pitch, it tended to be produced in higher F0 values when the syllables begin with aspirated consonants, have high vowels, diphthong or triphthong in the middle, end with /ɻ/ or nasals, in T4 or T1, and realized with wider pitch range and greater pitch slope. Syllables also tended to be realized with a wider pitch range when they start with unaspirated consonants, have diphthong, triphthong, or high vowels in the middle, in T3 and T4, and with longer syllable duration, higher mean pitch, and greater pitch slope. T1, T2, and T4 tended to vary more in pitch slope when the syllables start with unaspirated consonants and have diphthong or single vowels /o, e, y, i/ in the middle, with wider pitch range and higher mean pitch. T2 shows a rising pattern, T1 shows a flat

pattern, and T4 shows a falling pattern as their phonetic contrastiveness. Lastly, the turning point in T3 tended to occur earlier when the syllables start with unaspirated consonants, have triphthong, diphthong, or single vowel /a, u/ in the middle, and are produced in longer duration.

Pitch contour serves as an identical feature in lexical tone perception (Xu 1997; Hao 2018). As shown in Figure 1, the pitch contours in monolingual CDS and ADS show similar patterns in each lexical tone, which indicates that the speakers did not enhance the phonetic contrastiveness when addressing the three- and four-year-olds. At the same time, the tonal variation in terms of pitch contour can be identified in bilingual classroom CDS. For T1, the contour of bilingual CDS is still flat but higher than those of ADS and monolingual CDS. The slope of T2 and T4 is steeper in bilingual CDS, especially in the second half of the syllable from time point 100 to time point 200. This echoes the carry-over effect of contextual tonal variations (Xu 1997): the starting F0 of a tone is assimilated to the offset value of the previous one. As the target tokens are in T1Tx structure, the starting F0 value of the second syllable is assimilated to the offset value of the previous T1syllable. Thus, the second half of the pitch contour could better reflect the phonetic contrastiveness which distinguishes one lexical tone from another. Lastly, the pitch contour of T3 in bilingual classroom CDS shows a clear turning point where the pitch contour changes direction from falling to rising. This is not identified in monolingual CDS and ADS data in the same section.

The comparison of pitch contours indicates that except for T1, the pitch contour of all the other three lexical tones was enhanced in bilingual classroom CDS. This tonal variation is not this salient in monolingual CDS as the pitch contour of the lexical tones in monolingual CDS largely aligns with that in ADS. Besides pitch contour, lexical tones vary in bilingual CDS and monolingual CDS in terms of other factors such as syllable duration, mean pitch, pitch range, pitch slope 50%, and turning point of T3. In general, compared with monolingual CDS, lexical tones in CDS addressed young children who were emergent English-Mandarin bilinguals tended to be realized with longer syllable duration, higher mean pitch, wider pitch range, steeper pitch slope 50% in T2 and T4, and an earlier turning point in T3. With the enhanced categorical contrasts in bilingual CDS data, hyperarticulation of tonal variation is supported that acoustic parameters in lexical tones are hyperarticulated by enhancing the contrastiveness of phonetic categories in language input.

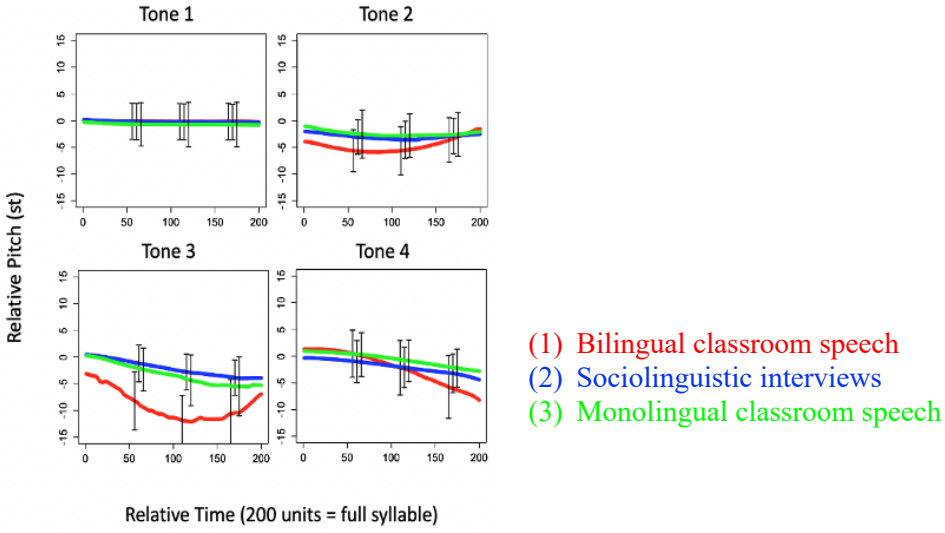

Figure 1. Tone contour in three tested registers

4.2. SIBILANT VARIATION. Statistical analysis shows that both linguistic constraints and social factors affected the use of sibilant variables by the two teachers. First, as shown in Table 2, Ms. Daisy had both dentalized and retroflexed sibilants in her speech, while Ms. Olivia only had one palatalized sibilant, which occurred during the interview. Considering that both teachers retroflexed the dental sibilants at a low rate (2.13%), I excluded the retroflexed variants in the following analysis and focused on the dentalization of /tʃ, tʃʰ, ʃ/.

Teachers	Dentalization	Palatalization	Standard	Total
Ms. Daisy	150 (12.16%)	43 (3.48%)	1041 (84.36%)	1234
Ms. Olivia	138 (16.61%)	1 (0.12%)	692 (83.27%)	831
Total	288 (13.95%)	44 (2.13%)	1733 (83.92%)	2065

Table 2. Summary of sibilant variation by teachers

Table 3 shows all the significant factors that constrain sibilant variation. First, among social factors, the two teachers used the post-alveolar sibilants differently. Compared to Ms. Daisy (77%), Ms. Olivia tended to use more standard sibilants (84%). This may be attributed to her identity as a Mandarin heritage speaker herself. Due to her language ideology, she preferred to provide standard input for heritage language learners. Discourse also significantly affected sibilant dentalization. The teachers tended to use more standard sibilants in classroom instruction but more dentalized sibilants in songs or nursery rhymes. This implies that singing may be treated as an informal classroom activity by the teachers, and it might be more challenging to deal with both melody/rhythms and language variation at the same time. However, the dentalization of sibilants was not obviously preferred in the sociolinguistic interviews as a causal and informal context. This may be explained better with more data collected in the future. Among linguistic constraints, vowels strongly affected the use of dentalized sibilants. In general, it seems that the use of standard sibilants tended to occur when the syllable had a nucleus that starts with a back vowel, such as /u/. This is consistent with the findings of previous studies (Li 2009). For word class, teachers tended to use the standard variants with numerals and adjectives. In classroom instructions, teachers often emphasized the pronunciation of numbers when counting together with the children. They also tended to produce some adjectives such as "好吃" (hǎo chī, yummy) for a longer duration and a louder volume as they were the keywords in the scenarios. Among all the three sibilants, /ʃ/ is the one that tended to be produced as the standard form. Compared with the other two affricates, the articulation of /ʃ/ as a dental fricative is relatively easier. Therefore it is more space to produce it as a retroflex. Syllables with dental nasals tended to be realized as dental variants. This could be interpreted as the consequence of coarticulation as dental nasals, and dental sibilants share the same place of articulation. Syllables in T1, T0, and T4 tended to be realized as the standard sibilants. T1 as a high-level tone and T4 as a falling tone bear precise tonal contours and may be emphasized more as a phonetic input for the emergent bilingual children. While the tonal contour in T0 is usually reduced, which may cause a certain loss in the acoustic information in the lexicon. To avoid more loss in the message, sibilants were not dentalized in this type of syllables. Lastly, sibilants were produced as standard forms in imperatives and exclamation sentences because these two types of sentences were often produced by the speakers with emphasis, strong emotional expressions, and some hyperarticulated modifications such as longer duration, louder voice, and higher pitch. Therefore, non-standard forms tended not to be used in this situation.

Factors group	P value
Vowel	1.1e-10
Word class	1.36e-08
Initial sibilant	2.35e-07
Discourse	0.00012
Final consonant	0.000894
Lexical tone	0.00218
Sentence type	0.0415
N = 1520; overall standard sibilant rate = 81.4%; input probability = 0.977; log-likelihood = -506.69; all factors were listed with their p values in an ascending order	

Table 3. Significant constraints on sibilant variation

In general, the use of dentalized sibilants by the teachers is quite systematic. The pattern is significantly constrained by both social and linguistic factors as discussed above. Ms. Olivia preferred to use the standard forms more than Ms. Daisy. And both teachers tended to use the standard variants in syllables that had /u/ in vowels, words that served as numerals and adjectives, syllables that started with /ʃ/ and ended with velar nasals or no final consonant, syllables that in T1, T0, and T4, and syllables which occurred in imperatives and exclamation sentences. It seems that most of the factors are driven by the emphasis on the discourse and the ease of production. Then how would the emergent bilingual children perceive this kind of pattern in sibilant dentalization from teacher speech? Could this language input affect the acquisition of sibilants as different phonetic categories in Mandarin as their non-dominant language? Would the children acquire the usage patterns of sibilants as their teachers and therefore develop the sociolinguistic competence in Mandarin?

5. Discussion. Addressing English-dominant CHL children, Ms. Daisy and Ms. Olivia in Lily Valley tended to extend the sibilant duration and enhance the phonetic distinction between /s/ and /ʃ/ in their classroom speech. These typical CDS modifications have been identified in previous findings in language input provided by caregivers across languages (Cristià 2010; Han, de Jong, & Kager 2018; Kuhl et al. 1997; Liu, Tsao, & Kuhl 2009; P. Tang et al. 2017). In general, it is believed that IDS/CDS serves two basic functions – social and analytical (Garnica 1977). On the one hand, language units are simplified, enhanced, or even exaggerated so that the language input for the young learner is easier to process. For instance, Kuhl et al. (1997) proposed that vowels were hyperarticulated in IDS to "provide exceptionally well-specified information about the linguistic units that form the building blocks for words" (p. 684). On the other hand, these adjustments in CDS were believed to support the social and emotional interaction between the child and the adult. With increased pitch and exaggerated prosodic patterns, CDS is modified to better facilitate the commutation and maintain the infant's attention during this process (Trainor & Desjardins 2002; Wong & Ng 2018; Soderstrom 2007). But most previous studies illustrated that adjustments in linguistic input are often observed in linguistic input to infants, and as children grow older, the way that parents talk with them will become similar to ADS (Garnica 1977; Wong 2018). That is to say, for older children, parents believe that the basic mastery of language has been achieved and the modifications of the analytic units in linguistic input are no longer needed. Similar findings were also reported in FDS to adult foreign-language learners (Hazan, Uther, & Grunlund 2015; Jian & Konopka 2012; Knoll, Scharrer, & Costall 2011). In this study, the children's limited Mandarin proficiency may be the main reason for the phonetic enhancements of Mandarin sibilants.

6. Conclusion and implications. This study investigated the use of sociolinguistic variables in linguistic input for CHL children in a dual-immersion preschool. Specifically, it compared the Mandarin sibilant variation by teachers in classroom instruction as a CDS genre and in sociolinguistic interviews as an ADS genre. Statistical analysis shows that phonetic environment, pragmatic function, and discourse context all significantly affected the realization of lexical tones and sibilants in Mandarin as a non-dominant language in class. The particular language learning needs of CHL children from English-dominant language backgrounds were well acknowledged and addressed by the teachers in classroom interaction. The analytic information in linguistic input was emphasized. This study extends the current understanding of language input for emergent bilingual children outside the family by illustrating the role of preschool instruction as a crucial part of CDS. It also contributes to the literature on CHL development in early childhood. By exposing CHL children to heterogeneous contexts where Chinese varieties can be used flexibly, the preschool class serves as an interactive setting where children can explore the available resources to expand the linguistic repertoire in their heritage language.

The current findings also lead to several pedagogical implications for the teaching of the heritage language in early childhood. First, the language backgrounds and learning needs of heritage children need to be well explained in professional development. Most of the time, teachers establish their own teaching strategies according to classroom observation and their understanding of the children in the class. Pedagogical suggestions based on language acquisition theories will be helpful to new teachers who may not be familiar with the complex situation in the classroom. Second, the differences in language development between heritage language learners and L2 students should be taken into account in curriculum planning. Also, when young children are exposed to heterogeneous linguistic environments, their speaking may be delayed to the complexity of language input. This should be carefully differentiated from language dysfunction. Lastly, using sociolinguistic variables in classroom activities may support children's development of sociolinguistic competence or the ability to use sociolinguistic variables appropriately in different contexts (Bayley & Regan 2004; Zhang 2021). Linguistic input in heritage language is often limited not only in amount but also in types of varieties. By introducing language varieties and sociolinguistic variables to heritage language children, teachers can further facilitate the development of heritage language in early childhood, especially the learning of underrepresented varieties.

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