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ARTICLE

Contrasting lexical biases in bilingual English–Mandarin speech: Verb-biased mothers, but noun-biased toddlers

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Abstract

Is noun dominance in early lexical acquisition a widespread or a language-specific phenomenon? Thirty Singaporean bilingual English–Mandarin learning toddlers and their mothers were observed in a mother-child play interaction. For both English and Mandarin, toddlers' speech and reported vocabulary contained more nouns than verbs across book reading and toy playing. In contrast, their mothers' speech contained more verbs than nouns in both English and Mandarin but differed depending on the context of the interaction. Although toddlers demonstrated a noun bias for both languages, the noun bias was more pronounced in English than in Mandarin. Together, these findings support early noun dominance as a widespread phenomenon in the lexical acquisition debate but also provide evidence that language specificity also plays a minor role in children's early lexical development.

Keywords: bilingualism; noun bias; lexical acquisition

1. Introduction

Examining early lexicalization provides insight as to how the world around us is conceptualized. Of particular interest is whether the world is segmented in a preestablished way that allows for natural acquisition of pre-individuated concepts or whether the world is segmented based on a speaker's linguistic system. The former might be revealed in a widespread bias in early lexicalization (i.e., a widespread noun bias), whereas the latter might be revealed by language-specific biases in early

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lexicalization. Whether noun dominance is widespread across languages or language-specific has been a long-standing question in language development (see Waxman et al., 2013, for review). Evidence from monolingual children's vocabulary is mixed. Some researchers support the dominance of nouns in early lexical acquisition (e.g., Au, Dapretto & Song, 1994; Bornstein et al., 2004; Gentner, 1982; Gentner & Boroditsky, 2009; Kauschke, Lee & Pae, 2007; Kim, McGregor & Thompson, 2000; Yamashita, 1997), whereas others support language-specific noun or verb dominance (e.g., Choi, 2000; Choi & Gopnik, 1995; Tardif, 1996; Tardif et al., 1997, 1999, 2008).

New insight into the noun-versus-verb dominance debate has emerged from studies examining bilingual samples, specifically children who are learning one language that is typically classified as "noun-privileged" (e.g., English, Dutch) and another language that is typically classified as "verb-privileged" (e.g., Mandarin, Turkish, Filipino). If early dominance of nouns in children's vocabulary is widespread, then bilinguals should demonstrate a noun bias in both their languages. However, if the early dominance of nouns in children's vocabulary is language-specific, then bilinguals should demonstrate a noun bias in their noun-privileged language and a verb bias in their verb-privileged language. In addition, from a language-specific lexical bias standpoint, parents, as children's primary source of verbal input, should produce lexically biased speech that is then reflected in their children's lexical biases. More specifically, a bilingual parent should produce noun-biased child-directed speech for noun-privileged languages and verb-biased child-directed speech for verb-privileged languages. The present study aims to explore the presence of cross-linguistic noun-versus-verb dominance in young bilinguals and the roles of language and parental input in bilinguals' early vocabulary by examining Singaporean English–Mandarin bilingual mothers' and toddlers' productive speech during mother-child play interactions, particularly in book reading and toy playing contexts.

Early noun dominance as a widespread or language-specific phenomenon

Gentner's (1981, 1982, 2006) seminal natural partitions and relational relativity hypotheses hold that early conceptual lexicalization is based on whether its referents are naturally individuated in the world and whether verbs' semantic structure is stable across languages. These hypotheses predict that noun concepts would be universally lexicalized earlier than verb concepts because nouns typically refer to naturally individuated referents and have stable meanings across languages. In contrast, verbs refer to referents that are not naturally individuated in the world and have meanings that are shaped by verbs' linguistic system. Moreover, it has been argued that learning verbs is more difficult than learning nouns because learning verbs requires understanding the arguments (e.g., nouns) that verbs can take in addition to relations between agents and objects (e.g., Golinkoff & Hirsh-Pasek, 2008; Imai, Haryu, Okada, Li & Shigematsu, 2006). However, in the first year of life, infants already show a rich understanding of physical relations and voluntary and involuntary movements (e.g., Baillargeon et al., 2012; Baillargeon & Wang, 2002; Leslie, 1982). On this basis, it is conceivable that verbs could appear early in children's vocabulary.

Researchers have argued that children's linguistic input is crucial in determining their early word-learning biases, and therefore early noun dominance in vocabulary emerges only in children who learn noun-privileged languages (Choi & Gopnik, 1995; Tardif, 1996). Parental input has been demonstrated to play a critical role in children's early vocabulary acquisition (Barrett, Harris & Chasin, 1992; Goldfield,

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1993, 2000; Huttenlocher, Haight, Bryk, Seltzer & Lyons, 1991). Depending on the language spoken, parental input could be lexically biased. For example, Chan, Brandone and Tardif (2009) showed that parents speaking a noun-privileged language (English) produced more nouns than verbs, whereas parents speaking a verb-privileged language (Mandarin) produced more verbs than nouns.

The privileged status of nouns versus verbs in a language is often characterized by the features of the language as well as language users' cultural differences. One such linguistic feature includes differences in noun and verb specificity, as between English and Mandarin, where English typically has high noun specificity and low verb specificity whereas Mandarin has high verb specificity and low noun specificity (Chan et al., 2009; Tardif et al., 1997; Tardif et al., 1999). Specificity is best defined by example. As described by Chan et al. (2009), it is more common to use highly specific nouns in English, such as differentiating between a "train" and a "bike", whereas it is more common to use generic nouns in Mandarin, such as "vehicle" ("车"), to refer to both trains and bikes. This contrast between English and Mandarin is flipped for verbs. It is more common to use generic verbs in English, such as "carry", to indicate moving an object from one location to another, whereas it is more common to use highly specific verbs in Mandarin, such as carrying an object on one's back ("背"), in one's arms ("抱"), and dangling from one's hand ("拎").

In addition to privilege, input, and specificity, some languages allow nouns to be dropped in sentences reducing the production frequency of nouns in comparison to verbs. For example, Mandarin allows subjects and objects to be dropped (Tardif et al., 1997). Because subjects and objects are often dropped, verbs are also typically positioned in either the initial or the final position of the sentence. Both have been argued to be salient word positions for children (e.g., Brown & Fraser, 1963; Naigles & Hoff-Ginsberg, 1998; Tardif, 1996; Tardif et al., 1997).

Cultural differences between English-speakers and Mandarin-speakers also contribute to differences in noun and verb usage. For example, English-speakers tend to focus on labeling objects, whereas Mandarin-speakers tend to focus on labeling actions (Chan et al., 2009; Nisbett, Peng, Choi & Norenzayan, 2001). Together, differences in these linguistic and cultural characteristics contribute to the relative frequency and saliency that nouns and verbs are used, and thus could provide an advantage in learning nouns versus verbs in early lexical acquisition for those acquiring a noun-privileged language versus those acquiring a verb-privileged language, respectively (Choi & Gopnik, 1995; Tardif, 1996).

The advantage in verb learning based on the linguistic characteristics of verb-privileged languages, however, is debatable (e.g., Waxman et al., 2013). Verb-privileged languages such as Mandarin lack grammatical and morphological cues such as determiners and tense that are thought to help infants distinguish between nouns and verbs. Similarly, it is argued that dropping nouns, as many verb-privileged languages tend to do, could also hinder verb learning as infants have been shown to use semantic or position information from the adjacent nouns to acquire novel verb meanings (e.g., Arunachalam & Waxman, 2011).

Beyond measuring the dominance of nouns or verbs in children's vocabularies, children's noun and verb learning abilities have also been examined by investigating how children map and extend novel nouns or verbs. However, following previous research on lexical bias in children's vocabulary, the results of an advantage for learning and extending novel nouns and verbs based on child language appear to be mixed. For children learning a noun-privileged language, studies have shown

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successful novel noun and verb learning by 18 months (Chan et al., 2011), but other studies show that children learning a noun-privileged language demonstrate successful novel verb learning by 5 years of age and only when the novel verb is presented in a linguistic structure that is similar to the child's own language (Imai et al., 2008). Children learning a verb-privileged language can successfully learn and extend a novel noun to another exemplar by 2 years of age (Arunachalam, Leddon, Song, Lee & Waxman, 2013) and can learn novel labels for actions as early as 18 months (Chan et al., 2011). Eighteen-month-olds learning a verb-privileged language also outperform children learning a noun-privileged language when learning novel verbs (Chan et al., 2011), but only under certain circumstances (e.g., when verbs appear in contexts when noun phrases are omitted; Arunachalam et al., 2013). Other research shows that children learning a verb-privileged language fail to learn and extend novel verbs even by 5 years of age unless the novel action is highlighted (Imai, Haryu & Okada, 2005; Imai et al., 2008). At first glance, there appears to be a discrepancy as to when verb-privileged language learning toddlers/preschoolers can learn and extend novel verbs, but the three studies do complement each other. Chan et al. (2011) found that 18-month-old verb-privileged language learners can learn novel action labels but did not test whether toddlers can extend the novel label to novel exemplars. Arunachalam et al. (2013) found that two-year-old verb-privileged language learners can learn and extend novel action labels but only when the verbs are presented in their own linguistic system. Imai et al. (2008) found that Chinese five-year-olds can learn and extend a novel action label only when the novel action is highlighted as opposed to the novel object (but they did not provide as much linguistic support as Arunachalam et al., 2013, did by providing contrasting examples). In sum, verb-privileged language learners appear to readily acquire and extend novel verb labels by 24 months of age.

Overlaying all these linguistic considerations are two methodological issues. First, biases in child-directed parental speech appear to be context specific to some degree. For example, book reading contexts tend to elicit more noun usage than verb usage, whereas toy play contexts tend to elicit more verb usage than noun usage regardless of the language spoken (Altınkamış, Kern & Sofu, 2014; Chen, Setoh, Meng & Tardif, 2009; Choi, 2000; Ogura, Dale, Yamashita, Murase & Mahieu, 2006; Tardif et al., 1999). Second, measuring children's vocabulary using a vocabulary checklist versus recording productive speech can lead to different results (Piccin & Waxman, 2007; Tardif et al., 1999). For example, using vocabulary checklists tends to support noun dominance in early lexical acquisition because checklists tend to list more nouns and so inflate the number of nouns reported in children's vocabulary (e.g., Pine, Lieven & Rowland, 1996), and (especially Western) mothers tend to be more exhaustive in reporting their children's nouns (Tardif et al., 1999).

To date, early noun dominance has been primarily examined in monolinguals. However, examining early noun dominance primarily in monolinguals raises potential concerns involving between-subjects variability and limits our understanding of early noun dominance. The toddlers who receive noun-privileged language input are also the toddlers whose parents are more culturally Western-affiliated. Similarly, the toddlers who receive verb-privileged language input are also the toddlers whose parents are more culturally Eastern-affiliated. These two populations may differ in many ways, but parental input and parental cultural affiliation are frequently discussed as principal factors that influence children's lexical biases. By investigating lexical biases in bilingual children learning noun-privileged and verb-privileged languages simultaneously, we can reduce participant variability between languages and compare two languages within the

same individual. When bilinguals acquire noun-privileged and verb-privileged languages at the same time, will their lexical bias resemble monolinguals learning one or the other language? Our study set out to answer this question.

Early noun dominance in bilinguals: A widespread or language-specific phenomenon?

To our knowledge, only four studies have investigated lexical biases in bilingual children simultaneously learning a noun-privileged language and a verb-privileged language (Levey & Cruz, 2003; Lucas & Bernardo, 2008; Özcan, Altinkamiş & Gillis, 2016; Xuan & Dollaghan, 2013). For all four studies, bilingual children were learning one noun-privileged language (English, Dutch) and one verb-privileged language (Mandarin, Turkish, Filipino). Three of the studies found that children's vocabularies (English–Mandarin and Dutch-Turkish) for both noun-privileged and verb-privileged languages were dominated by nouns (Levey & Cruz, 2003; Özcan et al., 2016; Xuan & Dollaghan, 2013). The remaining study, however, found that bilingual English-Filipino preschoolers' English vocabulary was noun dominated, but their Filipino vocabulary was not lexically biased (Lucas & Bernardo, 2008). Although results from these bilingual lexical bias studies largely support noun dominance in lexical acquisition, drawing the conclusion that early vocabulary acquisition is universally dominated by nouns would be premature because the three bilingual studies that found noun dominance in both languages relied on the checklist approach to evaluate children's vocabularies, whereas the study that only found English vocabulary to be noun-dominated used an observational approach to evaluate children's vocabularies. As noted, the checklist approach inflates noun counts (Lavin, Hall & Waxman, 2006; Pine et al., 1996; Tardif et al., 1999), and thus it is possible that the noun dominance observed in bilingual children's vocabularies could be an artefact of how children's vocabularies were measured as opposed to a true reflection of their vocabulary composition.

Finding a homogenous bilingual sample challenges bilingual research. Bilinguals have been characterized to have a "constellation of language experiences" (Place & Hoff, 2011, p. 1834), and normally have unbalanced language inputs and proficiencies. For example, most bilingual lexical bias studies have sampled children whose parents were either first generation immigrants (Levey & Cruz, 2003; Xuan & Dollaghan, 2013) or used one language dominantly in the household (Özcan et al., 2016), which can lead to unbalanced or unproficient input in one of the languages. Language frequency and proficiency are both important factors in bilingual language acquisition (Pearson, Fernandez, Lewedeg & Oller, 1997). Another potential concern is that the participants in bilingual lexical bias studies reside in countries where noun-privileged languages are the official or national language (e.g., English for U.S.) and verb-privileged languages are considered minority languages and less prestigious than the official or national language. Because of the lack of national support and these language status differences in bilinguals' languages, extant studies may paint an inaccurate picture of early bilingual lexical development (see Gathercole & Thomas, 2009).

Bilingualism in Singapore

Relatively homogenous and stable bilingual populations emerge when governments prioritize bilingualism and support dual-language learning in schools. For example, in Singapore bilingualism has been the central focus of the government's official language policies for over half a century. In 1966, the Singaporean government

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mandated that all Singaporeans learn both English and their "mother tongue" (Mandarin for Chinese Singaporeans, Malay for Malay Singaporeans, and Tamil for Indian Singaporeans) starting from preschool until at least 16 years of age. In 1979, to enhance the synchrony between home and school languages for Chinese Singaporeans, the government launched the "Speak Mandarin" campaign to promote Mandarin as the default Chinese language and to discontinue the use of local Chinese dialects in Singapore. It is possible, therefore, that Singaporeans could be either simultaneous or sequential bilingual learners. Singaporeans may learn English from infancy and only learn their mother tongue when they enter preschool.

In addition, the type of English spoken in Singapore is unique. Known colloquially as "Singlish", Singaporean English has been argued to take on the grammatical characteristics of local Chinese dialects such as Hokkien and Teochew (e.g., Bao, 2001). One of these characteristics, which is also a characteristic of verb-privileged languages, is the pro-drop feature (see Alsagoff & Ho, 1998; Bao, 2001; Sato & Kim, 2012; Tan, 2005, for more discussion of the pro-drop rule in Singaporean English). So, it is possible that Singaporeans' English child directed speech may be verb biased, meaning that Singaporean toddlers are also receiving English verb-biased input. With respect to the noun-versus-verb dominance debate, it is theoretically interesting to examine the degree to which Singaporean mothers' English child-directed speech is verb biased and, further, whether Singaporean toddlers' English would also be biased based on the verb-biased input they receive or would still be primarily dominated by nouns.

Singapore provides a unique setting and opportunity to study a bilingual population where speakers learn one of the languages that is central to conflicting results in the noun-versus-verb dominance debate (Mandarin-Chinese) and speak verb-biased English. Thus, this study is positioned to elucidate whether bilingual children's early vocabulary is noun-dominant or language-specific in its noun versus verb bias.

The present study

Our primary aim is to investigate whether noun bias is a widespread or a language-specific phenomenon by sampling Singaporean English–Mandarin bilingual mothers' and their toddlers' bilingual speech. Our secondary aim is to investigate whether toddlers' lexical biases are like their mothers' lexical biases in their respective languages. Specifically, the present study explores whether English- and Mandarin-learning toddlers demonstrate a noun bias regardless of which language (English or Mandarin) is spoken and whether toddlers' lexical bias reflects their mothers' lexical bias. Following previous studies on lexical biases (see Bornstein et al., 2004, for a cross-linguistic sample), we explored bilingual lexical biases in 20-month-old toddlers. To sample bilingual speech and avoid one language being used predominantly, mothers and toddlers were recorded for 20 min, 10 min per language, while freely interacting with their toddler using a standard set of toys and two books. Previous studies have indicated that 5 min of mother-child interaction is sufficient to sample mothers' and children's lexical biases (e.g., Choi, 2000; Gopnik, Choi & Baumberger, 1996).

Method

Participants

Thirty Singaporean Chinese toddlers (16 females, $M = 19.3$ months, $SD = 2.1$ months, age range = 15.8 months to 24.8 months) and their bilingual (English and Mandarin)

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mothers ($M = 33$ years, $SD = 3$ years, age range = 29 years to 40 years) participated. At the time the data of the current study were collected (2017), 28 mothers were born after the "Speak Mandarin" campaign, meaning that most mothers grew up with Mandarin as their mother tongue as opposed to another Chinese dialect. Mothers were recruited through online fora and Facebook pages. Mothers had a university degree (70%), a post-graduate degree (10%), a junior college or polytechnic diploma (13%), or completed secondary school (7%).

Mothers were asked their child's preferred language (English, Mandarin, or no preference). Most mothers reported that their child's preferred language was English (73%), but some reported that their child's preferred language was Mandarin (20%) or had no preference (7%). Mothers also reported the daily percentage that their child heard each language. Two mothers reported a summed percent that was greater than 100%. Excluding those two mothers, mothers on average reported that their toddlers heard more English ($M = 67\%$, $SD = 23\%$) on a day-to-day basis than Mandarin ($M = 34\%$, $SD = 22\%$). If the two mothers with percentages exceeding 100% were included by recalculating their reported percentages proportionally, the averages would be similar (English: $M = 66\%$, $SD = 21\%$, Mandarin: $M = 35\%$, $SD = 21\%$).

Mothers were given monetary compensation, and toddlers received a certificate for their participation. All methods were performed in accordance with the relevant guidelines and regulations, and the study was approved by the Institutional Review Board of Nanyang Technological University, Singapore. All data are available at this URL: https://researchdata.ntu.edu.sg/dataset.xhtml?persistentId=doi:10.21979/N9/QSCZ0P

Materials

Mothers were provided with a set of standard, gender-distributed, and age-appropriate toys to engage their child (see for example, Bornstein, Haynes, O'Reilly & Painter, 1996). These toys included a doll, a blanket, a tea set (including a tea pot with a lid, two cups, two saucers, and two spoons), a toy cellphone, a train, a foam ball, and five nesting barrels as well as two storybooks, '*Guess How Much I Love You*' (McBratney, 1994) and '*The Very Hungry Caterpillar*' (Carle, 1969) in both English and Mandarin.

Procedure

Mothers first completed a general demographic questionnaire and reported their toddler's vocabulary for both languages. Then, they were asked to engage their toddler with the materials provided for 20 min. Mothers were instructed to speak exclusively in English to their toddler for 10 min and exclusively in Mandarin to their toddler for 10 min. To ensure that mothers engaged in 10 min of free-play for each language, a research assistant timed each session and signaled mothers to switch languages when 10 min elapsed. Language order was counterbalanced.

Toddlers' reported vocabulary

Vocabulary checklists measuring the total vocabulary of toddlers were administered to the mothers. The short-form versions of the MacArthur-Bates Communicative Development Inventory (Fenson et al., 2007) and the Mandarin Communicative Development Inventory (Tardif et al., 2008) were used to measure toddlers' bilingual

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vocabulary. Mothers were instructed to check on the list the words they had heard their child produce. The number of nouns and verbs as well as the distribution of nouns and verbs varied slightly between languages: The English MCDI contained a total of 100 words: 50 nouns, 19 verbs, and 31 other words (e.g., pronouns, quantifiers), and the Mandarin MCDI contained a total of 113 words: 48 nouns, 29 verbs, and 36 other words. To equate the scores between vocabulary lists, reported vocabulary scores were prorated depending on the analysis. To compare language lists, a total reported vocabulary score was calculated by dividing the number of ticked words by the total number of words available on its respective list. To evaluate lexical biases, prorated noun (and separately verb) scores were computed by dividing the number of ticked nouns (or verbs) by the total number of nouns (or verbs) on its respective list.

Coding

Free-play sessions were video recorded and transcribed by one of four English–Mandarin bilingual research assistants using the Computerized Language Analysis (CLAN) program (CHILDES, MacWhinney, 2000). Each transcript was reviewed by at least one other research assistant, and any discrepancies in the transcriptions were resolved through discussion. Standard orthography was used for the English transcripts, and Mandarin characters were used to transcribe the Mandarin transcripts. Research assistants coded each word for its part of speech. Compound words are prevalent in Mandarin Chinese and were transcribed as a single unit. For example, "电池" ("battery") would be transcribed together, instead of "电" ("electric") and "池" ("pool"), hence computing as one noun as opposed to two individual nouns.

Mothers and children infrequently code-switched between languages (English in the Mandarin session and Mandarin in the English session). Mothers code-switched (English in the Mandarin session: 4.89% of noun-verb types in the Mandarin session, Mandarin in the English session: .69% of noun-verb types in the English session) and inserted Malay words (one of the other official languages in Singapore). Specifically, mothers used two Malay words, "sayang" and "kakak", which mean "to love" and "big sister" in Malay, respectively, and were produced infrequently (<.01% of types across both sessions). Table 1 displays the nouns and verbs that mothers produced outside of the language-designated session. For the English nouns and verbs in the Mandarin session, mothers tended to produce noun types referring to the toys (e.g., "baby", "ball", "train", "telephone"; 37.23% of English types in the Mandarin session) or referring to herself in the third person (9.57% of English types in the Mandarin session). For the Mandarin noun-verb types produced in the English session, mothers tended to produce kinship terms such as "奶奶" ("grandmother"), "弟弟" ("little brother"), or "姐姐" ("older sister"). Familial terms accounted for 41.86% of Mandarin noun-verb types that mothers produced in the English session. Producing Mandarin kinship terms in the English session is unsurprising as Mandarin kinship terms tend to be more specific than English kinship terms.

Toddlers also code-switched (infrequently) between languages (English in the Mandarin session: 4.21% of noun-verb types in the Mandarin session, Mandarin in the English session: 1.54% of noun-verb types in the English session). Table 2 displays the nouns and verbs that toddlers produced outside of the language-designated sessions. All English noun-verb types that toddlers produced in the Mandarin session were nouns, which often referred to the toys (e.g., baby, ball,

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Table 1. Nouns and verbs that mothers produced out of its language-designated sessions.

English N/V Types (in Mandarin Session)		Mandarin N/V Types (in English Session)	
Nouns	*Verbs*	*Nouns*	*Verbs*
aunt (*n* = 1)	clean (*n* = 1)	公公 (*n* = 1)	要 (*n* = 2)
baby (*n* = 19)	come (*n* = 4)	*paternal grandfather*	*want*
ball (*n* = 6)	give (*n* = 1)	阿公 (*n* = 2)	来 (*n* = 5)
bird (*n* = 1)	go (*n* = 4)	*maternal grandfather*	*come*
body (*n* = 1)	hug (*n* = 1)	奶奶 (*n* = 1)	讲 (*n* = 1)
book (*n* = 1)	kiss (*n* = 1)	*paternal grandmother*	*tell*
boy (*n* = 1)	listen (*n* = 1)	婆婆 (*n* = 2)	看 (*n* = 1)
bus (*n* = 2)	look (*n* = 1)	*maternal grandmother*	*see*
caterpillar (*n* = 1)	mix (*n* = 2)	姑姑, 阿嫲 (*n* = 5)	停 (*n* = 1)
cow (*n* = 2)	peek (*n* = 1)	*aunt*	*stop*
cup (*n* = 1)	put (*n* = 1)	舅舅 (*n* = 1)	到 (*n* = 1)
diaper (*n* = 1)	read (*n* = 1)	*uncle*	*reach*
doll (*n* = 1)	roll (*n* = 1)	子 (*n* = 1)	弄 (*n* = 1)
eyes (*n* = 1)	say (*n* = 2)	*son*	*do*
face (*n* = 1)	see (*n* = 3)	姐姐 (*n* = 4)	抱+抱 (*n* = 1)
finger (*n* = 1)	sit (*n* = 1)	*older sister*	*hug*
food (*n* = 1)	throw (*n* = 1)	弟弟 (*n* = 1)	
juice (*n* = 1)	try (*n* = 1)	*younger brother*	
kettle (*n* = 1)	want (*n* = 2)	妹妹 (*n* = 1)	
mommy (*n* = 9)		*younger sister*	
mouse (*n* = 1)		汤匙 (*n* = 1)	
mouth (*n* = 1)		*spoon*	
orange (*n* = 1)		草莓 (*n* = 1)	
pig (*n* = 1)		*strawberry*	
song (*n* = 1)		草 (*n* = 1)	
telephone (*n* = 1)		*grass*	
time (*n* = 1)		莓 (*n* = 1)	
train (*n* = 4)		*berry*	
wheel (*n* = 1)			

Note. *n*s represent the numbers of mothers who produced each word type.

Table 2. Nouns and verbs that toddlers produced out of its language-designated session.

English N/V Types (in Mandarin Session)		Mandarin N/V Types (in English Session)	
Nouns	*Verbs*	*Nouns*	*Verbs*
apple (*n* = 1)		公公 (*n* = 1)	要 (*n* = 2)
aunt (*n* = 1)		*parental grandfather*	*want*
baby (*n* = 6)		婆婆 (*n* = 2)	来 (*n* = 1)
ball (*n* = 4)		*maternal grandmother*	*come*
bread (*n* = 1)		姑姑, 阿嫲 (*n* = 3)	
cake (*n* = 1)		*aunt*	
cow (*n* = 2)		姐姐 (*n* = 2)	
cream (*n* = 1)		*older sister*	
egg (*n* = 1)		汤匙 (*n* = 1)	
ice (*n* = 1)		*spoon*	
mommy (*n* = 3)		猫 (*n* = 1)	
moon (*n* = 1)		*cat*	
spoon (*n* = 1)		草 (*n* = 1)	
strawberry (*n* = 1)		*grass*	
train (*n* = 1)			

Note. *n*s represent the numbers of toddlers who produced each word type.

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train). For Mandarin noun-verb types in the English session, toddlers produced mostly kinship terms (57.14% of Mandarin noun-verb types in the English session). English and Mandarin nouns and verbs produced outside of the language-designated sessions (English in the Mandarin session or Mandarin in the English session) were tabulated towards the participant's total English and Mandarin production, respectively (excluding code-switched words yielded similar results). Malay words were tagged but not considered in the tabulation of types and tokens.

The *freq* command in CLAN was used to tabulate the number of noun and verb types and tokens produced by each participant. The noun category consisted of object labels (e.g., "train", "cup", "book", "towel") and kinship terms (such as "mommy" in English and "妈妈" in Mandarin). The verb category contained main verbs, including action verbs (e.g., "sit", "drink", "jump"), dynamic verbs (e.g., "hopping", "spinning", "feeding"), and stative verbs (e.g., "feel", "love", "believe") as well as auxiliaries (e.g., "have", "do") and modals (e.g., "should", "may", "can").

Results

Overall, 11,725 utterances produced by mothers ($n = 5{,}868$ utterances for the English session, $n = 5{,}857$ utterances for the Mandarin session) and 2,206 utterances produced by toddlers were analyzed ($n = 1{,}089$ utterances for the English session, $n = 1{,}117$ utterances for the Mandarin session). There were no differences between the numbers of utterances produced between sessions, $t_{mothers}(29) = 0.04$, $p = .97$, $d = 0.00729$, $t_{toddlers}(29) = -0.19$, $p = .85$, $d = 0.0350$. We also examined differences in speech richness between the two languages by conducting *t*-tests on type-token ratios. Type-token ratio was calculated by dividing the number of types produced in one language by the number of tokens produced in the same language. Higher type-token ratios indicate more complex speech. Neither mothers' nor toddlers' type-token ratios differed between languages, $t_{mothers}(29) = -0.22$, $p = .83$, $d = 0.0396$, $t_{toddlers}(29) = 1.78$, $p = .08$, $d = 0.324$.

In the following analyses, we first examined toddlers' lexical biases using three measures: their token production, type production, and reported vocabulary. Both type and token production were used as measures to examine the consistency and robustness of the data. For each measure, we investigated whether noun counts differed from verb counts for each language and whether these counts differed across languages. Using the noun and verb counts, noun-verb ratios were also calculated and examined for each language. For each toddler, a lexical bias pattern was determined based on their noun-verb ratios for each language. Following the analyses of toddlers' lexical biases, analyses of mothers' lexical biases for each language were also determined using counts, noun-verb ratios, and bilingual lexical patterns. Mothers' speech was further examined for verb structure to determine if mothers dropped subjects and objects. Finally, the context in which the nouns and verbs were produced (book-reading vs. toy-playing) was examined.

Toddlers' noun and verb token production

Table 3 displays overall means and standard deviations of toddlers' noun and verb tokens across their two languages. First, to examine toddlers' overall lexical bias across languages, we calculated a noun-verb ratio (NVR) using the formula, nouns/(nouns + verbs). A score of greater than .50 indicates a noun-biased vocabulary and a

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Table 3. Toddlers' noun and verb tokens and noun-to-verb ratios.

	Nouns	Verbs	Nouns/(Nouns + Verbs)
English	8.43 (10.56)	2.87 (4.75)	.74* (.26)[a]
Mandarin	4.00 (5.50)	1.70 (3.80)	.79* (.29)[b]

Note. Means (standard deviations).
[a]Four toddlers did not produce nouns or verbs in English and were not taken into consideration for the NVR mean, SD, and the one-sample *t*-test.
[b]10 toddlers did not produce nouns or verbs in Mandarin and were not taken into consideration for the NVR mean, SD, and the one-sample *t*-test.
*Indicates that Nouns/(Nouns + Verbs) ratio is significantly different from .50, *ps* < .01.

score less than .50 indicates a verb-biased vocabulary. Three toddlers produced neither nouns nor verbs in either language, one only produced nouns or verbs in Mandarin but not English, and seven only produced nouns or verbs in English but not Mandarin. For three toddlers who did not produce any nouns or verbs in either language, one only babbled, one produced a quantifier in English, and one produced an article in English. For the one toddler who produced nouns/verbs in Mandarin, but not in English, only "please" was produced in English. For the toddlers who produced nouns/verbs in English, but not in Mandarin, five only babbled, one produced the English-equivalent of "yes" in Mandarin, and one produced the English-equivalent of "okay" in Mandarin. We excluded toddlers from the respective language if they produced neither nouns nor verbs because no noun-verb production yields a score of "0", which indicates a false verb bias. NVRs did not differ between language order counterbalances, *ps* > .40. Two-tailed one-sample *t*-tests using .50 to indicate no lexical bias revealed that toddlers produced more noun tokens than verb tokens in both English, $t(25) = 4.66$, $p < .01$, $d = 3.41$, and Mandarin, $t(19) = 4.47$, $p < .01$, $d = 2.65$.

Another way to investigate bilingual learning toddlers' lexical bias is to categorize toddlers as falling into one of four major bilingual lexical patterns: 1) noun biased in both languages, 2) verb biased in both languages, 3) noun biased in English and verb biased in Mandarin, or 4) verb biased in English and noun biased in Mandarin. In addition to these four major bilingual lexical patterns, five other possible patterns include "no bias" in one of the languages or no bias in either language. For each toddler, NVRs for each language were examined and categorized as noun biased for NVRs above .60, as verb biased for NVRs below .40, or no bias for NVRs between .40 to .60. To examine bilingual lexical bias patterns, we only included toddlers who produced tokens in both English and Mandarin ($n = 19$).

Overall, toddlers exhibited five of the nine possible bilingual lexical patterns. Of the 19 toddlers who produced nouns or verbs in both languages, 13 toddlers (68%) demonstrated a noun bias in both languages; three toddlers (16%) demonstrated no bias in either language. One toddler was noun biased in English, but verb biased in Mandarin; another toddler demonstrated a verb bias in English, but a noun bias in Mandarin. One toddler produced no-biased English speech, but verb-biased Mandarin speech. See Figure 1 for toddlers' bilingual lexical patterns for token production.

A two-way (Language x Word Type) repeated-measures ANOVA with the counts of noun or verb tokens children produced as the dependent variable showed an effect of Language, $F(1, 29) = 5.60$, $p < .05$, $\eta^2_{ges} = .04$, and an effect of Word Category, $F(1, 29) = 13.61$, $p < .01$, $\eta^2_{ges} = .08$. A significant interaction between Language and Word Category was also revealed, $F(1, 29) = 6.04$, $p < .05$, $\eta^2_{ges} = .02$. Pairwise *t*-tests with a Bonferroni

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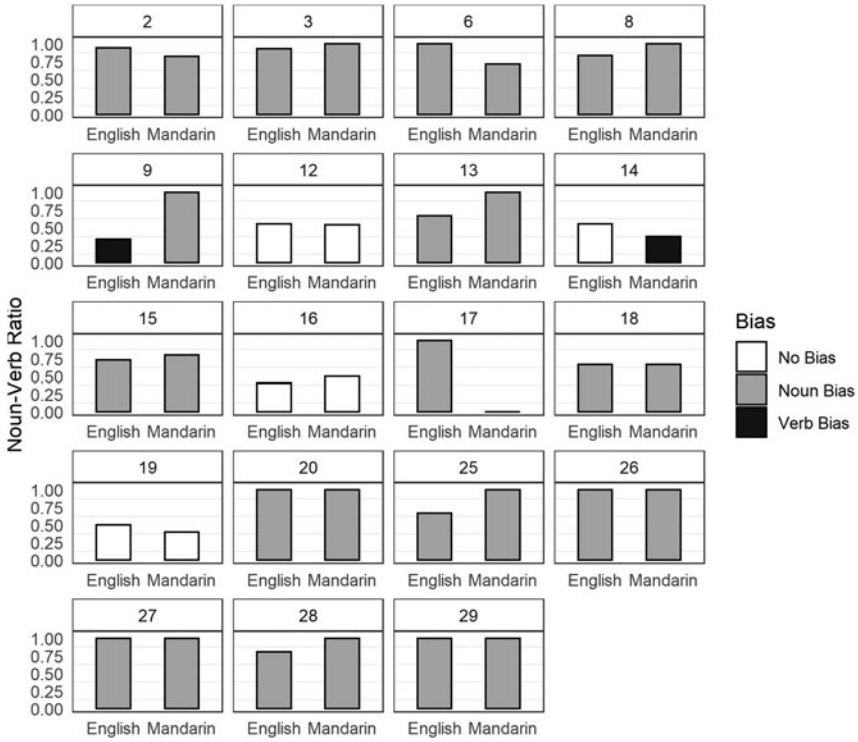

Figure 1. Toddlers' individual bilingual lexical bias patterns of noun-verb ratios for token production.
Note. Each subplot indicates a toddler's noun-verb ratio in English and Mandarin. 11 toddlers were excluded from the boxplot visualization because they did not produce any nouns/verbs in either language ($n = 3$), in English ($n = 1$), or in Mandarin ($n = 7$), and a bilingual lexical bias pattern could not be determined.

correction revealed that, on average, toddlers produced more noun tokens ($M = 6.22$, $SD = 8.64$) than verb tokens ($M = 2.28$, $SD = 4.30$) in both languages, but the difference between nouns and verbs was greater in English ($d = .73$) than in Mandarin ($d = .11$).

Toddlers' noun and verb type production

Table 4 displays overall means and standard deviations of toddlers' noun and verb types across languages. Again, 11 toddlers were excluded because they did not produce any nouns/verbs in either language ($n = 3$), in English ($n = 1$), or in Mandarin ($n = 7$). Two-tailed one-sample *t*-tests using .50 to indicate no lexical bias revealed that toddlers' type production for English, $t(25) = 4.66$, $p < .01$, $d = 3.53$, and Mandarin, $t(19) = 4.50$, $p < .01$, $d = 2.65$, were both noun biased.

Like token production, we then investigated the categorization of toddlers' type production according to the nine possible bilingual lexical patterns. Six of the nine bilingual lexical patterns emerged from toddlers' types speech. Of the toddlers who produced nouns or verbs in both languages ($n = 19$), 11 toddlers (58%) showed a noun bias in both languages. Two toddlers were noun biased in English, but verb biased in Mandarin. Two toddlers demonstrated no bias in Mandarin, but a noun bias ($n = 1$) or

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Table 4. Toddlers' noun and verb types and noun-to-verb ratios.

	Nouns	Verbs	Nouns/(Nouns + Verbs)
English	5.20 (6.40)	1.70 (2.60)	.72* (.28)[a]
Mandarin	2.37 (3.44)	.83 (1.74)	.81* (.32)[b]

Note. Means (standard deviations).
[a]Four toddlers did not produce nouns or verbs in English and were not taken into consideration for the NVR mean, SD, and the one-sample *t*-test.
[b]10 toddlers did not produce nouns or verbs in Mandarin and were not taken into consideration for the NVR mean, SD, and the one-sample *t*-test.
*Indicates that Nouns/(Nouns + Verbs) ratio is significantly different from .50, *ps* < .01.

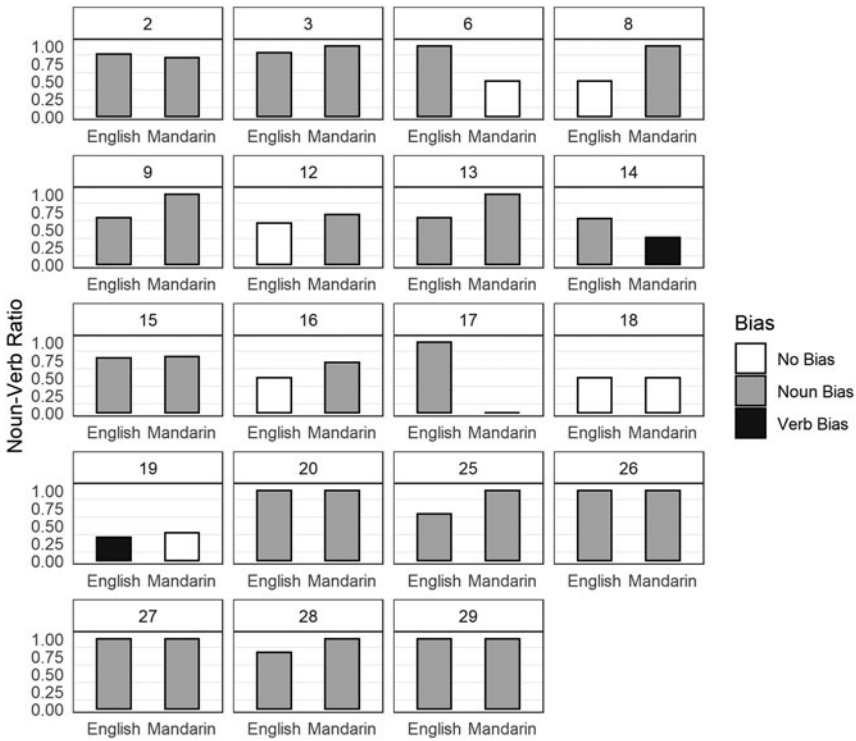

Figure 2. Toddlers' individual bilingual lexical bias patterns of noun-verb ratios for type production.
Note. Each subplot indicates a toddler's noun-verb ratio in English and Mandarin. 11 toddlers were excluded from the boxplot visualization because they did not produce any nouns/verbs in either language ($n = 3$), in English ($n = 1$), or in Mandarin ($n = 7$), and a bilingual lexical bias pattern could not be determined.

a verb bias ($n = 1$) in English; three toddlers demonstrated no bias in English, but a noun bias in Mandarin. Finally, one toddler was not biased in either language. See Figure 2.

A two-way (Language x Word Type) repeated-measures ANOVA with the counts of noun or verb types children produced as the dependent variable showed an effect of Language, $F(1, 29) = 7.94$, $p < .05$, $\eta^2_{ges} = .05$, and an effect of Word Type, $F(1, 29) = 14.36$, $p < .01$, $\eta^2_{ges} = .09$. A significant interaction between Language and Word Type was also revealed, $F(1, 29) = 5.62$, $p < .05$, $\eta^2_{ges} = .02$. Pairwise *t*-tests with a

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Bonferroni correction revealed that overall toddlers produced more noun types ($M = 3.78$, $SD = 5.29$) than verb types ($M = 1.27$, $SD = 2.24$) for both languages, but the difference between nouns and verbs was greater in English ($d = .78$) than in Mandarin ($d = .59$).

Toddlers' reported vocabulary

Given the modest amount of speech produced by toddlers and the methodological issue of checklist versus spontaneous speech possibly indicating different word biases, we also examined lexical biases in toddlers' mother-reported vocabulary. One toddler was reported to only produce "baa baa" and no nouns or verbs in English and so was subsequently excluded from the following analyses. An analysis of children's English and Mandarin MCDIs indicated that toddlers' reported English vocabulary ($M = .28$, $SD = .22$) was larger than their reported Mandarin vocabulary ($M = .10$, $SD = .13$), $t(28) = 4.45$, $p < .001$, $d = 0.90$. To examine potential lexical biases in toddlers' reported vocabularies, NVRs were again used. One-sample *t*-tests indicated that toddlers' reported English vocabulary, $t(28) = 18.50$, $p < .001$, $d = 3.44$, and Mandarin vocabulary, $t(29) = 2.07$, $p < .05$, $d = 0.38$, were both noun biased. A paired-samples *t*-test comparing toddlers' NVR in their English vocabulary to their NVR in their Mandarin vocabulary revealed a significant difference, $t(28) = 4.25$, $p < .001$, $d = 0.79$; toddlers' NVR in English was more noun biased ($M = .91$, $SD = .12$) than their NVR in Mandarin ($M = .62$, $SD = .30$).

Toddlers were categorized into the same possible nine bilingual lexical bias patterns as before. Only four bilingual lexical bias patterns emerged. Of the 29 toddlers, most fell in the noun-noun bilingual lexical pattern ($n = 20$). The remaining toddlers fell in the classical noun-verb English–Mandarin lexical pattern ($n = 5$), in the verb-verb bias English-Mandarin lexical pattern ($n = 1$), or in the noun-no-bias English–Mandarin lexical pattern ($n = 3$). See Figure 3.

Mothers' noun and verb token production

Table 5 displays overall means and standard deviations of mothers' noun and verb tokens across the two languages. Two-tailed one-sample *t*-tests revealed that mothers' English NVR, $t(29) = -6.93$, $p < .01$, $d = 5.25$, is verb biased, and mothers' Mandarin NVR is marginally verb biased, $t(29) = -1.93$, $p = .06$, $d = -0.35$. Like the toddlers, we categorized mothers into one of the nine bilingual lexical patterns. Mothers demonstrated six of the nine different bilingual lexical patterns. In contrast to their toddlers, most mothers demonstrated no bias in either language ($n = 14$). Six mothers were verb biased in both languages, and another six mothers were verb biased in English but not biased in Mandarin. Three mothers demonstrated no bias in English, but a noun bias ($n = 2$) or a verb bias in Mandarin ($n = 1$). Notably, none of the mothers demonstrated the same bilingual lexical pattern as their toddlers. See Figures 4 and 5 for mothers' bilingual lexical patterns for tokens and types respectively.

By comparing mothers' token counts in a two-way ANOVA (Language x Word Category), we found effects of Language, $F(1, 29) = 28.65$, $p < .01$, $\eta^2_{ges} = .14$, and Word Category, $F(1, 29) = 25.40$, $p < .01$, $\eta^2_{ges} = .09$. There was also an interaction between Language and Word Category, $F(1, 29) = 28.74$, $p < .01$, $\eta^2_{ges} = .05$. Pairwise *t*-tests with a Bonferroni correction indicated that, on average, mothers produced more English verb tokens ($M = 171.63$, $SD = 6.29$) than Mandarin verb tokens ($M = 107.30$, $SD = 41.18$). There was no difference between noun token production between languages.

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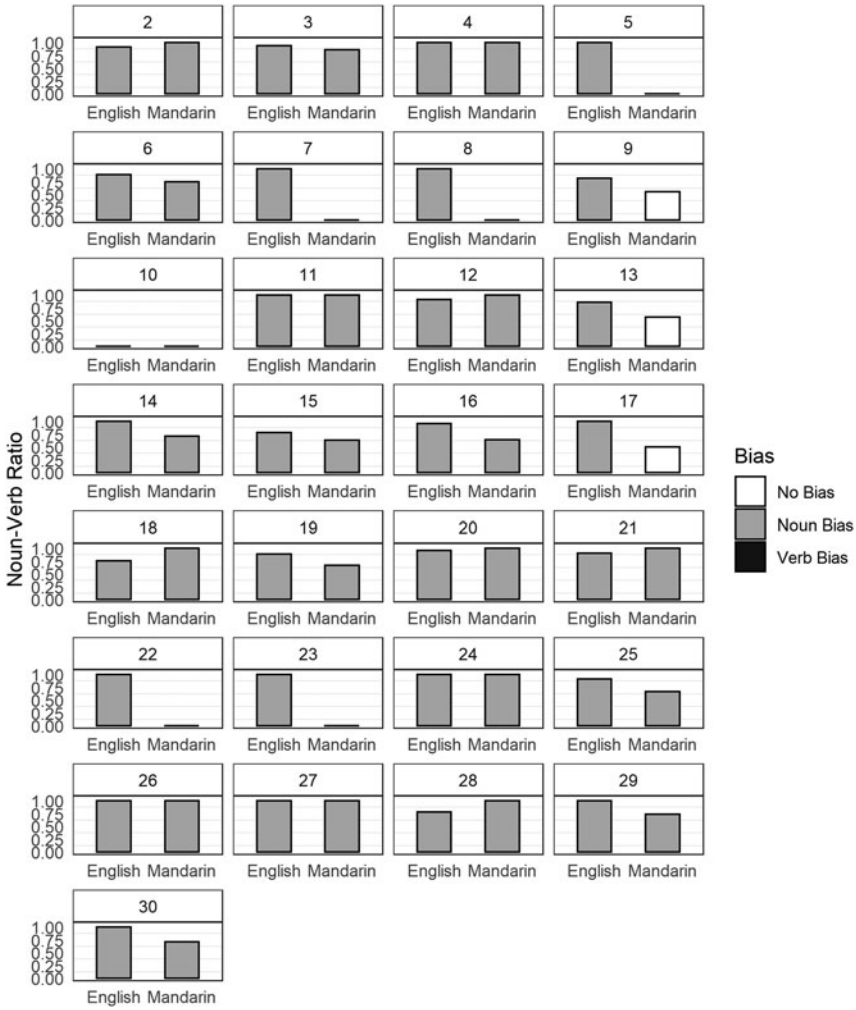

Figure 3. Toddlers' individual bilingual lexical bias patterns of noun-verb ratios for reported vocabulary.
Note. Each subplot indicates a toddler's noun-verb ratio in English and Mandarin. One toddler was reported to only produce "baa baa" and was excluded from the figure.

Table 5. Mothers' noun and verb tokens and noun-to-verb ratios.

	Nouns	Verbs	Nouns/(Nouns + Verbs)
English	116.4 (46.76)	171.63 (6.29)	40* (.08)
Mandarin	99.70 (51.05)	107.3 (41.18)	47* (.09)

Note. Means (standard deviations).
*Indicates that Nouns/(Nouns + Verbs) ratio is significantly different from .50, *ps* < .05.

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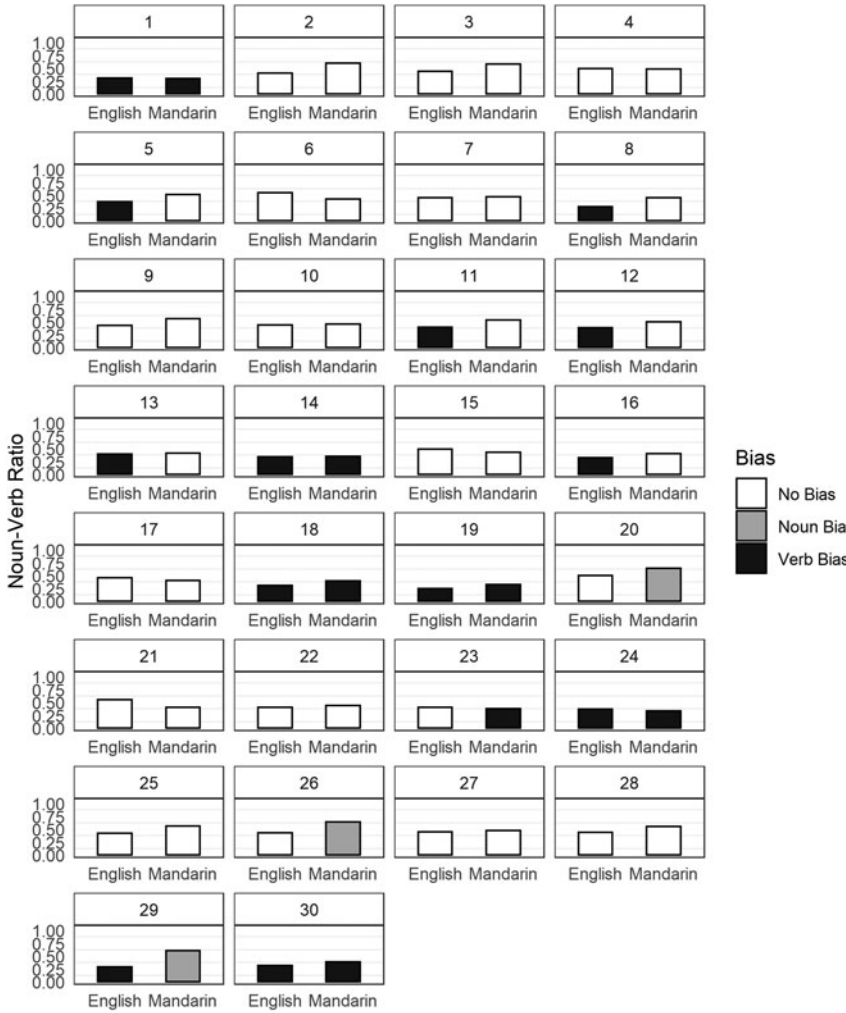

Figure 4. Mothers' individual bilingual lexical bias patterns of noun-verb ratios for token production.
Note. Each subplot indicates a mother's noun-verb ratio in English and Mandarin.

Mothers' noun and verb type production

Table 6 shows overall means and standard deviations of mothers' noun and verb types as well as their mean NVRs for each language. Two-tailed one-sample *t*-tests, using mothers' NVRs, revealed that both mothers' English, $t(29) = -3.21$, $p < .01$, $d = 5.70$, and Mandarin were verb biased, $t(29) = -2.42$, $p = .022$, $d = 4.37$. Mothers demonstrated seven of the nine possible bilingual lexical patterns. Most mothers were not biased in either language ($n = 14$) or verb biased in both languages ($n = 6$). Four mothers demonstrated the expected bilingual lexical pattern: noun biased in English and verb biased in Mandarin. Three mothers demonstrated no bias in Mandarin, but a noun bias ($n = 1$) or a verb bias ($n = 2$) in English. Six mothers demonstrated no bias in English, but a noun bias ($n = 2$) or a verb bias ($n = 4$) in Mandarin. See Figure 5.

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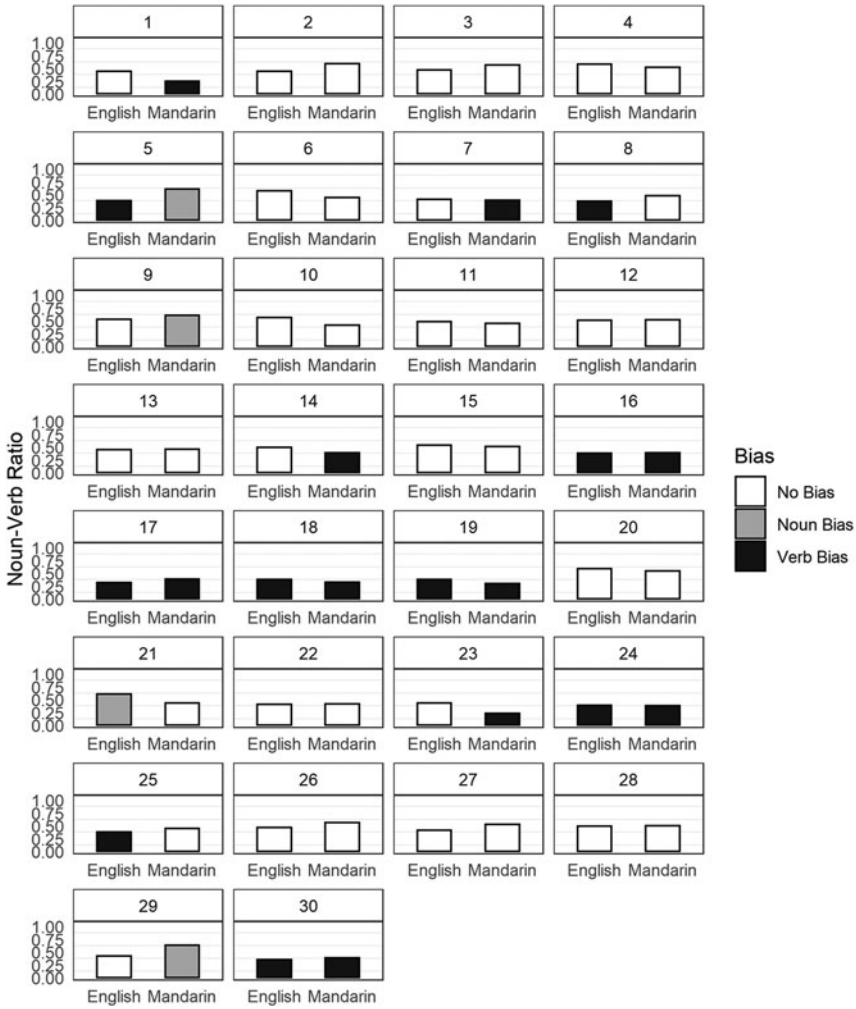

Figure 5. Mothers' individual bilingual lexical bias patterns of noun-verb ratios for type production.
Note. Each subplot indicates a mother's noun-verb ratio in English and Mandarin.

Table 6. Mothers' noun and verb types and noun-to-verb ratios.

	Nouns	Verbs	Nouns/(Nouns + Verbs)
English	40.73 (20.27)	46.73 (15.84)	.45* (.08)
Mandarin	29.57 (16.99)	31.50 (10.79)	.45* (.10)

Note. Means (standard deviations).
*Indicates that Nouns/(Nouns + Verbs) ratio is significantly different from .50, *ps* < .05.

To examine the differences in noun and verb type production between the two languages, a two-way ANOVA (Language x Word Category) was conducted. We found a main effect of Language, $F(1,\ 29) = 28.86,\ p < .01,\ \eta^2_{ges} = .14$, and a main

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Table 7. Proportions of verb structures.

	Mean	Standard Deviation
Subject-Verb-Object	.19	.07
Subject-Verb	.26	.10
Verb-Object	.14	.07
Verb	.41	.11

effect of Word Category, $F(1, 29) = 4.90$, $p < .05$, $\eta^2_{ges} = .02$. On average, mothers produced more types in English ($M = 43.73$, $SD = 18.28$) than Mandarin ($M = 30.53$, $SD = 14.14$) and more verb types ($M = 39.12$, $SD = 15.48$) than noun types ($M = 35.15$, $SD = 19.37$).

Pro-drop in Singaporean English

To examine whether the pro-drop rule plays a pervasive role in Singaporean mothers' English child-directed speech, we extracted all sentences containing verbs and coded each sentence's structure into one of four categories: 1) at least one subject and at least one object (S-V-O), 2) at least one subject and no object (S-V), 3) no subject, but at least one object (V-O), or 4) verbs without subjects nor objects (V). Table 7 displays the means and standard deviations of the proportions of each sentence structure as produced by mothers. An ANOVA contrasting the four sentence categories showed an effect of sentence structure, $F(13, 89) = 37.21$, $p < .01$, $\eta_{ges}{}^2 = .56$. Pairwise *t*-tests with a Bonferroni correction revealed that, on average, mothers used sentence category four, omitting both subjects and objects, more often than any of the other sentence categories ($ps < .01$).

Effects of context on mothers' and children's noun-verb production

Because researchers instructed mothers to freely engage with their toddler with the materials provided, some mothers read to their toddlers only in the English session ($n = 3$), some read to their toddlers only in the Mandarin session ($n = 7$), and one mother did not read to her child in either session. For purposes of post-hoc analysis of the effects of context on mothers' and children's noun/verb production, we only included dyads whose mothers engaged in book reading in both language sessions ($n = 19$). A two-way (Context x Language) repeated-measures ANOVA with time spent in each context as the dependent variable revealed that mothers spent more time engaging in toy play than book reading, $F(1, 18) = 347.83$, $p < .01$, $\eta_{ges}{}^2 = .90$. Because of the large discrepancy in time durations between the two contexts, proportions of noun and verbs were analyzed instead of counts. Proportions were calculated by language and word type. For example, the proportion of English nouns produced during book reading was calculated as the number of English nouns produced during book reading divided by the total number of nouns produced in both contexts. Similarly, the proportion of English nouns produced during toy play was calculated as the number of English nouns produced during toy play divided by the total number of nouns produced in both contexts. We first report the effect of context on toddlers' and mothers' token production and then the effect of context on toddlers' and mothers' type production.

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Two three-way (Context x Language x Word Type) repeated-measures ANOVAs with the proportion of tokens produced as the dependent variable were conducted. For toddlers, there was a main effect of Context, $F(1, 18) = 27.05$, $p < .01$, $\eta_{ges}^2 = .24$. Toddlers produced more tokens during toy play ($M = .45$, $SD = .46$) than in book reading ($M = .07$, $SD = .18$). There was a main effect of Language, $F(1, 18) = 4.80$, $p < .05$, $\eta_{ges}^2 = .02$. Toddlers produced more English tokens ($M = .32$, $SD = .41$) than Mandarin tokens ($M = .21$, $SD = .39$). There was also a main effect of Word Type, $F(1, 18) = 5.06$, $p < .01$, $\eta_{ges}^2 = .04$. Toddlers produced more noun tokens ($M = .33$, $SD = .41$) than verb tokens ($M = .20$, $SD = .38$). No significant interactions were found. For mothers, there was a main effect of Context, $F(1, 18) = 230.91$, $p < .01$, $\eta_{ges}^2 = .85$. On average, mothers produced more tokens in toy play ($M = .83$, $SD = .15$) than book reading ($M = .17$, $SD = .15$). The repeated-measures ANOVA also revealed an interaction between Context and Word Type, $F(1, 18) = 21.28$, $p < .01$, $\eta_{ges}^2 = .05$. Mothers produced more verb tokens ($M = .86$, $SD = .13$) than noun tokens ($M = .80$, $SD = .16$) during toy play, and more noun tokens ($M = .20$, $SD = .16$) than verb tokens ($M = .14$, $SD = .13$) during book reading.

Two three-way (Context x Language x Word Type) repeated-measures ANOVAs with the proportion of type production as the dependent variable revealed similar patterns as the proportion of token production. For toddlers, there was a main effect of Context, $F(1, 18) = 25.60$, $p < .01$, $\eta_{ges}^2 = .22$. Toddlers produced more types during toy play ($M = .44$, $SD = .46$) than in book reading ($M = .08$, $SD = .19$). There was a main effect of Language, $F(1, 18) = 4.80$, $p < .05$, $\eta_{ges}^2 = .02$. Toddlers produced more English types ($M = .31$, $SD = .40$) than Mandarin types ($M = .21$, $SD = .38$). There was also a main effect of Word Type, $F(1, 18) = 5.06$, $p < .01$, $\eta_{ges}^2 = .04$. Toddlers produced more noun types ($M = .33$, $SD = .20$) than verb types ($M = .20$, $SD = .38$). No significant interactions were found. For mothers, there was a main effect of Context, $F(1, 18) = 155.13$, $p < .01$, $\eta_{ges}^2 = .77$. On average, mothers produced more types in toy play ($M = .77$, $SD = .16$) than book reading ($M = .23$, $SD = .16$). The repeated-measures ANOVA also revealed an interaction between Context and Word Type, $F(1, 18) = 37.32$, $p < .01$, $\eta_{ges}^2 = .10$. Mothers produced more verb types ($M = .82$, $SD = .13$) than noun types ($M = .72$, $SD = .14$) during toy play, and more noun types ($M = .28$, $SD = .17$) than verb types during book reading ($M = .18$, $SD = .13$).

Discussion

The main aims of the present study were to investigate the presence or absence of early noun dominance in a bilingual population and whether toddlers' lexical biases are similar to their mothers' lexical biases. Previous studies investigating lexical biases in monolinguals and bilinguals have been mixed as to whether noun-dominance is widespread or language-specific. In the current study, English–Mandarin learning toddlers demonstrated a clear noun bias in both their languages in both contexts while their mothers' child-directed speech was generally verb biased in both languages albeit differing depending on the context of the mother-child interaction. Overall, the present study provides three findings that support noun dominance in early lexical development. Each finding is elaborated in turn.

First, English–Mandarin-learning toddlers produced more noun types and tokens than verb types and tokens in both English and Mandarin regardless of the context of their mother-child interaction. In fact, mothers and toddlers spent most of their time playing with toys, reserving little time for book reading. The former context has

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been shown in previous research to be a verb-favoring context (Altınkamış et al., 2014; Chen et al., 2009; Choi, 2000; Ogura et al., 2006; Tardif et al., 1999). Despite engaging in the context that favors verbs more, English–Mandarin toddlers produced more nouns than verbs. This finding shows that noun bias persisted in toddlers' English and Mandarin production despite play context.

Second, toddlers' bilingual lexical patterns revealed that most English–Mandarin-learning toddlers (~68% for tokens, 58% for types, and 59% for reported vocabulary) were noun biased in both languages; further, only a minority of toddlers (5% for tokens and types, 24% for reported vocabulary) demonstrated a lexical pattern predicted by a language-specific account (noun biased in English and verb biased in Mandarin). These findings add to extant cross-linguistic research on early lexical biases showing that noun bias is present regardless of whether a language is noun-privileged or verb-privileged (e.g., Bornstein et al., 2004), supporting the widespread noun bias account (Gentner, 1982).

It is noteworthy that, although children's vocabularies were noun biased for both languages, the noun-verb disparity was greater in English than in Mandarin. This finding is consistent with other studies in both monolingual and bilingual populations. Tardif et al. (1999) found that, although monolingual English-speaking children and monolingual Mandarin-speaking children's vocabularies were noun biased, Mandarin-speaking children's vocabularies contained more verbs than those of English-speaking children. Similarly, bilingual English- and Mandarin-learning toddlers also demonstrated a weaker noun bias in Mandarin than in English (Levey & Cruz, 2003; Xuan & Dollaghan, 2013). A weaker noun bias in verb-privileged languages compared to noun-privileged languages also emerged in non-Chinese languages such as bilingual children's Turkish vocabularies when compared to their Dutch vocabularies (Özcan et al., 2016), indicating that, although children's early vocabularies may be broadly noun biased, there is likely some influence from the specificity of the language that shapes how dominant nouns may be in children's early vocabularies (Bornstein, 2013; Gentner, 1982; Gentner & Boroditsky, 2009). In fact, monolingual toddlers learning Navajo, which can be characterized as a verb-privileged language, were reported to produce more nouns than verbs, but the proportion of verbs produced was positively correlated with children's total vocabulary (Gentner & Boroditsky, 2009). It is likely then that Singaporean children's Mandarin vocabulary may also become more verb biased as their vocabulary grows.

Finally, the current study's findings on mothers' lexical biases cast doubt that language specificity plays a major role in children's developing noun-verb lexical biases. If language specificity plays a major role in the development of children's early lexical biases, children's lexical biases should be like their mothers' lexical biases. In contrast to their toddlers, Singaporean mothers' child-directed speech was verb biased in both languages, and none of the mothers demonstrated a noun biased bilingual lexical pattern. Taken together, these findings are consistent with other research showing a widespread noun bias in children's early vocabularies for both monolingual (see Bornstein et al., 2004 for a cross-linguistic study) and bilingual populations (Levey & Cruz, 2003; Özcan et al., 2016; Xuan & Dollaghan, 2013).

To our knowledge, this is the first study to document a condition of English as verb biased in mothers' child-directed speech. We speculate that this finding may have emerged for several reasons. First, Singaporean mothers' verb-biased speech may emerge from a parenting style instilled by their culture's socialization goals. Specifically, verb-biased English may reflect Singaporean mothers striving to maintain

Eastern parenting socialization goals, leading mothers to focus more on actions than objects (Bornstein, 2007; Bornstein, Cote, Haynes, Suwalsky & Bakeman, 2012; Cote & Bornstein, 2000; Tamis-LeMonda, Bornstein, Cyphers, Toda & Ogino, 1992; Taumoepeau, 2015). A second, although not mutually exclusive, reason is that mothers were speaking "Singlish" to their children, which takes on grammatical characteristics of local Chinese dialects (Bao, 2001), such as pro-drop where subjects and objects are omitted from sentences (Alsagoff & Ho, 1998; Bao, 2001; Sato & Kim, 2012; Tan, 2005). Indeed, verbs appearing without either subjects or objects was the most common sentence structure produced by Singaporean mothers in this sample. For example, one mother using a doll to play with her toddler said, "put on baby" to refer to putting a handkerchief on the doll; another mother said, "don't want" to ask their child if they wanted to push the train. Singaporean toddlers' English being noun biased despite receiving verb-biased input provides more compelling evidence that noun dominance is widespread and not solely dependent on language input.

Even with lexical variability in noun-verb input for English and Mandarin, toddlers' vocabulary was dominated by nouns in both their languages. Although the current study presents unique findings that contribute to the early noun dominance debate, this study is limited by its methodology. The play session was structured to be language-exclusive such that mothers were instructed to speak only English for 10 min and then only Mandarin for the remaining 10 min or vice-versa. Imposing language-exclusive sessions was intended to allow each language to be sampled equally. However, by instructing mothers to use the two languages according to the predetermined sessions, we may have created a somewhat unnatural environment for the dyads because bilinguals frequently switch languages (e.g., Grosjean, 1989). Despite being instructed to use one of the two languages exclusively, some mothers still codeswitched within sessions, albeit to a limited extent. Future studies might explore bilingual lexical development without constraining mothers' speech, thus allowing interactions that are more natural for bilingual mothers.

Conclusion

Understanding how lexical acquisition develops in bilinguals is becoming more important as bilingualism continues to grow and as bilinguals come to outnumber monolinguals (De Bot & Kroll, 2002). The current study supports the noun dominance account in lexical acquisition but also shows indications that language specificity may contribute to early bilingual lexical development. Specifically, English- and Mandarin-learning toddlers' vocabularies were noun biased for both languages in all contexts and did not reflect their mothers' verb bias for either language. However, toddlers' noun bias appears to be weaker in English than in Mandarin, suggesting that language specificity plays a more minor role in children's early lexical acquisition.

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