UK bilingual toddlers show a lag in vocabulary size relative to monolinguals in both comprehension and production

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Abstract

A widely researched question in bilingualism asks whether bilinguals' vocabulary growth is equal to or lower than that of monolinguals. Some studies have found smaller vocabularies in bilingual toddlers than monolingual toddlers when comparing in one language, but others have found no significant group differences. We compared 12 to 32-month-old bilingual toddlers growing up in the UK with English and one additional language (AL) to age-matched UK English monolinguals. We evaluated both vocabulary size in English and conceptual vocabulary. Bilinguals' English vocabulary sizes in both comprehension and production were significantly smaller than monolinguals' after controlling for age and socioeconomic status. This was seen across bilinguals of different levels of language dominance. The bilingual lag in vocabulary size was smaller when calculated using conceptual vocabulary but still significant for both comprehension and production. We discuss the implications for measurements of bilingual toddlers' vocabulary size.

Keywords: bilingualism; vocabulary; infant development; language exposure

Introduction

Researchers, medical practitioners and parents alike have long been interested in the question of whether bilinguals' vocabulary growth is comparable to that of monolinguals. For bilingual toddlers living in communities that predominantly speak one language (e.g., the UK, which uses English), it is particularly important for them to acquire the community language which would be widely used for communication outside the home and schooling. The literature on bilinguals' vocabulary size has generally found a bilingual delay when comparing vocabulary in a single language between monolinguals and bilinguals. Significant differences have been found between monolingual and bilingual groups in receptive vocabulary in children (3–10 years old) (Bialystok, Luk, Peets, & Sujin, 2010) and adults (Bialystok & Luk, 2012), with bilinguals having smaller vocabulary sizes than monolinguals. With school-age children, Yan and Nicoladis (2009) found that while comprehension was comparable, school-age bilinguals performed significantly poorer in a production task compared to monolingual peers.

When considering younger bilinguals, a bilingual vocabulary delay in production has also been found in young children aged between 2.5 and 5 years old when compared against monolingual peers (Hoff & Ribot, 2017). This group difference was also found by Vagh, Pan, and Mancilla-Martinez (2009) in 24 to 36 month olds. Cattani et al. (2014) tested receptive and expressive vocabulary, finding that bilinguals performed worse than monolinguals (22 to 30 months old) when tested with a single language. Interestingly, De Houwer, Bornstein, and Putnick (2014) found no significant difference in the receptive vocabulary sizes of monolingual toddlers learning Dutch and bilingual toddlers learning Dutch and French at 13 months, but monolinguals knew significantly more Dutch words at 20 months, suggesting an age-related change in vocabulary growth.

Academic achievement

For bilingual toddlers living in communities that predominantly speak one language (e.g., the UK, in which the main language is English), it is particularly important for them to acquire the community language which would be widely used for communication outside the home and schooling. Language proficiency in the majority language can have repercussions for school achievement. A study by Howard et al. (2014) showed that Spanish-speaking bilingual children's English vocabulary size in spoken production (as tested using a picture naming task) is positively associated with their English reading proficiency, even after accounting for the effect of socioeconomic status and amount of English exposure. A report by Strand, Malmberg, and Hall (2015) analysing the England National Pupil Database in 2013 indicated that the percentage of students in England classified to be learning English as an additional language (EAL) was 16.2%. As a group, EAL students were identified by Strand et al. to have lower rates of academic achievement compared to students with English as their first language when tested at the end of their first year of schooling. However, this lag decreased over the years of schooling, with EAL students catching up to their peers by age 16. Research has suggested that within-group differences in school-age language outcomes can be predicted by language development in infancy. In monolinguals, larger vocabulary size and faster speed of word recog-

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nition tested at 25 months of age have been linked to better expressive vocabulary, IQ and working memory at 8 years old (Marchman & Fernald, 2008). Studying the early vocabulary development of children in their first three years of life, when their early language skills are rapidly developing, can help us better understand the potential sources of divergences for EAL students.

Effect of language exposure

The size of the vocabulary difference between monolinguals and bilinguals is also dependent on the amount of exposure bilinguals receive for the tested language. Vocabulary size in a single language has been found to be positively correlated with the relative amount of exposure the child has to that language (Pearson, Fernández, Lewedeg, & Oller, 1997; Hoff et al., 2012; Cattani et al., 2014). English-dominant bilingual toddlers (i.e., toddlers who hear more English than their other language in their day-to-day lives) have been found to display larger English vocabulary than Spanish-dominant bilinguals, using evidence from 8–30 month olds (Pearson, Fernández, & Oller, 1993) and 24–36 month olds (Vagh et al., 2009). Further supporting the effect of language exposure, Pearson et al. (1993) also found that while Spanish-dominant bilinguals had smaller English vocabulary, they had larger Spanish vocabulary than English-dominant peers. It is particularly important to be aware of the language exposure effects when comparing bilinguals to monolinguals in a single language, as it can significantly affect the size of any observed vocabulary gap. Notably, Hoff et al. (2012) found that 2.5 year old bilingual toddlers with at least 60% English exposure performed equally well as monolingual peers on various language measures in English.

Single language vs total vs conceptual vocabulary

When studying vocabulary growth in bilinguals, the method of calculating vocabulary size is important as it can produce varied results. Researchers have used several measures for vocabulary, the most common being single language size, total vocabulary size and conceptual vocabulary size. Single vocabulary sizes focuses on vocabulary known in one language, for example the community language or the minority language. Total vocabulary size sums the vocabulary sizes in both languages. Conceptual vocabulary is defined by summing the number of concepts known by the child. A child is said to know a concept if they understand the word in one language or both. Conceptual scoring has been noted to bring school-age bilingual's vocabulary into normal monolingual range (Gross, Buac, & Kaushanskaya, 2014) for both comprehension and production. Bilingual toddlers have been found to have smaller vocabularies than monolinguals when comparing single language vocabulary, but comparable or even larger vocabularies when comparing total vocabulary and conceptual vocabulary (Pearson et al., 1993, 1997). The appropriate method of vocabulary size calculation would therefore depend on the intention of the comparison. The evaluation of single language vocabulary size (e.g. of the majority language) may be useful when investigating later language and academic outcomes. For clinical judgements of language delay, a conceptual or total vocabulary would provide a more reliable estimate. In this paper, we compare bilingual and monolingual toddlers using two methods of calculating vocabulary size – (1) vocabulary in English, which is the community language of our sample; (2) conceptual vocabulary.

The Present Study

This study investigates whether bilingual toddlers growing up in the UK have comparable or smaller vocabulary sizes compared to monolinguals of the same age. As the UK is a predominantly English-speaking community, the development of English proficiency is important for both monolingual and bilingual toddlers' long-term communicative and academic outcomes. We are also interested in the extent to which the degree of English exposure a child receives influences their English vocabulary size. Additionally, we investigate whether bilinguals and monolinguals have comparable vocabulary sizes when measured using conceptual vocabulary.

To answer our research question, we compared vocabulary acquisition trajectories between British monolinguals and bilinguals growing up in the UK aged 12 to 32 months, comparing cross-sectional data collected using vocabulary questionnaires. We obtained parent-reported data on both word comprehension and production for each child, allowing us to study toddlers' parallel growth in comprehension and production. We predicted that bilinguals will have smaller vocabulary sizes in English than monolinguals, with the difference largest for AL-dominant bilinguals and smallest for English-dominant bilinguals. We also expected to find an increase in the size of group differences with increased age, following findings by de Groot (1989) of a significant difference in vocabulary size between bilinguals and monolinguals in 20 month olds but not 13 month olds. On the other hand, we predicted that all groups will have similar conceptual vocabulary sizes, with no significant differences between bilinguals and monolinguals after controlling for age and mother's education level.

Methods

Participants

Bilingual Our sample consisted of 12 to 32-month-old bilingual toddlers (N = 357, N female = 184) (age 12.0–32.4, mean 21.9 months) growing up in the UK with English and one additional language (AL) (Dutch, French, German, Italian, Polish, Portuguese or Spanish), with data collected between 2020 and 2021. An additional 42 parents who expressed uncertainty about their ability to report their child's English vocabulary (e.g., due to not speaking English at home) were excluded from the analysis. We collected information about toddlers' language environment using a simplified version of the Language Exposure Questionnaire

(LEQ) developed by Bosch and Sebastián-Gallés (2001). To obtain a quantitative metric for overall language exposure, we asked parents to give an estimate of the percentage of English their child is exposed to in their daily life. We split bilinguals into three groups based on this reported English exposure: English-dominant (60-75% English exposure, N = 186), Balanced (40-60% English exposure, N = 67) and AL-dominant (25-40% English exposure, N = 104). For each family in our sample, at least one parent was a native speaker of the AL – 125 reported that both parents were native speaker of the AL (this included those who reported to be natively bilingual); 232 families reported that one parent was a native speaker of the AL and one parent was a native speaker of English. The parent native in the AL was more commonly the mother – 317 mothers were reported to be native AL speakers, 17 native bilingual speakers and 23 native English speakers. In contrast, 141 fathers were reported to be native AL speakers, 7 bilingual speakers and 209 English native speakers. We also required at least one parent to have fluent English proficiency (self-rated proficiency of 7 or higher out of 10).

Monolingual The monolingual sample consisted of British English monolinguals aged between 12 and 32 months (N = 209, N female = 79) (age 12.0–32.4, mean 23.7 months), with data also collected between 2020 and 2021.

Vocabulary questionnaire

Data on vocabulary knowledge in English, for both the bilingual and monolingual groups, was collected using the Oxford Communicative Development Inventory (CDI) (Hamilton, Plunkett, & Schafer, 2000), which is a questionnaire containing a list of words commonly known to British toddlers. Parents indicated for each word whether their child understands and says, understands but does not say, or does not understand the word. The utility of CDIs to evaluate vocabulary development in toddlers has been supported by studies showing good congruence between parent-reported vocabulary and toddlers' performance on vocabulary tasks for both monolinguals (Gillen et al., 2021) and bilinguals (Marchman & Martínez-Sussmann, 2002; Vagh et al., 2009). Vocabulary data for the monolingual sample was collected using the Oxford CDI (418 words). Parents of bilingual toddlers completed the Oxford CDI and also an adaptation of the Oxford CDI in their AL (also 418 words). These adaptations were created by working with native speakers of each AL, who translated the Oxford CDI and replaced words that were not relevant to the target language – for example, "penny" was replaced with its closest equivalent "coin" in most languages. We also compared the translations to normed adaptations of the MacArthur-Bates CDI in those languages, using the same words if possible – to given an example, "lorry/truck" was listed as "Lastwagen / Laster" in our German CDI, following FRAKIS (Szagun, Stumper, & Schramm, 2009).

For all analyses reported in this paper, we used only the concepts that overlap across all our adaptations (365 out of 418 words). While normed versions of the CDI exist in these languages, they vary considerably in length and also have variable amounts of overlapping concepts with the Oxford CDI. We chose to use adaptations of the Oxford CDI as this allowed us to have a high level of conceptual overlap for our analyses of conceptual vocabulary size.

Both English vocabulary sizes and conceptual vocabulary sizes were calculated using the 365 concepts that overlap across all CDIs used in this study. A monolingual child was coded as knowing a concept if they knew the English word for the concept. A bilingual child was coded as knowing a concept if they knew the English word, the word in their other language, or both.

Socioeconomic status

We used mother's highest education level as a proxy for socioeconomic status. Only entries where information on mother's education level was available were included in the analysis. Education level was converted into a numerical score, with 0 - no qualifications; 1 - Left school at 16 with GCSE or equivalent; 2 - Left school at 18 with A-Levels or equivalent; 3 - University degree or equivalent. Overall, mothers' educational level in our sample was high, with 89.4% of mothers in the bilingual sample and 93.8% of mothers in the monolingual having a University degree or equivalent.

Results

We ran linear regressions (separately for comprehension and production) with vocabulary size as the dependent variable, language exposure group as the predictor and age and mother's highest education level (numerical score) as covariates. Age was centered on the mean (22.7 months) and scaled by standard deviation (5.67 months). The three bilingual groups (English-dominant, Balanced and AL-dominant) were contrasted against the reference level of monolinguals. We added an interaction between age and group to test age-related changes in vocabulary size. This analysis was done for both English vocabulary size and conceptual vocabulary size separately. The model is defined in R (R Core Team, 2013) as below:

```
lm(vocabulary_size ~ age +
    mother_education + group +
    age:group)
```

English vocabulary

The relationship between age, language group and English vocabulary size are visualised for comprehension (Figure 1) and production (Figure 2) respectively. In both figures, we see the expected strong positive trend of vocabulary size growth with age. As predicted, we also observe a difference between the vocabulary trajectories of monolinguals and bilinguals, with bilinguals of all three levels of language exposure having smaller vocabulary sizes in English compared to monolinguals of the same age.

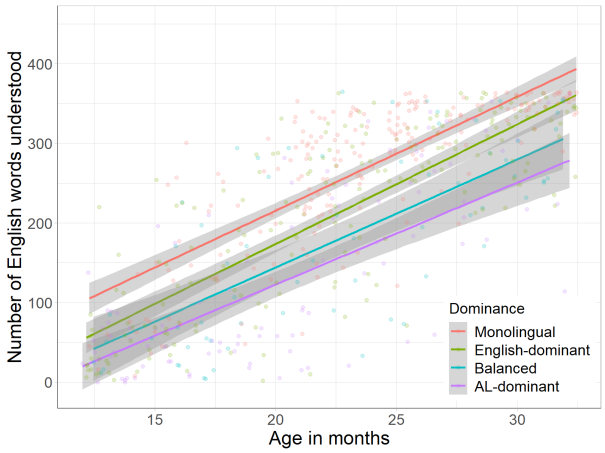

Figure 1: Scatterplot of English vocabulary size in comprehension by age, split by language dominance groups.

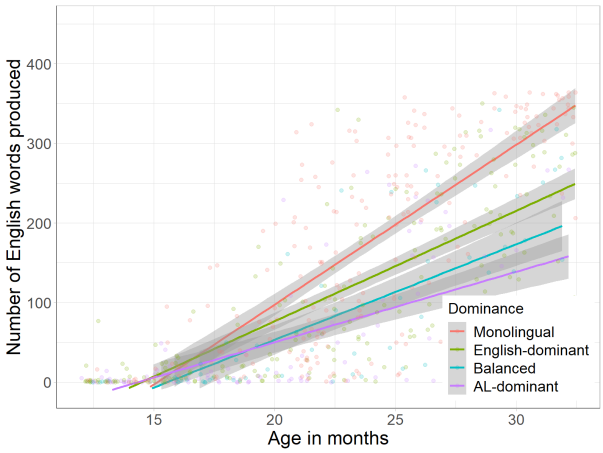

Figure 2: Scatterplot of English vocabulary size in production by age, split by language dominance groups.

On average, the bilingual sample had smaller vocabulary sizes than same-age monolinguals for English vocabulary in comprehension ($t = -9.82$, $p < .001$) and English vocabulary in production ($t = -8.51$, $p < .001$). When bilinguals are split by dominance groups, we see the expected trend for English vocabulary size across groups. All three groups had significantly smaller vocabulary size compared to monolinguals (Figure 1, Table 1). As shown by the model estimates, on average English-dominant bilinguals knew 39.0 fewer English words than monolinguals (out of 365 concepts), Balanced bilinguals knew 74.5 fewer words and AL-dominant bilinguals knew 98.9 fewer words. This was also seen for production (Figure 2, Table 2). Interactions between age and language dominance were significant in production, with monolinguals showing a steeper slope of vocabulary growth with age relative to all three bilingual groups, while AL-dominant bilinguals showed the flattest slope of all four groups.

Table 1: Linear model for English vocabulary size in comprehension, with age and language dominance as predictors (Monolingual is reference level).

Predictor	Estimate	Std Error	*t*	*p*
(Intercept)	278.2	19.6	14.2	<.001
Age	94.2	6.42	14.6	<.001
Mother edu	-1.88	6.59	-0.287	.775
Eng-dom	-39.0	7.14	-5.47	<.001
Balanced	-74.5	9.93	-7.50	<.001
AL-dom	-98.9	9.05	-10.9	<.001
Age:Eng-dom	4.81	8.46	0.568	.570
Age:Balanced	-4.74	11.4	-0.415	.679
Age:AL-dom	-9.50	9.99	-0.952	.342

Note. Mother edu = Mother's education; Eng-dom = English-dominant; AL-dom = AL-dominant

Table 2: Linear model for English vocabulary size in production, with age and language dominance as predictors (Monolingual is reference level).

Predictor	Estimate	Std Error	*t*	*p*
(Intercept)	188.2	20.5	9.19	<.001
Age	132.3	6.71	19.7	<.001
Mother edu	-3.61	6.87	-0.525	.600
Eng-dom	-45.8	7.44	-6.15	<.001
Balanced	-76.5	10.4	-7.39	<.001
AL-dom	-92.4	9.44	-9.78	<.001
Age:Eng-dom	-40.8	8.82	-4.63	<.001
Age:Balanced	-52.9	11.9	-4.45	<.001
Age:AL-dom	-73.5	10.4	-7.06	<.001

Note. Mother edu = Mother's education; Eng-dom = English-dominant; AL-dom = AL-dominant

Conceptual vocabulary

We then studied the relationship between age, language group and conceptual vocabulary size. In Figure 3, which visualises the relationship for conceptual vocabulary in comprehension, we see that the difference between bilinguals with different levels of language exposure (as seen in the previous figure of English vocabulary comprehension) has largely disappeared. The difference between the monolingual group and the bilingual groups has also reduced, though it remains significant. This trend is reflected for production, as seen in Figure 4. As with English vocabulary, there is a strong positive relationship between conceptual vocabulary size and age.

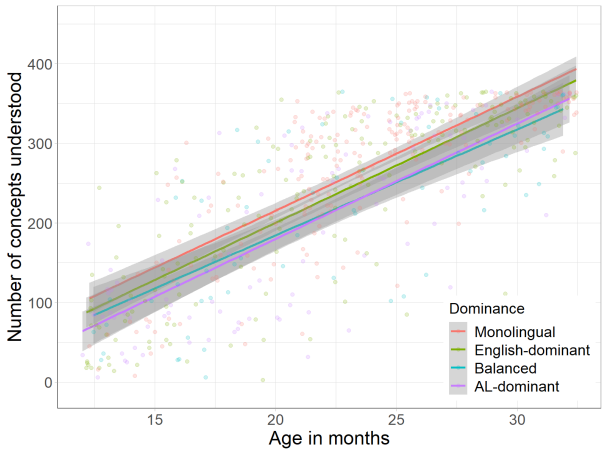

Figure 3: Scatterplot of conceptual vocabulary size in comprehension by age, split by language dominance groups.

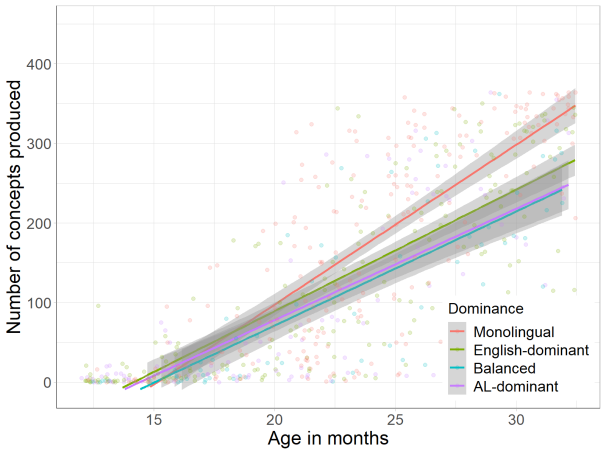

Figure 4: Scatterplot of conceptual vocabulary size in production by age, split by language dominance groups.

Table 3: Linear model for conceptual vocabulary size in comprehension, with age and language dominance as predictors (Monolingual is reference level).

Predictor	Estimate	Std Error	*t*	*p*
(Intercept)	275.5	18.4	15.0	<.001
Age	94.2	6.02	15.7	<.001
Mother edu	-0.97	6.16	-0.157	.875
Eng-dom	-14.9	6.68	-2.23	.026
Balanced	-35.0	9.29	-3.77	<.001
AL-dom	-34.9	8.47	-4.12	<.001
Age:Eng-dom	0.494	7.92	0.063	.950
Age:Balanced	-6.44	10.7	-0.603	.547
Age:AL-dom	1.36	9.35	0.145	.885

Note. Mother edu = Mother's education; Eng-dom = English-dominant; AL-dom = AL-dominant

Contrary to our predictions, the bilingual sample had smaller vocabulary sizes than same-age monolinguals even when vocabulary size was calculated using conceptual vocabulary, both in comprehension ($t = -4.27$, $p < .001$) and production ($t = -4.83$, $p < .001$). These group differences were smaller in size than for English vocabulary but remained significant. All three bilingual groups had significantly smaller conceptual vocabulary size compared to monolinguals (Figure 3, Table 3). English-dominant bilinguals knew 14.9 fewer concepts than monolinguals (out of 365 common concepts), Balanced bilinguals knew 35.0 fewer concepts and AL-dominant bilinguals knew 34.9 fewer concepts. The same trend was also observed for production (Figure 4, Table 4). Again, there was a striking interaction effect for production, with monolinguals having a steeper slope of vocabulary growth with age relative to all three bilingual groups.

Table 4: Linear model for conceptual vocabulary size in production, with age and language dominance as predictors (Monolingual is reference level).

Predictor	Estimate	Std Error	*t*	*p*
(Intercept)	187.3	20.9	8.98	<.001
Age	132.3	6.83	19.4	<.001
Mother edu	-3.29	7.00	-0.469	.639
Eng-dom	-27.6	7.58	-3.64	<.001
Balanced	-49.3	10.5	-4.68	<.001
AL-dom	-44.0	9.62	-4.57	<.001
Age:Eng-dom	-31.8	8.99	-3.54	<.001
Age:Balanced	-37.7	12.1	-3.10	.002
Age:AL-dom	-39.9	10.6	-3.76	<.001

Note. Mother edu = Mother's education; Eng-dom = English-dominant; AL-dom = AL-dominant

Discussion

We present findings regarding the vocabulary growth of a large sample of bilingual and monolingual toddlers that are convergent with previous findings in the literature (Vagh et al., 2009; Cattani et al., 2014; Hoff & Ribot, 2017). We saw a trend for bilinguals' English vocabulary size to be smaller than same-age monolinguals, with the difference significant in both comprehension and production. This difference was modulated by the amount of English exposure received by the child, with English-dominant bilinguals being most similar to monolinguals (but still significantly smaller in English vocabulary size) and AL-dominant bilinguals having the smallest English vocabulary size.

We further show an age-related change in the vocabulary gap between monolinguals and bilinguals in production, with the difference increasing with age. Monolinguals had significantly steeper slopes compared to all three bilingual groups. This is consistent with De Houwer et al.'s (2014) findings

where 20-month-old bilinguals showed a vocabulary lag in relation to monolinguals but there was no significant difference between groups at 13 months-old.

Bilingual lag even in conceptual vocabulary

While the group differences in English vocabulary size are consistent with our predictions, the persistent lag in bilinguals' vocabulary size even when vocabulary size was calculated using the number of concepts known was unexpected. Our predictions were that conceptual scoring would fully eliminate the difference in vocabulary size between monolinguals and bilinguals. Instead, while conceptual scoring reduced bilinguals' lag in vocabulary size relative to that of monolinguals, the group difference remained significant. This result is concerning, as it suggests that bilinguals have overall smaller vocabularies compared to their monolingual peers, which could have negative implications for their later academic outcomes.

However, we do acknowledge certain limitations in our study. The CDI is not an exhaustive list of all the words that a child may know, but instead is a subset of commonly-known words aimed to provide an estimate of a child's vocabulary knowledge compared to their peers. Our AL CDIs were adapted from the Oxford CDI, which was normed using data from monolingual British toddlers. As such, the subset of words in the Oxford CDIs (and subsequently our AL CDIs) may be biased towards concepts that are familiar to the UK English-speaking community. While the toddlers in our bilingual sample were also growing up in the UK, there may be certain concepts less common in their home environment due to cultural differences. We attempted to reduce this bias by using only the subset of concepts that was common across all our CDIs after appropriate substitutions were made by native speakers of those languages, but we acknowledge that words common to the UK English-speaking community may still have received greater weight in our calculation of conceptual vocabulary. There may also be limitations in the use of CDIs to measure vocabulary size of bilingual toddlers in their less-dominant language. In our study, several parents of bilingual toddlers indicated uncertainty in answering the CDI in their non-native language. Vagh et al. (2009) observed a similar issue, with 16 parents of 118 opting out of reporting their child's English vocabulary due to lack of confidence. This opt-out rate of approximately 10% is similar to the rate observed in our study. The 42 families who explicitly expressed uncertainty in their reporting accuracy were excluded from our analyses. We also required at least one parent to be a native speaker of the AL, and at least one parent to have fluent English proficiency (operationalised as self-rated proficiency of at least 7 out of 10). Through these criteria, we aimed to reduce the variability in parents' reporting accuracy as a result of low proficiency in one of the target languages. Nevertheless, research on bilingual vocabulary growth would benefit from further investigations using direct measures of toddlers' vocabulary, such as word-referent matching tasks for comprehension and picture naming tasks for production, to shed light on whether this bilingual lag in vocabulary size reflects a true delay.

Conclusion

In this paper, we found that bilingual toddlers' vocabulary size in comprehension was significantly smaller than monolinguals after controlling for age, both when measured using English vocabulary and conceptual vocabulary. For English, the vocabulary gap between monolinguals and bilinguals was larger for bilinguals with lower English exposure, supporting the role of language exposure in guiding bilinguals' vocabulary growth in a single language. Bilinguals also displayed flatter slopes for vocabulary growth in production with age relative to monolinguals for both English and conceptual vocabulary. Given the links between early vocabulary and later academic achievement, awareness of this increasing bilingual lag in vocabulary size in production should guide teaching strategies in supporting bilingual language development.

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