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Sometimes larger, sometimes smaller: Measuring vocabulary in monolingual and bilingual infants and toddlers

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Abstract

Vocabulary size is a crucial early indicator of language development, for both monolingual and bilingual children. Assessing vocabulary in bilingual children is complex because they learn words in two languages, and there remains significant controversy about how to best measure their vocabulary size, especially in relation to monolinguals. This study compared monolingual vocabulary to different metrics of bilingual vocabulary, including combining vocabulary across languages to count either the number of words or the number of concepts lexicalized, and assessing vocabulary in a single language. Data were collected from parents of 743 infants and toddlers aged 8–33 months learning French and/or English, using the MacArthur-Bates Communicative Development Inventories. Results showed that the nature and magnitude of monolingual–bilingual differences depended on how bilinguals’ vocabulary was measured. Compared to monolinguals, bilinguals had larger expressive and receptive word vocabularies, similarly-sized receptive concept vocabularies, and smaller expressive concept vocabularies. Bilinguals’ single-language vocabularies were smaller than monolinguals’ vocabularies. The study highlights the need to better understand the role of translation equivalents in bilingual vocabulary development and the potential developmental differences in receptive and expressive vocabularies.

Abbreviated abstract

Vocabulary size data were collected from parents of 743 infants and toddlers aged 8–33 months learning French and/or English, using the MacArthur-Bates Communicative Development Inventories. Compared to monolinguals, bilinguals had larger expressive and receptive word vocabularies, similarly-sized receptive concept vocabularies, and smaller expressive concept vocabularies. Bilinguals' single-language vocabularies were smaller than monolinguals' vocabularies. Bilingual and monolingual vocabulary sizes differ across most metrics, pointing to potential developmental differences.

Keywords: Bilingualism, Vocabulary development, Infants

Sometimes larger, sometimes smaller: Measuring vocabulary in monolingual and bilingual infants and toddlers

Age-appropriate vocabulary size is an important marker of typical language development, and predicts a variety of language, literacy, and academic outcomes (Duff et al., 2015; Marchman & Fernald, 2008). Given the growing number of immigrant children and bilingual families (Luk, 2017; Prevoo et al., 2016; Schott et al., 2022), there is an increasing need for understanding how to best quantify vocabulary development in bilingual toddlers. For monolingual children, the words a child knows can simply be counted to yield a receptive (words understood) or expressive (words produced) vocabulary score, which can be compared to age-referenced vocabulary norms (Fenson et al., 2007). Measuring vocabulary is more complex in bilingual toddlers, as they learn words in two languages from early in development (Petitto et al., 2001).

Bilingual children's vocabulary can be measured either in a single language or by combining their knowledge across languages. A recent review found that most studies that measured vocabulary in young bilinguals reported single-language measures in each language (68%), but many fewer reported a combined measure (43%; Weisleder et al., 2022). When single-language vocabulary is measured, bilingual children tend to have smaller productive vocabularies than monolinguals (e.g., Bialystok et al., 2010; Hoff & Ribot, 2017; Pearson et al., 1993; Thordardottir et al., 2006; Uccelli & Páez, 2007). This monolingual–bilingual difference is typically larger in children's non-dominant (weaker/least-heard) language than in their dominant (stronger/most-heard) language (Altman et al., 2018; Cattani et al. 2014; Thordardottir, 2011).

To overcome the limitations of single-language vocabulary assessment, researchers have long advocated for assessing bilingual vocabulary in a way that considers both languages (Kohnert, 2010;

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Pearson et al., 1993). “Total vocabulary” and “total conceptual vocabulary” are two commonly used combined metrics of bilingual children’s vocabulary development. In the current study we have updated these terms to be more concise and transparent, in order to clarify interpretation of the outcomes they provide. We call *word vocabulary* the measure that combines the total number of words the child knows in each of their languages (historically referred to as total vocabulary), while we call *concept vocabulary* the measure that only includes the number of concepts the child knows in either language (historically referred to as total conceptual vocabulary). These two metrics differ in their treatment of translation equivalents (i.e., cross language synonyms like English “dog” and French “*chien*”): word vocabulary gives credit for all words the child produces, including translation equivalents, whereas concept vocabulary does not give double credit for translation equivalent pairs. As an example, a child who knows both “dog” and “*chien*” would obtain 2 points for word vocabulary (since they know both words) but only 1 for concept vocabulary (since both words refer to the same concept).

Several studies have compared monolinguals and bilinguals on concept and/or word vocabulary. When comparing expressive word vocabularies at various ages between 14 and 36 months, multiple studies have reported that bilinguals have similar vocabulary scores to monolinguals (Spanish–English, Core et al., 2013; Hoff et al., 2012; Various language pairs, Brito et al., 2014; Russian–Finnish, Silvén et al., 2014). However, other studies reported that bilinguals have larger expressive word vocabularies than monolinguals at 18 months (Spanish–Catalan; Bosch & Ramon-Casas, 2014) and 24 months of age (English–German; Junker & Stockman, 2002). Of interest, one study of 20-month-olds found different results depending on cultural context: English–Japanese and English–Korean bilinguals had similar expressive word vocabularies to their monolingual peers,

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while Spanish–English bilinguals had lower word vocabularies than either Spanish or English monolinguals (Cote & Bornstein, 2014).

In relation to concept vocabulary, some studies have found that this measure disadvantages bilinguals (Spanish–English expressive vocabulary, Core et al., 2013; French–English expressive vocabulary, Thordardottir et al., 2006), while other studies have found that this approach yields comparable scores across monolinguals and bilinguals (e.g., Dutch–French receptive and expressive vocabulary, De Houwer et al., 2014; English–German expressive vocabulary, Junker & Stockman, 2002; Spanish–English receptive and expressive vocabulary, Pearson et al., 1993). Studies that have looked at both word and concept vocabulary have had mixed findings, with some suggesting that word vocabulary (e.g., Core et al., 2013), and other studies suggesting that concept vocabulary (Junker & Stockman, 2002), is most similar between monolinguals and bilinguals, and still others finding that both metrics are comparable (De Houwer et al., 2014). Finally, another approach has been to develop bilingual-specific norms (receptive and expressive vocabulary in learners of English and another language, Floccia et al., 2018; receptive vocabulary in multiple language pairs, Gampe et al., 2018), although currently these are only available for children of very specific ages.

Additional large-scale data is needed given the mixed findings in the literature regarding how bilinguals compare to monolinguals when measured on different vocabulary metrics, particularly given the small sample sizes and/or limited ages assessed in most previous studies (for a summary of these studies, see Table 1). Such information can provide theoretical insight into the nature of bilingual vocabulary development, the role of translation equivalents, and the development of receptive versus expressive vocabulary.

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The current study examined the vocabularies of 743 children aged 8–33 months, a much larger sample than in previous studies. Children were learning French and/or English in a community where languages have similar sociolinguistic status, providing an optimal control for potentially confounding variables that may differ systematically between monolinguals and bilinguals in some contexts. Uniquely, our study examined both receptive and expressive vocabulary across four metrics: word vocabulary, concept vocabulary, dominant language vocabulary, and non-dominant language vocabulary.

Table 1

Summary of Studies Comparing Combined Vocabulary Development in Monolinguals vs. Bilinguals Using the CDI

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Authors	N		Languages	Age (months)	Findings			
	Bi	Mono			Expressive Vocabulary		Receptive Vocabulary	
					Word	Concept	Word	Concept
Bosch & Ramon-Casas, 2014	24	24	Spanish–Catalan	18	B > M	B = M	–	–
Brito et al., 2014	18	18	Various	24	B = M	–	–	–
Core et al., 2013; Hoff et al., 2012	47	56	English–Spanish	22	B = M	B = M	–	–
				25	B = M	B = M		
				30	B = M	B < M		
Cote & Bornstein, 2014	90	140	English–Spanish	20	B < M	–	–	–
			English–Japanese		B = M			
			English–Korean		B = M			
De Houwer et al., 2014	31	30	Dutch–French	13	B = M	–	B > M	–
				20	B = M	–	–	–
Junker & Stockman, 2002	10	20	English–German	24–27	B > M English monolinguals	B = M English monolinguals	–	–
					B = M German monolinguals	B = M German monolinguals		
Pearson et al., 1993	24	33	English–Spanish	14–30	B = M	B = M	B = M	B = M
Silvén et al., 2014	28	26	Finnish–Russian	14, 18, 24, 36	B > M	–	–	–
Thordardottir et al., 2006	8	20	English–French	20–36	B = M	B < M English monolinguals	–	–
						B = M French monolinguals		

Current Study	416	337	English–French	8–33	B > M	B < M	B > M	B = M

Method

This research was conducted according to the Declaration of Helsinki, and was approved by the Human Research Ethics Board of Concordia University (certification numbers UH2011-04 and 10000439). Parents provided informed consent.

Participants

Data were collected from typically developing infants aged 8–33 months (47% female) between 2010 and 2018. Recruitment was carried out through government birth lists, daycares, and online ads. Children visited the lab one (75.4%), two (19.9%), three (4.2%), or four (0.5%) times for experimental studies, and vocabulary data was collected on each visit (see next section for details). The analyzed dataset includes data from 743 infants who collectively took part in 947 lab visits. Following criteria similar to the norming sample for the American English CDI (Fenson et al., 2007), we excluded children who were born premature (< 36 weeks gestation), who had low birth weight (< 2500 grams), who presented with major medical conditions (e.g., meningitis, major surgeries), or who fell outside our target age range of 8–33 months. Children were mainly reported to be of European descent (48%), followed by Other (12%) and Multiple Ethnicities (10%). Sixteen percent of parents did not report their child’s ethnic background. Other ethnic groups each made up 5% or less of the sample.

Families lived in Montréal, Québec, a multicultural Canadian city where English and French are regularly used in everyday life and are both held in high regard (Kircher, 2014). While French is the official language provincially, French and English have official status federally. Public schooling is

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available in both languages, and 46% of individuals living in Québec identify as French–English bilinguals (Statistics Canada, 2022). These attributes are ideal for comparison of the two groups, as they avoid confounds often present in studies that compare monolingual and bilingual samples that differ in the proportion of immigrants, socioeconomic status, social prestige, and official status of the two languages (e.g., Cattani et al., 2014; Floccia et al., 2018; Hoff et al., 2014). Parental education was used as a proxy for socioeconomic status; maternal education was reported for 98.5% of participant visits, paternal education was reported in a further 0.3% of visits, and parental education was not reported for 1.2% of visits. Overall, parental education was high, with an average of 16.7 years for parents of monolinguals and 16.9 years for parents of bilinguals. All parents with the exception of four mothers of monolinguals and 10 mothers of bilinguals reported at least some post-secondary education.

Language Background Assessment

Participants' language background was defined based on lifetime exposure to different languages, as assessed by the Language Exposure Questionnaire (Bosch & Sebastián-Gallés, 2001) using the Multilingual Approach for Parent Language Estimates (MAPLE; Byers-Heinlein et al., 2019), which has good reliability for this population ($r = .88$; Orena et al., 2019). Monolingual children were exposed to either English or French 90% of the time or more. Following prior research (e.g., Byers-Heinlein & Werker, 2009), bilingual children were exposed to both English and French 25% to 75% of the time, with no more than 10% exposure to a third language. Language exposure was assessed at each lab visit. Children were classified as monolingual at 437 lab visits and bilingual at 510 lab visits. Ten children who participated at multiple ages experienced differences in their language exposure

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between visits great enough to switch their language background category from monolingual to bilingual or vice-versa.

A child's dominant language was deemed to be the language the child had greater exposure to (or for most monolinguals, exclusive exposure to). For children with perfectly balanced exposure (50% of exposure to each language), the dominant language was the one in which the child was reported to produce the most words. English was the dominant language at 523 lab visits, and French at 424 visits. For 17 children who participated at multiple ages, the language assessed to be their dominant one switched from English to French or vice-versa between visits.

Vocabulary measures

The words children knew in English and/or French were measured via American English and Québec French adaptations of the MacArthur-Bates Communicative Development Inventories (CDI, Fenson et al., 2007; Trudeau et al., 1999), using the Words and Gestures form for children aged 8–16 months (which measures both receptive and expressive vocabulary) and the Words and Sentences form for children aged 17–33 months (which measures expressive vocabulary only).

CDIs were administered at each lab visit. Parents completed the CDI either on paper or on a tablet computer. We asked that the caregiver who was most familiar with the child's vocabulary in the specific language being evaluated complete the questionnaire. Each completion of a specific CDI form (i.e., in English or French) at a specific age was considered one administration. CDI administrations for monolingual children were filled out mainly by mothers (59%), fathers (4%), or both parents (1%); the respondent was not indicated for 36% of administrations. CDI administrations for bilingual children were completed by mothers (63%), fathers (7%), both parents (4%), or other

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family members (< 1%; e.g., grandmother); the respondent was not indicated for 25% of administrations.

The analyzed dataset consisted of 1,338 CDI administrations ($n = 647$ Words and Gestures administrations; $n = 691$ Words and Sentences administrations). We retained the data from all administrations wherever possible, as our statistical models were able to account for dependencies in the data for children who contributed data at multiple ages and children whose language group or language dominance switched between lab visits, and because the additional data increased statistical power and reliability.

For monolinguals, there were a total of 510 administrations: 277 administrations in English-learning children ($n_{children} = 217$) and 233 administrations in French-learning children ($n_{children} = 199$). For bilinguals, there were a total of 828 administrations: 472 administrations in English-dominant children ($n_{children} = 196$) and 356 administrations in French-dominant children ($n_{children} = 157$). The proportion of administrations where English was the native/dominant language was similar across monolinguals (54%) and bilinguals (57%). In cases where bilingual children had missing data in one of the CDI questionnaires (i.e., $n = 46$, 11 cases missing data in the dominant language, 35 cases missing data in the non-dominant language), data were excluded for analyses that required the combination of both questionnaires (e.g., concept vocabulary, word vocabulary), but were included in analyses that focused on one language (e.g., dominant language, non-dominant language).

Monolinguals' vocabulary scores were determined by tallying the number of words children produced and (when available) understood in their single native language. For bilinguals, four different scores were calculated for expressive and (when available) receptive vocabulary. Dominant and non-dominant language vocabulary was calculated by tallying the number of words bilinguals

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knew either English or French, depending on the child's dominant and non-dominant languages.

Word vocabulary counted the words bilinguals knew in both languages (English + French). Concept vocabulary counted the concepts for which bilinguals produced or (when available) understood a word. To do so, it was necessary to identify words across the two languages that refer to the same concept (i.e., translation equivalents; a full list of these pairs is available at <https://osf.io/78hua/> and methodological details are reported in Tsui et al., 2022), then subtracting these from bilinguals' word vocabulary.

Results

Data were analyzed using R Version 4.1.3 (R Core Team, 2022). Analysis scripts and the full dataset are available at <https://osf.io/78hua/>.

Analytic approach

We conducted a series of regression models investigating how bilinguals compared to monolinguals in expressive and expressive vocabulary – with age as an additional predictor – across four ways of measuring bilinguals' vocabulary: dominant language, non-dominant language, concept vocabulary, and word vocabulary. In each model, the same score was entered for monolinguals (i.e., their vocabulary size in their single native language). Because some children contributed vocabulary data at more than one age, we used the *lmer* package (Kuznetsova et al., 2017) to fit linear mixed-effects models that included random intercepts for participants, accounting for repeated measures of the same individual (Bates et al., 2015).

Previous research has suggested that early vocabulary growth has a quadratic trajectory (Bauer et al., 2002; Huttenlocher et al., 1991). Data visualizations and model comparisons showed that a quadratic age term improved fit for expressive vocabulary models (see

https://osf.io/78hua/?view_only=105a1318b5524c42bb7c31a50c79c62e), but not for receptive vocabulary models, possibly due to the smaller age range available for receptive vocabulary. We thus included a linear age term for all models, and a quadratic age term for expressive models only. The expressive models were fit with orthogonal polynomials to remove collinearity of the age predictors, thus, the intercept represents the number of vocabulary words at the average age in the dataset. To ease comparing expressive and receptive models, and because an intercept of 0 months would be outside our data range, we centred the age term in the receptive vocabulary models at 12 months. We also included the interactions between linear (and for expressive models, quadratic) age terms and language group, to examine whether the effect of age on these vocabulary measures was similar for monolinguals and bilinguals. We present analyses for expressive vocabulary prior to those for receptive vocabulary, as all children contributed expressive vocabulary data but only children 16 months and under contributed receptive vocabulary data.

Expressive vocabulary

Figure 1 displays children's expressive vocabulary across age, comparing monolinguals to bilinguals measured on word, concept, dominant, and non-dominant language metrics. Linear and quadratic terms for age were positive and significant for all models, showing that productive vocabulary size grew in an accelerating fashion (see Tables 2 and 3). All models showed significant interactions between age term(s) and language group indicating different patterns of vocabulary growth, but the nature and the direction of the effect depended on bilinguals' vocabulary measure. Bilinguals had a steeper increase in word vocabulary size with age compared to monolinguals, as shown by the significant positive interaction between linear age term and language group. By contrast, when bilinguals' concept vocabulary or dominant vocabulary was measured, monolinguals

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had a higher and more steeply increasing vocabulary, as indicated by the significant negative interaction between the linear age term and language group. Monolinguals had larger, more steeply increasing, and more accelerated vocabulary growth compared to bilinguals' non-dominant vocabulary, as indicated by significant negative interactions between language group and both linear and quadratic age terms.

In sum, when measured by word vocabulary, bilinguals' expressive vocabulary development outpaced monolinguals', whereas when bilinguals' vocabularies were measured by concept, dominant, or non-dominant language vocabulary, monolinguals' development outpaced bilinguals'. The differences with monolinguals were largest when bilinguals' vocabularies were measured in a single language (i.e., dominant and non-dominant vocabulary).

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Figure 1: A comparison of monolinguals’ expressive vocabulary size across age to bilinguals’ vocabulary measured via four different metrics. Lines show group trajectories, and points show individual scores. Values above 750 have been truncated for visualization purposes. Note that monolinguals have the same vocabulary score for word, concept, dominant and non-dominant vocabulary.

Table 2

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Expressive Vocabulary - Combined Measures

<i>Predictors</i>	Word Vocabulary			Concept Vocabulary		
	<i>Estimates</i>	<i>CI</i>	<i>p</i>	<i>Estimates</i>	<i>CI</i>	<i>p</i>
Intercept	144.74	133.56 – 155.92	<0.001	144.78	135.81 – 153.74	<0.001
Age (Linear Term)	5056.33	4764.92 – 5347.74	<0.001	5059.75	4826.92 – 5292.58	<0.001
Age (Quadratic Term)	1131.38	829.37 – 1433.40	<0.001	1128.42	887.03 – 1369.82	<0.001
Bilingual	20.28	3.21 – 37.36	0.020	-17.70	-31.39 – -4.02	0.011
Age (Linear Term) * Bilingual	810.61	342.56 – 1278.65	0.001	-618.22	-992.26 – -244.18	0.001
Age (Quadratic Term) * Bilingual	267.18	-197.50 – 731.87	0.259	-132.31	-503.59 – 238.97	0.484
Marginal R ² / Conditional R ²	0.702 / 0.826			0.743 / 0.853		

Table 3

Expressive Vocabulary - Single-Language Measures

<i>Predictors</i>	Dominant Vocabulary			Non-Dominant Vocabulary		
	<i>Estimates</i>	<i>CI</i>	<i>p</i>	<i>Estimates</i>	<i>CI</i>	<i>p</i>
Intercept	144.68	135.94 – 153.42	<0.001	145.12	136.94 – 153.31	<0.001
Age (Linear Term)	5067.86	4836.73 – 5299.00	<0.001	5067.66	4851.03 – 5284.29	<0.001
Age (Quadratic Term)	1127.43	888.28 – 1366.57	<0.001	1125.85	901.75 – 1349.96	<0.001
Bilingual	-35.10	-48.46 – -21.74	<0.001	-90.00	-102.51 – -77.50	<0.001
Age (Linear Term) * Bilingual	-1188.08	-1558.95 – -817.21	<0.001	-3101.00	-3448.56 – -2753.43	<0.001
Age (Quadratic Term) * Bilingual	-169.92	-538.41 – 198.57	0.366	-660.98	-1006.33 – -315.62	<0.001
Marginal R ² / Conditional R ²	0.737 / 0.834			0.731 / 0.829		

Receptive vocabulary

Figure 2 displays monolinguals' receptive vocabulary across age compared to bilinguals' word, concept, dominant, and non-dominant language metrics. Receptive vocabulary size grew with age, as indicated by the significant linear term for age across all models (see Tables 4 and 5). For word vocabulary, the pattern for receptive vocabulary was similar to that seen in expressive vocabulary: bilinguals' word vocabularies grew faster than monolinguals' vocabularies, as evidenced by the higher bilingual intercept and significant positive interaction between language group and age. For bilinguals' concept vocabulary, however, there were no statistical differences in vocabulary growth with monolinguals. Monolinguals had slightly larger vocabularies when bilinguals' dominant language vocabulary was measured, although the rate of vocabulary growth was similar for both language

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groups, indicated by the positive baseline age term and its non-significant interaction with language group. Monolinguals again had steeper vocabulary growth when bilinguals' non-dominant vocabulary was measured, as shown by the positive age term and its negative significant interaction with language group.

To summarize, when measured by combined vocabulary metrics – word vocabulary or concept vocabulary – bilinguals had receptive vocabularies either larger than or similar to monolinguals' vocabularies, depending on the bilingual measure. For single-language vocabulary, whether bilinguals were measured in the dominant or non-dominant language, monolinguals had larger vocabularies, but the differences were less pronounced than for expressive vocabulary.

Figure 2: A comparison of monolinguals' receptive vocabulary size across age to bilinguals'

vocabulary measured via four different vocabulary metrics. Lines show group trajectories, and points

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show individual scores. Values above 400 have been truncated for visualization purposes. Note that monolinguals have the same vocabulary score for word, concept, dominant and non-dominant vocabulary.

Table 4

Receptive Vocabulary - Combined Measures

<i>Predictors</i>	Word Vocabulary			Concept Vocabulary		
	<i>Estimates</i>	<i>CI</i>	<i>p</i>	<i>Estimates</i>	<i>CI</i>	<i>p</i>
Intercept	92.97	82.68 – 103.27	<0.001	92.57	83.97 – 101.17	<0.001
Age	17.32	13.06 – 21.58	<0.001	17.80	14.43 – 21.16	<0.001
Bilingual	44.07	26.93 – 61.22	<0.001	11.39	-2.91 – 25.70	0.118
Age * Bilingual	8.54	1.30 – 15.78	0.021	1.16	-4.57 – 6.89	0.690
Marginal R ² / Conditional R ²	0.260 / 0.549			0.243 / 0.655		

Table 5*Receptive Vocabulary - Single-Language Measures*

<i>Predictors</i>	Dominant Vocabulary			Non-Dominant Vocabulary		
	<i>Estimates</i>	<i>CI</i>	<i>p</i>	<i>Estimates</i>	<i>CI</i>	<i>p</i>
Intercept	92.59	84.36 – 100.81	<0.001	92.59	84.56 – 100.61	<0.001
Age	17.69	14.43 – 20.95	<0.001	17.69	14.51 – 20.86	<0.001
Bilingual	-13.79	-27.48 – -0.10	0.048	-34.94	-48.29 – -21.58	<0.001
Age * Bilingual	-2.58	-8.12 – 2.96	0.361	-6.35	-11.76 – -0.94	0.021
Marginal R ² / Conditional R ²	0.229 / 0.628			0.247 / 0.636		

Discussion

Monolingual and bilingual children face different tasks in building vocabularies, as only bilinguals must learn words from two different languages. We examined how monolingual and bilingual environments impact vocabulary development across age. In a large sample of 1,338 CDI administrations for 743 children learning French and/or English, we compared monolingual and bilingual children's expressive (8- to 33-month-olds) and receptive (the subset of children who were 8–16 months old) vocabulary sizes. The size of our sample gave us the statistical power to detect effects that might have been missed in previous studies.

First, we confirmed that assessing bilinguals in a single language—whether their dominant or non-dominant—yielded a smaller vocabulary size for bilinguals relative to monolinguals for both expressive and receptive vocabulary, replicating and extending previous findings (Bialystok et al., 2010; Thordardottir et al., 2006). Bilinguals' single-language vocabularies reflect their reduced

exposure to these languages compared to monolinguals, with a larger discrepancy when bilinguals were measured in the non-dominant (least-heard) compared to the dominant (most-heard) language.

Second, we found that traditional metrics combining bilinguals' vocabularies across the two languages also resulted in significantly different vocabulary trajectories compared to monolinguals. Word vocabulary (traditionally referred to as total vocabulary size)—which counts all words children know regardless of whether they know its translation equivalent—advantaged bilinguals in comparison to monolinguals. This effect was particularly strong in receptive as compared to expressive vocabulary, and was magnified at older ages. Concept vocabulary (traditionally referred to as total conceptual vocabulary size)—which gives no additional credit to words for which children know a translation equivalent—disadvantaged bilinguals in comparison to monolinguals, although only for expressive vocabulary. On the surface, our results appear to differ from most previous studies undertaking monolingual–bilingual comparisons on combined metrics, which have largely failed to find statistically significant differences in word and/or concept vocabulary (Bosch & Ramon-Casas, 2014; Core et al., 2013; De Houwer et al., 2014; Hoff et al., 2012; Junker & Stockman, 2002; Pearson et al., 1993). Nonetheless, when differences have been reported, the pattern was the same as in the current study: bilinguals had larger word vocabulary than monolinguals (Bosch & Ramon-Casas, 2014; Junker & Stockman, 2002; although see Cote & Bornstein, 2014 for one counter-example) and monolinguals had larger concept vocabularies than bilinguals (Core et al., 2013; Thordardottir et al., 2006). One potential explanation for these patterns is that our sample was larger by an order of magnitude than those of previous studies (hundreds of children and over a thousand CDI administrations versus a few dozen at most). A lack of statistically robust monolingual–bilingual

differences in previous studies might be due to low statistical power, rather than a true null effect. Future studies with large samples will be needed to confirm this interpretation.

The findings with regards to concept and word vocabularies have implications for understanding the nature of word learning in bilinguals, particularly regarding translation equivalents. Traditional combined metrics of bilingual vocabulary implicitly assume that learning a second label for a referent is equally difficult to learning the first label (word vocabulary) or that it is trivial (concept vocabulary). Our data suggest that the truth lies in between, consistent with studies reporting a moderate bilingual advantage for translation equivalent learning (Bilson et al., 2015; Tsui et al., 2022). In the future, it may be possible to develop a “bilingual adjusted vocabulary” metric, whereby monolingual and bilingual vocabularies can be equated by giving bilinguals partial credit for translation equivalents, perhaps even in a way that changes across development.

Our study also demonstrates developmental differences in receptive versus expressive vocabularies across monolinguals and bilinguals. For word vocabulary, bilinguals’ receptive vocabulary development strongly outpaced that of monolinguals, with a much smaller advantage seen in expressive vocabulary. For concept vocabulary, bilinguals did not differ from monolinguals in receptive vocabulary, whereas monolinguals outpaced bilinguals in expressive vocabulary. This pattern is consistent with the so-called receptive–expressive gap in bilingual children, whereby bilinguals’ receptive language ability often outpaces their expressive ability (Gibson et al., 2014; Giguere & Hoff, 2020; Kan & Kohnert, 2005; Mancilla-Martinez et al., 2018). At the same time, due to the instruments we used, our study examined receptive vocabulary across a more restricted age range (8–16 months) than expressive vocabulary (8–33 months), which could attenuate differences as our results consistently showed greater divergence between language groups at older ages. The only

monolingual-bilingual comparison that did not show group differences was in receptive concept vocabulary, and it is possible that a difference would have emerged at older ages.

The current findings are relevant for clinicians in assessing bilingual vocabulary using the CDI (e.g., Core et al., 2013; Hoff & Core, 2015). Although bilingual norms have been developed for specific ages and language pairs (e.g., Floccia et al., 2018), they are currently limited in their coverage of children learning different languages and of different ages. In recent years, professional organizations and researchers have increasingly recommended evaluating bilingual children in both of their languages (American Speech-Language-Hearing Association, 2004; Bedore & Peña, 2008; Kohnert, 2010), but there are not yet clear guidelines for how to interpret the results obtained from this assessment. Our results confirm that using a single-language CDI for bilinguals may not yield a score comparable to monolinguals as they only partially measure bilinguals' knowledge, and thus is typically inappropriate except possibly when children are strongly dominant in one language (Cattani et al., 2014; see also Vagh et al., 2009). Both word vocabulary and concept vocabulary yield bilingual scores that are more similar to monolinguals' scores, although neither exactly equates the two groups, and on both measures the word gap between the two groups increases with age. In practice, given the high level of individual variability observed across both monolinguals and bilinguals, either word vocabulary or concept vocabulary might be appropriate for the assessment of vocabulary knowledge, with concept vocabulary being more conservative and word vocabulary being more liberal. Lastly, our results revealed that bilinguals strongly outpace monolinguals in early receptive word vocabulary, thus bilinguals who show limited early comprehension when both languages are considered might be of particular clinical concern.

Finally, we note that our study examined one particular group of bilinguals, those learning French and English in Montréal, where both languages have high sociolinguistic status. A strength of data from this population is that results are unlikely to be due to confounding variables such as socioeconomic or immigration status. However, many bilingual populations do differ from monolinguals on these dimensions, and it is important to understand their development as well. Future studies will be needed to understand the extent to which our results generalize to bilinguals growing up in other contexts, and learning other language pairs.

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