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The absolute frequency of maternal input to bilingual and monolingual children

A first comparison

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This study examines the actual amount of maternal language input received by young bilingual versus matched monolingual children. All mothers had always addressed their children in Dutch. The bilingual children in addition heard French from other caregivers since they were born. Analyses are based on video recordings of mother-child interaction when children were 13 and 20 months old. There was considerable interindividual variation amongst mothers in how much they talked with their children, regardless of whether mothers were part of a bilingual family or not. Based on analyses of 13 measures of input frequency, no differences emerged in the quantity of language input between mothers in bilingual and monolingual families. A number of bilingual children heard more Dutch from their mothers than children in monolingual families did. This study, likely the first to compare mothers in matched bilingual and monolingual families and to empirically compare maternal input, thus finds no evidence of reduced (maternal) language input for bilingual children. Instead, the absolute amount of maternal language input varied considerably for both bilingual and monolingual children. The study of this variation holds great potential for a better understanding of the underpinnings of bilingual children's language development.

1. Introduction

Young children find themselves in a variety of bilingual input settings. This chapter focuses on children who have heard two languages from birth, and are thus experiencing bilingual first language acquisition (BFLA; De Houwer 1990; Meisel 1989). Their family is bilingual by virtue of the fact that two languages are regularly used in the home.

Language input in bilingual families has many faces (see, for example, De Houwer 2009). For instance, different bilingual families use different language patterns in terms of who speaks what language to children, different proportions of mixed utterances combining words from both languages, discourse patterns fostering early bilingual usage to a lesser or greater extent, and different proportions of typically second language forms such as accented speech and grammatical transfer from a first language. Like monolingual families, bilingual families show variability in the way they respond to children, in the degree to which they use features typical of child-directed speech, and in their lexical choices. The study reported here considers yet another input variable, namely input frequency.

Input frequency in bilingual family settings can be approached from two basic perspectives: (1) the perspective of absolute input frequency, focusing on the actual quantity of occurrence of overall talk or particular forms in each of a bilingual child's two input languages, and (2) the perspective of relative input frequency, focusing on the proportional occurrence of overall talk or particular forms in one language compared to the other (see also Grüter, Hurtado, Marchman & Fernald, this volume).

The first systematic studies to focus on input frequency in early BFLA, published in the same year, covered both these perspectives: De Houwer (1997) investigated the number of lexical verb forms expressing anteriority in the language input to a Dutch-English-learning child, and Pearson, Fernández, Lewedeg, and Oller (1997) presented data on the relative proportions with which Spanish-English-learning children heard each language. Both studies showed correlations between the quantitative input measures and bilingual acquisition: De Houwer (1997) demonstrated that child use of Dutch past verbs was correlated with their distribution in the Dutch input, while child use of English past verbs was correlated with their distribution in the English input, and Pearson et al. (1997) found that children produced more words in the language they heard most often.

Other studies since De Houwer (1997) have found evidence for links between the absolute input frequency of particular forms in each of bilingual children's languages and child language measures. Paradis and Navarro (2003) suggested that the frequency with which parents modelled the use of Spanish overt subjects influenced their use by a Spanish-English BFLA child. Rieckborn (2006) found correlations between the number of different German past verb forms in the actual input and their distribution in a German-French BFLA child's use of German. Furthermore, differences in the absolute input frequency of French and German future verbs accounted for three BFLA children's earlier use of particular forms in French versus German and the distribution of future verbs in each of their languages (Rieckborn 2006). Different token frequency patterns of Spanish and English copula forms in the adult input to a BFLA child were

reflected in the child's use of copula forms in each language (Silva-Corvalán & Montanari 2008).

The case studies listed here relied on transcript-based counts of the token frequency of particular forms in speech addressed to BFLA children. In contrast, Pearson et al.'s (1997) group study on relative input quantity relied on parental estimates of the proportion of time that BFLA children spent with speakers of each language. (Mixed language input was not considered.)

Following Pearson et al. (1997), later studies also report relative input frequency effects on BFLA children's vocabulary. Two case studies attributed BFLA children's greater production of word types in one language to their hearing that language more frequently (Chan & Nicoladis 2010; Petitto & Kovelman 2003). In the second group study of Spanish-English BFLA toddlers designed to assess links between relative amount of exposure and vocabulary size, Marchman, Fernald, and Hurtado (2010) found that children who heard more Spanish than English had higher Spanish production vocabularies. In yet another group study of Spanish-English BFLA toddlers, Hoff et al. (2012) showed that children whose proportion of English input was higher said more English words than children with a lower proportion of English input; the same was, *mutatis mutandis*, true for Spanish (see also Hoff, Welsh, Place, and Ribot, this volume). Thus, Hoff et al. (2012) compared a relative input measure with absolute measures of vocabulary. Based on within-child analyses investigating links between relative amount of input to Spanish and English on the one hand and the ratio of Spanish to English words known by a group of young Spanish-English BFLA children, Hurtado, Grüter, Marchman, and Fernald (2014) found that children who heard more Spanish had larger Spanish than English vocabularies, and children who heard more English also had larger English than Spanish vocabularies, confirming the findings of Pearson et al. (1997), who also used a proportional measure for vocabulary size (see Grüter et al., this volume, for further discussion).

Going beyond measures involving the lexicon, Hoff et al. (2012, this volume) found an effect of relative input frequency on the rate of BFLA children's early grammatical development in each language: At the group level, children with 70% or more input in a particular language developed faster in that language than children with more balanced exposure. Case studies of BFLA children suggest that the proportion of exposure to each language also affects individual children's comparative rate of grammatical development in each language. Bonnesen (2009) and Schlyter (1993) found slower grammatical development in the language that BFLA children were exposed to less frequently, and De Houwer (1990) found a similar rate of grammatical development across both languages for a BFLA child who heard each language about equally (see also Elin Thordardottir, this volume,

Paradis, Tremblay, and Crago, this volume, and Unsworth, this volume, for input effects on grammatical development).

Findings from studies linking relative amounts of input to BFLA children's language development are often cited as showing that the actual amount of input in each language affects early bilingual development. However, this conclusion is premature, since none of the studies concerned provides information on the absolute amount of input in either language. Rather, quantity of input is presented as an estimated percentage of an unspecified time that children hear each language.[1]

It is well-known that the amount of time people spend with children does not necessarily correspond with the absolute amount of speech that children hear within that time period (Hart & Risley 1995). The reason is that individual speaking rates vary widely. As Hart and Risley (1995, p. 132) documented for English-speaking monolinguals, some adults interacting with children used a low average speaking rate of around 620 words per hour, whereas other adults used an average speaking rate that was more than 3 times as high (2,150 words per hour). Adults' different speaking rates correlated with the average number of different words produced by the 3-year-olds they interacted with (Hart & Risley 1995). Adults may thus be spending similar amounts of time with children but some adults will be speaking much more than others, and it is the cumulative absolute amount of input speech that affects child language development. The implication for bilingual settings is that simply knowing the proportion of time that children spend with people who speak each language is not adequately informative. Information on actual amounts of speech addressed to bilingual children is required (see also De Houwer 2009, 2011, and Grüter et al., this volume).

It is often assumed that bilingual children receive less input in *each* of their languages than monolingual children receive in theirs (e.g. Genesee 2010; Montrul 2008). Given the substantial variation in the input in monolingual settings (Hart & Risley 1995), and assuming that such variation is present amongst language input providers in bilingual settings as well, there would appear to be no *a priori* reason for assuming that a bilingual child's input in a particular language is necessarily less than the input a monolingual child receives in that language. In fact, it is theoretically possible for a bilingual child's amount of language input in one of his or her languages to equal or surpass that received by a monolingual child (De Houwer 2009, p. 120). For instance, if we take the medium average speaking rate of 1,250 words per hour that Hart and Risley (1995) found for monolingual English-speaking adults in families with children, we may find an Arabic-English

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1.   Mixed utterances are not usually part of this equation, although these may also be used in conversations with bilingual children.

bilingual family in which the average speaking rate is also 1,250 words per hour for English, with an additional average speaking rate for Arabic of, say, 1,000 words per hour (the total being 2,250 words per hour, slightly higher than the total average found by Hart and Risley). English input in this bilingual family would be the same as in some monolingual families. Monolingual speech rates of, for instance, 1,000 English words per hour would be surpassed by the hypothetical Arabic-English bilingual family.

To date, very few studies have offered quantitative data on the absolute amount of speech addressed to bilingual children. To my knowledge, Van de Weijer's (2000, 2002) study of German and Dutch input to two children in the same bilingual family is the first to have done so (however, this study was not directly focused on bilingual aspects). Based on measures of nearly all the input to these BFLA children (within a 3-month period), Van de Weijer (2002) showed that on average they each heard a total of 2,990 words per hour. This amount is 39% greater than the highest average speaking rate reported by Hart and Risley (1995) for input to monolingual children.

Oller (2010) also presented transcript-based measures relating to the absolute amount of input in BFLA. Using the LENA[TM] system (see also Grüter et al., this volume), he recorded home interactions in his daughter's presence throughout her second year of life. Oller and his wife had addressed their daughter in German from birth, whereas amongst each other they spoke English. Thus the child had heard German and English from birth. The child also had a part-time Spanish-speaking governess. The main finding from this study was that Oller's daughter produced the fewest words in the language that she was mainly overhearing (English). German was by far the child's most frequently used language and was also used most frequently in speech addressed to her.

Allen (2007) presented analyses based on a total of 24,755 utterances collected through recordings of adult-child conversations in 5 bilingual families using Inuktitut and English. In all families, children produced relatively more English than their caregivers (Allen 2007, p. 520). As can be seen from Tables 2 and 3 in Allen (2007), in one case (family AI) the child even used relatively more English although adult input consisted of relatively more Inuktitut. (These findings do not invalidate links between relative amount of input and the proportion of word types that children use in each language, given that the Allen data were not lexical data but concerned the number of utterances as used by adults and children).

A comparison of the total number of recorded caregiver and child utterances as presented in Tables 2 and 3 in Allen (2007) shows that bilingual children who heard more adult utterances overall talked more themselves (see also De Houwer 2009, p. 124), thus confirming monolingual findings (Hart & Risley 1995).

De Houwer (2011) transformed the percentages in Tables 2 and 3 from Allen (2007) into absolute frequencies of use for English and Inuktitut separately. Children who heard more Inuktitut than others spoke more Inuktitut than others, and the same was true within English. However, it should be noted that the number of hours recorded was not identical for all adult-child dyads.

After correcting for the amount of time that was recorded, comparisons of the input information from Allen (2007) in relative terms (the proportions with which each language was used in the transcripts) and in absolute terms (the actual numbers of utterances per hour) gives rise to several observations (see Table 1).

Table 1. Absolute and relative frequencies of adult caregiver utterances addressed to children in English and Inuktitut in 5 families (based on Tables 2 and 3 in Allen 2007, and on information about total number of hours of data per child provided by Shanley Allen, personal communication)

Family	English		Inuktitut	
	absolute	relative (%)	absolute	relative (%)
SR	336/hr	72.7	109/hr	23.6
PN	242/hr	50.9	197/hr	41.5
AI	203/hr	39.7	267/hr	52.3
SA	109/hr	20.9	379/hr	72.4
AW	75/hr	13.3	474/hr	84.6

Note. Relative frequencies do not add up to 100% because mixed utterances were not counted here.

First, families differed extensively from each other with regard to the total number of utterances they addressed to children in each language per hour (for English the range was 75 to 336 utterances per hour; for Inuktitut the range was even larger: 109 to 474 utterances per hour). This large variability accords with monolingual findings.

Second, similarities in the proportional use of each language can mask large differences in absolute terms: The caregivers in families AW and SA spoke much more Inuktitut than English to the children (84.6% and 72.4% Inuktitut use, respectively). Following Hoff et al.'s (2012) approach, in any group analyses (and assuming these patterns of use were regular) one might group these families together as being "Inuktitut-dominant" (relative exposure in one language of more than 70%). Considering these families as very similar in terms of input, however, would not be appropriate, since the actual number of Inuktitut utterances addressed to children was nearly 25% higher in family AW (474 utterances per hour) than in family

SA (379 utterances per hour). Another example comes from two other families, AI and PN, with similar proportions of use of Inuktitut, and where this use was closer to a balanced use with English (52.3% and 41.5%, respectively). Again, these fairly similar proportions mask substantial differences in the actual number of Inuktitut utterances, which was nearly 36% greater for family AI (267 utterances per hour) than for family PN (197 utterances per hour).

These observations demonstrate that having information on the actual number of input utterances used in BFLA settings can yield a different picture compared to the proportional figures. The present study aims to contribute information on the absolute quantity of input that BFLA children hear. In addition, this study aims to investigate the extent to which this quantity differs from input addressed to monolingual children. I examine and compare various frequency measures of maternal input to children who differed only in the number of languages they were exposed to: One group of children heard two languages from birth whereas the other group heard only one. Because only one monolingual comparison group was available (with mothers addressing their children exclusively in Dutch), and in order to avoid introducing another variable (the actual language addressed to children), the bilingual data are focused on just Dutch as well.

2.   Method

2.1   Participants

The participants were 46 middle- to upper middle SES mothers living in Belgium. The children that the mothers interacted with in this study were their firstborn child, and all mothers had carried their children to full term. Children were born without any health problems. When children were 13 months of age, they had no siblings. By the time children were 20 months of age, 7 mothers had had another baby. All mothers and children lived with the children's biological fathers, except that one of the fathers (in the monolingual group; see below) had moved out of the child's home by the time the child was 20 months old. All mothers were the children's main, most regular, and most constant caregiver, even though many mothers were working outside the home.

According to maternal report, all mothers had spoken mostly or solely Dutch to their children since they were born. Sixteen of the children's fathers had always spoken mostly or solely French to their children. Thus, 16 of the mothers had become part of a bilingual family upon their child's birth. The remaining 30 mothers were living in an entirely monolingual Dutch-speaking family. Mothers in both groups reported that they understood at least Dutch, French and English and were

conversant in two or more languages. As such, mothers were typical of educated Belgian adults, especially in the officially Dutch-speaking region of Flanders, where most mothers were living at the time of data collection.

Children were participants only in the sense that characteristics of maternal speech directed at them in dyadic interactions are reported on. Data were collected at the child ages of 13 and 20 months. The children of the 16 mothers in the bilingual group had heard both Dutch and French every day from birth until at least 20 months. Children of mothers in the monolingual group had heard mainly Dutch from birth.

Mothers and children in the bilingual and monolingual groups were matched on sociodemographic characteristics (Table 2).

Table 2. Demographic characteristics

	Bilingual N = 16		Monolingual N = 30		
	M	*SD*	*M*	*SD*	*t*
Child					
Age (months; 1st visit)	13.23	.30	13.24	.55	.03
Age (months; 2nd visit)	19.97	.21	20.02	.23	.45
Gender (% female)[a]	43.75		53.33		.38
Mother					
Age (years)	32.31	4.94	30.08	2.32	−1.71
Education[b]	5.25	.68	5.56	.85	1.22
Weekly hours of employment	32.53	10.90	33.39	11.93	.23

[a] Statistic reported is a χ^2.
[b] Measured on the 7-point Hollingshead (1975) scale. A score of 5 corresponds to partial college or specialized post-secondary training.

2.2   Instruments and procedures

At child ages 13 and 20 months, a researcher visited families' homes and made audio-video recordings of mother-child dyadic interactions in families' living rooms. Prior to recording, the researcher briefly spoke to the child's mother for instructional purposes but never addressed the child and did not speak once recording commenced.

At each visit, the researcher brought the same set of age appropriate toys and wordless books. These were made available to child and mother just prior to recording. All other toys and books were hidden from view. At the 13-month visit, mothers played with their children for 15 minutes. At the 20-month visit, mothers played with their children for 10 minutes. Recordings were also made of

mothers feeding their children. At child age 13 months, these mealtime sessions were 15 minutes long; at child age 20 months, they took up to 10 minutes.

For transcription, 5 consecutive minutes for each play and mealtime session were selected, so that a total of 10 minutes was transcribed at each age level. However, transcripts for the play and mealtime sessions were kept separate. Transcription started at the point where mother and child were fully engaged with each other and had "settled" into their activity; for instance, for the mealtime sessions transcription started after mother had finished setting out food and utensils and had actually started to feed her child.

Transcription followed the CHAT format (MacWhinney 2000). Maternal utterances were transcribed orthographically. Two transcribers independently transcribed all the material. On a total of 13,461 maternal Dutch utterances, there was disagreement for only a handful utterances. This was resolved in consultation with the author.

Each maternal utterance was manually coded for the number of words, morphemes and syllables. Each transcript was in addition coded for the number of turns. These codes were all checked by a second coder, who corrected them when necessary after discussion with the author. There were 4 coded transcripts per mother: two transcripts for the play sessions at 13 and 20 months, and two transcripts for the mealtime sessions at 13 and 20 months, yielding a total of 184 coded transcripts (4 transcripts for each of 46 mothers). Using the CLAN software (MacWhinney 2000), each transcript was separately analyzed for the number of turns (1), utterances (2), word types (3), word tokens (4), morphemes (5), and syllables (6). In addition, the following frequency measures were calculated:

–   Utterance level: the average number of utterances per turn (7);
–   Word level: the average number of words per utterance (8), and the highest number of words per utterance (9);
–   Morpheme level: the average number of morphemes per utterance (MLU) (10) and the highest number of morphemes per utterance (11);
–   Syllable level: the average number of syllables per utterance (12) and the highest number of syllables per utterance (13).

For each of the 184 transcripts, there were thus 13 measures of input frequency.

3.   Results

The 13 different measures of maternal input frequency that were coded for each of 4 transcripts of dyadic mother-child interaction yielded a total of 52 measures per mother-child dyad. Resources (personnel, reporting space) were not sufficient to compare these 4×13 measures across the bilingual and monolingual groups. Hence a selection needed to be made.

Rather than compare all 13 measures for each of the 4 transcripts separately (4 × 13 bilingual-monolingual comparisons) and/or grouped according to age (2 × 13 additional bilingual-monolingual comparisons), this chapter presents an analysis of each of the 13 measures just once, spread out over the 4 types of transcripts (play sessions at 13 and 20 months, and mealtime sessions at 13 and 20 months, each representing 5 minutes' interaction in real time), and over transcripts combining play and mealtime sessions for a particular child age (10 minutes in total). Play and mealtime contexts were kept separate for some analyses since different contexts often give rise to different language use (Cazden 1970; Bornstein, Tamis-LeMonda & Haynes 1999).

At 13 months, 7 measures were analyzed; at 20 months, the remaining 6 measures were considered. Types of measures were balanced across transcripts, ensuring that not all syllable measures would be investigated only at 13 months, for instance. Besides this criterion, the choice of which measure to investigate for what context at what age was random. The distribution of the analyses is shown in Table 3. A selected measure was analyzed for all mothers. Thus, for instance, all mothers were compared for the number of turns during mealtimes when their child was 20 months old. Each of the 13 measures was analyzed for just a single age, with contexts kept separate for 8 measures.

Table 3. Distribution of the input frequency measures over the various transcripts

13 months

mealtime: number of utterances, highest number of morphemes per utterance

play: average number of words per utterance, number of word tokens

mealtime and play combined (all): number of word types, highest number of syllables per utterance, number of morphemes

20 months

mealtime: number of turns, average number of syllables per utterance

play: number of syllables, highest number of words per utterance

mealtime and play combined (all): average number of utterances per turn, average number of morphemes per utterance

In order to more deeply analyze possible bilingual-monolingual similarities or differences, a longitudinal comparison of the total number of maternal word tokens and utterances was conducted. Finally, data for the two ages were combined to see if there were any bilingual-monolingual differences in (1) the total number of maternal word tokens and utterances and in (2) the number of maternal utterances in the mealtime and the play sessions. The deepened focus on word tokens and utterances rather than on any of the other 13 measures accords with the work of Hart and Risley (1995), a main inspiration for the present work.

3.1   13 month measures

First, Levene's F-tests were used to test for differences in the variance in the bilingual and monolingual groups because the *t*-test assumes that variance is homogeneous across groups and also because different variance in the groups may be indicative of different processes in both groups. For 6 of the 7 comparisons no differences in variance emerged, but in the play session the variance for the average number of words per utterance was higher in the bilingual group, $F(1,44) = 15.45$, $p < .001$. The degree of freedom for the ensuing *t*-test was adjusted accordingly. Because of multiple comparisons, Bonferroni correction reduced the alpha level for the *t*-tests to 0.007 (Table 4). No differences emerged between mothers in bilingual and monolingual families for any of the 7 variables investigated at 13 months.

Table 4. Input frequency measures (13 months)

	Bilingual M (SD)	Monolingual M (SD)
Utterances (mealtime)	68 (19)	66 (25)
range	24–97	13–103
statistical comparison	$t(44) = -.14, p = .89$	
Highest number of morphemes		
per utterance (mealtime)	12 (3)	14 (5)
range	7–18	7–27
statistical comparison	$t(44) = 1.38, p = .18$	
Average number of words		
per utterance (play)	2.37 (1.32)	2.96 (.41)
range	.00–4.33	2.23–3.91
statistical comparison	$t(16.59) = 1.73, p = .10$	
Number of word tokens (play)	145 (121)	181 (77)
range	0–481	3–306
statistical comparison	$t(44) = 1.21, p = .23$	
Word types (all)	157 (58)	183 (50)
range	55–269	58–263
statistical comparison	$t(44) = 1.63, p = .11$	
Highest number of syllables		
per utterance (all)	13 (3)	15 (5)
range	7–20	8–28
statistical comparison	$t(44) = .84, p = .41$	
Morphemes (all)	424 (203)	488 (163)
range	142–997	110–782
statistical comparison	$t(44) = 1.16, p = .25$	

The ranges and standard deviations showed extensive variation amongst mothers in each group for all measures (e.g. one mother in the monolingual group used 8 times as many utterances in the mealtime session compared to the most silent mother in that group; for both sessions combined, one mother in the bilingual group's total number of morphemes exceeded that of the least talkative mother in that group by a factor of 7).

3.2   20 month measures

As for the 13 month measures, Levene's F-tests were used to test for any difference in the variance in the bilingual and monolingual groups. No differences in variance emerged. Because of multiple comparisons, a Bonferroni adjustment reduced the alpha level for the *t*-tests to 0.008. There were no differences between mothers in bilingual and monolingual families on any of the 6 measures investigated at 20 months (Table 5). There was, however, extensive variation amongst mothers in each group for all measures (see the ranges and standard deviations in Table 5). For example, one mother in the bilingual family group used more than 4 times as many syllables in the play session compared to the most silent mother in that group; for both sessions combined, the number of word tokens used by one mother in the monolingual group exceeded that of the least talkative mother in that group by a factor of 6.3.

Table 5. Input frequency measures (20 months)

	Bilingual M (SD)	Monolingual M (SD)
Turns (mealtime)	55 (15)	51 (23)
range	27–75	3–90
statistical comparison	$t(44) = -.66, p = .51$	
Average number of syllables		
per utterance (mealtime)	4.28 (.96)	4.14 (.64)
range	2.70–6.15	2.79–6.00
statistical comparison	$t(44) = -.60, p = .55$	
Syllables (play)	406 (172)	374 (163)
range	204–892	49–652
statistical comparison	$t(44) = -.63, p = .54$	
Highest number of words		
per utterance (play)	10 (2)	11 (3)
range	6–14	6–18
statistical comparison	$t(44) = .91, p = .37$	

(*Continued*)

Table 5. (Continued)

	Bilingual *M* (*SD*)	Monolingual *M* (*SD*)
Average number of utterances		
per turn (all)	1.43 (.32)	1.41 (.22)
range	1.18–2.52	1.19–2.24
statistical comparison	$t(44) = -.25, p = .81$	
Average number of morphemes		
per utterance (all)	4.06 (.87)	4.00 (.46)
range	2.44–5.77	2.83–4.78
statistical comparison	$t(44) = .29, p = .77$	

3.3   13 and 20 months compared

Additional comparisons involved the number of word tokens and utterances that mothers produced at child ages 13 and 20 months (Table 6). No group differences emerged at either age.

Table 6. Numbers of word tokens and maternal utterances (13 and 20 months)

	Bilingual *M* (*SD*)	Monolingual *M* (*SD*)
Word tokens		
13 months	340 (155)	380 (128)
range	126–774	90–584
statistical comparison	$t(44) = 0.95, p = .35$	
20 months	565 (198)	510 (197)
range	235–1106	148–928
statistical comparison	$t(44) = 0.89, p = .38$	
Maternal utterances		
13 months	118 (46)	169 (30)
range	59–225	34–236
statistical comparison	$t(44) = 0.89, p = .38$	
20 months	169 (30)	158 (54)
range	127–234	47–259
statistical comparison	$t(44) = 0.74, p = .53$	

In both participant groups, word tokens at 13 months correlated with word tokens at 20 months (bilingual group: ρ = .87, $p \leq$ .01, two-tailed; monolingual group: ρ = .73, $p \leq$ .01, two-tailed). Yet, the number of word tokens used in each group was greater at 20 than at 13 months (bilingual group: $t(15)$ = 8.12, $p \leq$ .01; monolingual group: $t(29)$ = 5.51, $p \leq$ .01).

Similarly, in both participant groups, maternal utterances at 13 months correlated with the number of utterances at 20 months (bilingual group: ρ = .77, $p \leq$ .01, two-tailed; monolingual group: ρ = .75, $p \leq$ .01, two-tailed). Yet, the number of utterances used in each group was greater at 20 than at 13 months (bilingual group: $t(15)$ = 7.40, $p \leq$ .01; monolingual group: $t(29)$ = 4.99, $p \leq$ .01).

3.4   13 and 20 months combined

Comparisons were also undertaken for the two child ages combined (Table 7). Mothers in the bilingual and monolingual groups did not differ in the number of utterances or word tokens they used to address their children in the absence of others.

Table 7. 13 and 20 months combined (20 minutes in total)

	Bilingual M (SD)	Monolingual M (SD)
Utterances	287 (72)	290 (92)
range	205–459	81–459
statistical comparison	$t(44)$ = .10, p = .92	
Word tokens	905 (338)	891 (306)
range	438–1880	241–1469
statistical comparison	$t(44)$ = .14, p = .88	

Based on the number of word tokens mothers produced in both recordings combined, mothers' speaking rates were extrapolated into words per hour when they were alone with their children. On average, the 16 mothers in the bilingual families produced 2,715 Dutch words per hour (SD = 1,015, range = 1,314 – 5,640), and the 30 mothers in the monolingual families produced 2,673 Dutch words per hour (SD = 918, range = 723 – 4,407). These rates seem quite comparable. Further statistical evaluation was not carried out because the figures are extrapolations based on only 20 minutes of recordings.

3.5   Mealtime and play contexts compared

Finally, possible differences between maternal language use in the mealtime and play contexts were investigated based on the number of utterances (Table 8). In the

mealtime context the variance was larger in the monolingual group ($F(1,44) = 5.30$, $p = .03$), but no mean group differences were found as regards the number of utterances in each context for both ages combined.

Table 8. Number of utterances in the mealtime and play contexts

	Bilingual M (SD)	Monolingual M (SD)
Mealtime	140 (33)	134 (55)
range	64–197	36–223
statistical comparison	$t(43.03) = -.46, p = .65$	
Play	147 (53)	156 (53)
range	78–290	45–278
statistical comparison	$t(44) = .52, p = .60$	

4.   Discussion and conclusion

In a likely first effort to do so, this study investigated and compared the amount of maternal language input to children growing up bilingually and monolingually. Mothers and children in each group were demographically matched to the extent possible. Children differed only in the number of languages exposed to since birth. Mothers all spoke the same language to their children, namely Dutch.

Analysis of a wide variety of frequency measures based on dyadic mother-child interactions ranging from the number of syllables to the number of turns failed to show any bilingual-monolingual differences in the amount of maternal input. Rather, each measure exhibited considerable intra-group variation.

The extrapolated average maternal speech rate per hour was about a quarter higher for both groups than the average rate Hart and Risley (1995) found for upper middle class English-speaking adults (2,150). The average hourly speech rates were 2,715 and 2,673 words for the mothers in the bilingual and monolingual groups, respectively. These averages mask extensive variation amongst mothers (bilingual group: 1,314 – 5,640; monolingual group: 723 – 4,407). Three-quarters of the mothers had speech rates above the high-SES average in Hart and Risley's study, with no difference between groups (12/16 mothers in the bilingual group; 21/30 mothers in the bilingual group); two mothers (one in each group) even produced more than twice the hourly number of words compared to the Hart and Risley (1995) high-SES average (in both groups, some numbers close to Hart and Risley's numbers for low- and middle-SES parents were found, too). The

monolingual group had the lowest speech rate (723) and the bilingual group had the highest (5,640).

Because the data are based on just 20-minute recordings, comparisons with Hart and Risley's averages for a much larger database should be approached with caution. Importantly, though, hourly speech rates were equally high in both groups. Children in the bilingual families did not hear less Dutch from their mothers in dyadic interactions than the children in the monolingual families. Thus, there is no evidence of reduced (maternal) language input for the bilingual children in Dutch.

Within each group, mothers differed considerably from each other in terms of how much they talked. This finding, combined with the finding that there were no group differences in the absolute amounts of maternal speech to children, means that several children in the bilingual group heard a lot more Dutch from their mothers than some children in the monolingual group (and the other way round). Although obvious, this point needs to be explicitly stated, given that it is often assumed that compared to monolinguals, *all* bilingual children by default have reduced input in *each* of their languages (e.g. Hyams 1991; Sorace 2005). The claim that bilingual children overall hear *each* language much less frequently than monolingual children warrants precise empirical and unbiased investigation.

Studies investigating the role of the relative input in each language to bilingual children do not give information on the absolute amount of input in each language. This study's findings show that this actual input can differ dramatically from bilingual family to bilingual family: There was a large range of variation for all the input measures studied. Given the important role of variation in the absolute frequency of input for early child language development found in monolingual settings, these findings of variation in the absolute input frequency in bilingual families support the need to take into account this variation in bilingual acquisition settings as well, even though the labor-intensive nature of documenting actual amounts of input speech is a big methodological hurdle (see also Grüter et al., this volume).

Beyond analyzing the actual frequency of maternal input to young children, the current study also investigated stability and continuity in maternal input across time (Bornstein & Bornstein 2008). To this end, maternal word tokens and utterances at the child ages of 13 and 20 months were compared. As can be expected, mothers in both groups spoke more to children when children were older, thus showing discontinuity. According to an earlier re-analysis (De Houwer 2009, pp. 121–122) of some of the data on bilingual maternal input in Van de Weijer (2000, 2002), the mother in this family spoke to her toddler about twice as frequently as to her infant, thus suggesting more talk to an older than a younger child. This confirms findings for monolingual families (e.g. Bornstein et al. 1999; but see Song et al. 2012, who found that U.S.-based Mexican mothers, some of whom lived in bilingual families, actually spoke *less* with their children when they were older).

In spite of discontinuity, there was stability in the absolute amount of input over time. Within each group, mothers who used fewer words and utterances when their child was 13 months old also used fewer words and utterances, respectively, when their child was 20 months old. Although all mothers talked more when children were older, mothers who were more talkative at the younger age were also more talkative at the older age. The present study is likely the first to document this pattern for mothers in bilingual families and confirms earlier findings of stability for mothers in monolingual families (Bornstein et al. 1999). Given the cumulative nature of language input, stability is an important factor in yielding large inter-individual differences between absolute amounts of input over time. Extrapolations only make sense if there is stability, and the finding of maternal stability validates the extrapolations for maternal hourly speech rates made earlier. Additional data on the numbers of hours that mothers spent alone with their children between the child ages of 5 and 20 months are available for a portion of the mothers reported on in this study, as are observational data at the child age of 5 months. Future analyses of these data will make further extrapolations possible and will be able to yield more substantial information on the absolute amount of maternal input in dyadic interactions in both the bilingual and monolingual groups.

A final set of findings relates to relations between the language contexts in which mothers adddressed their children. These relations were very similar across the bilingual and monolingual groups. The average number of maternal utterances used in the mealtime and play contexts was the same for both ages combined. This is not to say that on the individual level, mothers were equally talkative in both contexts (analyses not shown due to lack of space). In fact, most mothers were not, and said more in one context than the other. At 20 months, most mothers said more in the play context than in the mealtime context. These findings validate the decision not to consider all measures of input frequency for both sessions combined (cf. Table 3), and show that in collecting input data, it is important to reflect on the contexts in which these are collected (see also Bornstein et al. 1999).

The language input considered here refers to maternal input in dyadic interactions only. This exclusive attention to maternal input follows the tradition in many language input studies relating to monolingual acquisition. Of course, mothers are not the only people to interact with children, but other data for somewhat older, lower middle-SES Dutch-speaking monolingual children growing up in the same society as the children reported on here showed that the main adult to regularly and continuously interact with a child, regardless of work status, continues to be the child's mother (De Houwer 2000). In the present study, mothers were the only individual to spend time with the same child every day. As such, mothers fulfilled a pivotal role in children's language input and development.

It can be expected that in conversations involving other participants than just mother and child, maternal attention is also directed towards other speakers, and maternal speech addressed to children may be less frequent. Due to the nature of the data available, focusing exclusively on mother-child dyadic interactions, an assessment of maternal speech rates in these different conversational contexts for the same participants as reported on here is not possible.

A further limitation is the fairly small number of Dutch-speaking mothers in the bilingual group for whom video recordings were available ($N = 16$). However, for most measures the ranges for the mothers in the bilingual group fell within the ranges for the larger group of mothers in the monolingual group.

Bilingual children's language input is divided over two languages. Yet the findings here on maternal input to young bilinguals strongly suggest that this fact does not necessarily imply a reduction in the absolute amount of input in *each* language compared to monolinguals. Instead, bilingual children have the same learning opportunities as monolingual children when the absolute frequency of just maternal language input in dyadic situations is considered. However, as the current study shows, there is substantial and notable variation in the maternal language input that children receive, regardless of whether they are growing up bilingually or monolingually. It is the large variability in this input frequency that needs to be addressed, rather than purported bilingual-monolingual group differences.

Variation in the absolute amount of input that children receive is a major explanatory factor in children's early language development (Hart & Risley 1995). It is likely to be similarly important for bilingual acquisition (De Houwer 2009, 2011; Grüter et al., this volume). Absolute amount of input is not only relevant for children growing up with a particular language from birth (be it one or two), but also for children learning a second language later on. Studies of the actual amount of input that young children receive, regardless of the number of languages they encounter, hold great promise for a better understanding of the language acquisition process.

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