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BRIEF REPORT

More than use it or lose it: The number-of-speakers effect on heritage language proficiency

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Abstract Acquiring a *heritage language* (HL), a minority language spoken primarily at home, is often a major step toward achieving bilingualism. Two studies examined factors that promote HL proficiency. Chinese–English and Spanish–English undergraduates and Hebrew–English children named pictures in both their languages, and they or their parents completed language history questionnaires. HL picture-naming ability correlated positively with the number of different HL speakers participants spoke to as children, independently of each language's frequency of use, and without negatively affecting English picture-naming ability. HL performance increased also when primary caregivers had lower English proficiency, with later English age of acquisition, and (in children) with increased age. These results suggest a prescription for increasing bilingual proficiency is regular interaction with multiple HL speakers. Responsible cognitive mechanisms could include greater variety of words used by different speakers, representational robustness from exposure to variations in form, or multiple retrieval cues, perhaps analogous to contextual diversity effects.

Keywords Picture naming · Bilingual · Heritage language · Contextual diversity · Social network

A question of great interest in personal, political and educational settings concerns how to best help children acquire language, and often more than one language, including both a language spoken by the community and a heritage language (HL) spoken by parents in the home. Numerous papers and books have been written on this topic (Cenoz & Gorter, 2009). Several factors have been identified as important for increasing and maintaining HL proficiency. These include pragmatic (Edwards, 1997), sociolinguistic (De Houwer, 2009; Pearson, 2008; Wei, 1994), socioeconomic and educational (Baker, 2006), processing efficiency (Hurtado, Grüter, Marchman, & Fernald, 2013), and frequency of HL use (Bedore et al., 2012; De Houwer, 2007; Gathercole & Thomas, 2009; Hakuta & D'Andrea, 1992; Tsai, Park, Liu, & Lau, 2012).

Relatively few research studies have addressed this question with objective proficiency measures in both languages. Instead, investigators often relied on self-ratings of language proficiency and tended to focus primarily on the HL, while assuming that the dominant language was more or less at ceiling or at such a high level of proficiency as to be of little interest as a topic of investigation. An advantage of this approach is that large numbers of participants can be studied. For example, De Houwer (2007) gathered questionnaire data from 1,899 families (3,677 parents and 4,556 children) and concluded that if both parents speak both languages in the home, the chance that the child will speak the HL increases dramatically, relative to if just one parent speaks the HL. The reason for this finding is not clear but could be at least in part due to frequency of HL versus English use,[1] which has been proposed as a major factor explaining bilingual language acquisition (as cited above) and bilingual disadvantages in lexical retrieval (Gollan, Montoya, Cera, & Sandoval, 2008; Gollan et al., 2011). Although De Houwer (2007) speculated that frequency of HL input might play a role, she also suggested that frequency alone is unlikely to explain the effect entirely.

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[1] Although input and output are likely to be correlated (i.e., children who hear an HL more often would likely also speak in the HL more often), dissociations are possible. We did not attempt to systematically investigate the precise relationship between input and output here. By "use," we refer specifically to input and leave open the possibility that output also plays a role.

Other work documents the importance of having access to a large "community of HL speakers" and reveals higher levels of HL proficiency in those who use the HL with many different HL-speaking people (Gathercole & Thomas, 2006; Hulsen, de Bot, & Weltens, 2002; Landry & Allard, 1992; Wang, 2012; Wei, 1994). Measurement is a challenge in testing this hypothesis, both in terms of quantifying the number of speakers and in determining which aspects of HL proficiency should be affected. In one study (Gibbons & Ramirez, 2004), HL proficiency in Spanish–English bilingual teenagers was tested with a number of complex measures, including a multiple-choice cloze test, a morphological completion test, and oral interviews. Several measures of the number-of-speakers variable were also included to distinguish between strong and more distant ties (e.g., grandparents, parents, siblings vs. school mates, teachers, family friends, neighbors) and factoring in quality of contact (importance and pleasantness ratings of the relationships). Correlations between these and proficiency measures tended to be small or modest but statistically robust and generally suggested that interaction with a diversity of HL speakers supports HL maintenance. However, it is difficult to identify the underlying cognitive mechanism in these results, given the considerable complexity of the measures used (both of language proficiency and of the social network size; similar results with a very small number of Korean–English bilingual children have reported elsewhere; Oh, 2003).

Having hypothesized that both frequency of HL use and the number of HL speakers influence HL proficiency, a question that follows is to what extent these effects are independent of each other, given that frequency of use of the HL likely increases with the size of the community of speakers. The present study was designed to address this question, while also asking whether these effects could be quantified with relatively simple measures including just one question to assess the number-of-speakers effect, one to assess frequency-of-use effects, and a brief picture naming test as the measure of HL knowledge. Given results reported in previous studies, we hypothesized that we might observe independent effects of both variables.

Experiment 1: Chinese–English and Spanish–English bilingual university students

Method

Participants

Thirty-six Mandarin-speaking Chinese–English and 32 Spanish–English bilinguals at the University of California, San Diego (UCSD) participated for course credit. Table 1 shows participant characteristics. All but 6 Chinese–English and 1 Spanish–English bilinguals named more pictures correctly in English than in their other language on the picture-naming test described below; the pattern of results remains as reported when these participants are excluded.

Materials and procedure

Bilinguals completed a language history questionnaire (developed by the authors at UCSD) and attempted to name 33 pictures from the Multilingual Naming Test, or MINT, including all even-itemed pictures between items 2 and 64 and the final picture in the test (skipping items 66 and 67, which correspond to a single picture of a *mortar and pestle*). The MINT was designed for speakers of English, Spanish, Mandarin, or Hebrew and any combination of these languages, and MINT scores have been shown to be significantly correlated with more complex language measures (i.e., oral proficiency interviews) in English, Spanish, and Chinese (Gollan, Weissberger, Rupnqvist, Montoya, & Cera, 2012; Sheng, Lu, & Gollan, 2014). Target names or alternative acceptable names were counted as correct and summed to obtain a total score. Half the participants were tested in English first and in their other language second, and the other half were tested in the other language first and in English second. Participants were given up to 3 s to name each picture.

Results

To address the primary goal of determining whether the number-of-speakers variable might explain unique variance in HL proficiency[2] above and beyond frequency of use of the HL, we began by entering participants' responses to two questions into a simultaneous regression with picture-naming scores in the HL as the dependent variable. The questions were (1) "When you were growing up (from birth through high school), how many different people did you regularly speak to only (or mostly) in Chinese or Spanish (regularly = had a conversation in that language at least once every two weeks)?" and (b) "When you were growing up please approximate the percentage of time during an average day that you used each language. These numbers should add up to 100%."

The variance explained by the model was $r^2 = .36$, and the total model was significant, $F(2, 64) = 17.93$, $MSE = .02$, $p < .01$. Confirming the independence of the two predictors, both the number-of-speakers variable, $\beta = .35$, $p < .01$, and frequency of English (vs. HL) use, $\beta = -.35$, $p < .01$, were

[2] For efficiency of exposition, we use the term "proficiency" in place of "ability to name pictures"; note that in previous work, we demonstrated robust correlations between MINT scores and HL proficiency in bilinguals of different language combinations ranging from children to elderly speakers (rs = .58–.79; all ps < .01; Gollan et al., 2012; Sheng, Lu, & Gollan, 2014).

Table 1 Characteristics of Chinese–English (n = 36) and Spanish–English (n = 32) bilingual heritage language (HL) speakers at the University of California, San Diego

	Chinese–English Bilinguals				Spanish–English Bilinguals			
	M	*SD*	Minimum	Maximum	*M*	*SD*	Minimum	Maximum
Age in years	19.9	1.4	18	23	20.8	1.8	16	25
Age of acquisition of English	4.2	3.0	0.0	12	2.5	2.2	0.0	6
Years of education	13.8	1.2	12	16	14.4	1.3	12	16
Self-rated spoken English proficiency[a]	6.3	1.0	3.5	7	6.4	1.2	2	7
Self-rated spoken HL proficiency[a]	5.9	1.3	1	7	5.5	1.5	1.5	7
Percentage of English use daily	77.1	24.4	30	100	81.1	12.6	60	100
Percentage of English use daily when growing up	51.3	20.8	5	90	59.4	17.0	20	99
Primary caregiver's ability to speak English[a]	3.8	1.6	1	7	4.2[d]	2.2	1	7
Primary caregiver's ability to speak HL[a]	7.0	0.2	6	7	6.8	0.8	3	7
Primary caregiver's years of education	16.7	2.2	12	21	12.0	3.9	4	21
Secondary caregiver's ability to speak English[a]	3.6[b]	1.7[b]	1[b]	7[b]	4.2[d]	2.2	1	7
Secondary caregiver's years of education	16.0	2.9	8	21	10.6	5.2	0	21
Secondary caregiver's ability to speak HL[a]	6.9[c]	0.4[c]	5[c]	7[c]	6.5[d]	1.4	1	7
Frequency of reading in HL[e]	4.6	1.5	1	6	4.6	0.7	3.3	6
Frequency of language switching when conversing with bilinguals[f]	2.9	1.2	1	5	3.0	1.4	1	5
Frequency of language switching when growing up[f]	2.8	1.3	1	5	3.1	1.2	1	5
How much (0%–100%) identify with culture of HL	64.0	23.2	10	100	66.5[d]	23.7	30	100
Number of people regularly spoke to in HL as a child[g]	5.8	2.8	1	9	5.5[d]	3.0	0	9
Number of people currently speak to regularly in HL[g]	3.7	2.7	0	9	3.1	2.5	0	9
Percentage of pictures named correctly in HL	72.3	19.1	27.3	100	61.4	16.3	27.3	90.9
Percentage of pictures named correctly in English	90.5	7.5	63.6	100	90.8	5.6	75.8	100

[a] 1 = *little to no knowledge*; 2 = *very poor*; 3 = *fair*; 4 = *functional*; 5 = *good*; 6 = *very good*; 7 = *like a native speaker*

[b] n = 35

[c] n = 34

[d] n = 31

[e] 1 = *more than 2 h per day*; 2 = *one-half to 2 h daily*; 3 = *weekly*; 4 = *monthly*; 5 = *rarely*; 6 = *almost never or never*

[f] 1 = *just once*; 2 = *occasionally*; 3 = *2–3 times in each conversation*; 4 = *several times in each conversation*; 5 = *a lot or sometimes constantly*

[g] How many different people did/do you regularly speak to only (or mostly) in Chinese or Spanish (regularly = had/have a conversation in that language at least once every 2 weeks)

significant. The same analyses done separately for each language group revealed a significant effect of the number of speakers variable, $\beta = .51$, $p < .01$, but not the frequency-of-English-use variable, $\beta = -.19$, $p = .24$, for Chinese–English bilinguals, whereas Spanish–English bilinguals exhibited the opposite pattern, a significant effect of the frequency-of-English-use variable, $\beta = -.44$, $p < .01$, but not of the number-of-speakers variable, $\beta = .24$, $p = .16$. The difference in relative importance of each of these predictors between language groups is difficult to interpret but could be vulnerable to cross-cultural variation in interpretation of questionnaire items (see the General Discussion section). We also conducted a stepwise regression analysis to assess the theoretically motivated possibility that number of speakers might affect HL picture naming above any effect of frequency of use. Entering frequency of English use first accounted for 26% of the variance in HL picture naming ($p < .01$); adding number of speakers significantly increased the variance accounted for to 36% ($p < .01$). Thus, the number-of-speakers variable accounted for unique variance in picture naming above any effect of frequency of use.

To further explore the relative strength of these predictors of HL proficiency, we next considered whether number of speakers and frequency predicted HL naming scores when considered together with all other possible predictors from the language history questionnaire. We began by considering responses to all questions that were significantly correlated with picture naming scores in the HL (with threshold for significance at $p \leq .01$). These are shown in Table 2. To reduce co-linearity among the possible predictors, we dropped the weaker predictor in any pair of variables that was correlated at $r = .6$ or higher. Obviously circular predictor variables were

Table 2 Pearson bivariate correlations between picture-naming ability in heritage language (HL) and English and language history questionnaire responses in University of California, San Diego undergraduates (n = 34–36 Chinese–English bilinguals; n = 31–32 Spanish–English bilinguals)

	Percentage of correct pictures named in HL	Percentage of correct pictures named in English	Age of acquisition of English	Self-rated ability to speak English	Self-rated ability to speak HL	**Percentage of current English use**	Percentage of English use when growing up	Number of people speak to regularly in HL when growing up	Number of people speak to regularly in HL now	Primary caregiver's ability to speak English	**Secondary caregiver's ability to speak English**
Percentage of correct pictures named in English	-0.23										
Age of acquisition of English	0.44**	-0.29*									
Self-rated ability to speak English	-0.35**	0.35**	-0.17								
Self-rated ability to speak HL	0.41**	-0.32**	0.36**	0.29*							
Percentage of current English use	-0.40**	0.40**	-0.20	0.47**	-0.37**						
Percentage of English use when growing up	-0.50**	0.46**	-0.32**	0.48**	-0.37**	**0.65****					
Number of people speak to regularly in HL when growing up	0.51**	-0.18	0.18	-0.32**	0.28*	-0.33**	-0.45**				
Number of people speak to regularly in HL now	0.38**	-0.16	0.24*	-0.40**	0.31**	-0.65**	-0.44**	0.50**			
Primary caregiver's ability to speak English	-0.53**	0.33**	-0.27*	0.22	-0.26*	0.15	0.29*	-0.10	-0.01		
Secondary caregiver's ability to speak English	-0.35**	0.22	-0.27*	0.22	-0.12	0.06	0.31**	-0.06	-0.02	**0.69****	
Current frequency of reading in HL[a]	0.50**	-0.47**	0.38**	-0.39**	0.42**	**-0.75****	**-0.61****	0.49**	0.54**	-0.23	-0.08

Note. Not included in the table: (1) less robust predictors of HL ability, including secondary caregiver's education level and ability to speak the HL and current degree of language switching (all rs $\leq .27$, ps $\geq .03$), and (2) nonsignificant predictors of HL ability: age, primary caregiver education level and ability to speak the HL, degree of language switching when growing up, and percentage of identify with HL culture (all rs $\leq .17$, ps $\geq .16$).

Variables shaded in gray included in regressions as predictors. Variables in bold excluded because of high correlation with other predictor variables. Self-rated proficiency not included because of circularity.

[a] Sign in this row reversed for ease of interpretation (see note "e" in Table 1; rating scale assigned lower values to more frequent reading)

also excluded (e.g., self-rated proficiency in the HL). This procedure left five variables (shown shaded in gray in Table 2), which we then entered into a simultaneous regression analysis with HL naming scores as the dependent variable. The variance explained by the model was $r^2 = .58$, and the total model was significant, $F(5, 60) = 16.41$, $MSE = .02$, $p < .01$. Results revealed significant effects of number of speakers during childhood, $\beta = .31$, $p < .01$, participants' ratings of their primary caregiver's proficiency level in speaking English, $\beta = -.40$, $p < .01$, and participants' reported age of acquisition of English, $\beta = .20$, $p = .03$. Surprisingly, frequency of English use in childhood did not explain unique variance, $\beta = -.14$, $p = .18$ (although frequency was significant when we included all of the same predictors except for the primary caregiver's English proficiency, $\beta = -.25$, $p = .03$). Number of speakers with which participants *currently* (rather than during childhood) speak in the HL also was not significant, $\beta = .11$, $p = .28$, likely reflecting the recent change for university students in HL use after moving away from home).

These results demonstrate independence of the number-of-speakers variable in predicting bilinguals' HL naming ability and even suggest that number of speakers may be more powerful than frequency of use for predicting HL proficiency. A possible weakness in the evidence reported here is that university students may be more accurate in remembering the number of HL speakers they interacted with as children than they are at estimating childhood frequency of HL use. Experiment 2 addressed this concern by testing Hebrew–English bilingual children for their current ability to name pictures in Hebrew and English, and their parents were surveyed on their current exposure to and use of Hebrew.

Experiment 2: Hebrew–English bilingual children

Method

Participants

Twenty-two Hebrew–English bilingual children enrolled in afterschool Hebrew language classes in San Diego participated. Table 3 shows participant characteristics and parent survey data. Four parents reported some use of Spanish at home; the pattern of results does not change when these participants are excluded.

Materials and procedure

Children attempted to name the same 33 pictures used in Experiment 1 first in Hebrew (the language dominant to the environment at the Hebrew school) and then in English. For each child, one parent completed an online survey on the child's language history.

Results

As in Experiment 1, we first asked whether number of speakers and frequency of use explained unique variance in predicting picture naming scores in the HL. The parent questionnaire administered to parents differed slightly from that used in Experiment 1. The number-of-speakers question was phrased as "How many different Hebrew speakers does your child speak to in (or mostly in) Hebrew on a regular basis (meaning they have a conversation in Hebrew at least once every two weeks)? Please count only people with whom your child actually converses (i.e., hearing YOU speak to other people does not count)." The decision to exclude overheard conversations in the children's surrounding environment was a conservative first step in the present study; additional work will be needed to determine how variation in speakers in the children's input versus output might or might not affect HL proficiency. The frequency-of-use variable was calculated by multiplying the answer to a question about weekday Hebrew exposure by five (for days of the week) and a weekend use question by two and adding these together. The questions were (1) "During week days how often is your child hearing Hebrew as the primary language being spoken in surrounding conversation?" and (2) the same as in (1), but with "weekends" instead of "week days." Response options for both questions were "0, 1, 2, 3, 4–5, 6–7, and 9 or more hours per day"; "4–5" responses were entered as 4.5, "6–7" as 6.5, and "9 or more" as 9.

The variance explained by the model was $r^2 = .33$, and total model was significant, $F(2, 19) = 4.76$, $MSE = .03$, $p < .01$. As in Experiment 1, the number-of-speakers variable was significant, $\beta = .41$, $p = .05$ (or $\beta = .48$, $p = .03$ when Spanish-exposed children were excluded), and the frequency- (i.e., total hours) of-Hebrew-use variable was not as robust, $\beta = .29$, $p = .16$ (or $\beta = .39$, $p = .07$ when Spanish-exposed children were excluded). Stepwise regression showed that frequency of Hebrew use when entered first accounted for 18% of Hebrew picture-naming variance ($p < .05$). Adding number of speakers significantly increased this to 33% ($p < .05$). Number of speakers thus accounted for unique variance above frequency-of-Hebrew-use effects.

Following the same procedures as in Experiment 1, we further explored other possible predictors from the parent survey (with significance threshold adjusted to $p \leq .05$ because of the smaller n). Correlations are shown in Table 4. This procedure revealed just one additional variable—age—that was independently associated with higher Hebrew-

Table 3 Characteristics of Hebrew–English bilingual children tested in Experiment 2 (n = 22)

	Hebrew–English Bilinguals			
	M	*SD*	Minimum	Maximum
Age in years	7.6	1.3	5.9	10.0
Age in months	90.5	15.1	70.8	120.0
Grade in School	2.2	1.3	1	5
Child's ability to speak English[a]	6.7	0.6	5	7
Child's ability to comprehend English[a]	6.8	0.4	6	7
Child's ability to speak Hebrew[a]	4.0	1.8	1	7
Child's ability to comprehend Hebrew[a]	5.1	1.4	2	7
Number of people child speaks to regularly in Hebrew[b]	3.5	2.5	0	8
Hours per week Hebrew is spoken[c]	39.3	25.5	0	63
Percentage of Hebrew spoken by adults at home[d]	58.9	27.2	25	100
Percentage of Hebrew spoken by child at home[d]	34.5	30.3	0	100
Frequency of visits to Israel[e]	2.8	1.3	0	4
Frequency of reading in Hebrew over past summer[f]	1.1	1.1	0	3
Percentage of pictures named correctly in Hebrew	27.8	21.3	3.0	78.8
Percentage of pictures named correctly in English	74.5	8.7	60.6	90.9

[a] Parent-rated proficiency scale: 1 = *almost none*; 2 = *very poor*; 3 = *fair*; 4 = *functional*; 5 = *good*; 6 = *very good*; 7 = *like a native speaker*

[b] How many different adult and child Hebrew speakers does your child speak to in (or mostly in) Hebrew on a regular basis (meaning they have a conversation in Hebrew at least once every 2 weeks)

[c] How often is your child hearing Hebrew as the primary language being spoken in surrounding conversation? Calculated as the sum of reported daily hours multiplied by 5 and weekend hours multiplied by 2 (4–5 entered as 4.5; 6–8 entered as 7; maximum per day entered as 9 h)

[d] English only = 0%; mostly English, some Hebrew = 25%; equal parts English and Hebrew = 50%; mostly Hebrew, some English = 75%; Hebrew only = 100%

[e] How often do you go to Israel? 0 = *never*; 1 = *once in a while*; 2 = *every few years*; 3 = *every other year*; 4 = *every year*

[f] Over this past summer, did your child practice reading in Hebrew? 0 = *not at all*; 1 = *a little*; 2 = *about once per week*; 3 = *between 2 and 4 times per week*; 4 = 5 or more times per week

naming scores. With all three predictors entered into a simultaneous regression, the variance explained was r^2 = .49, and total model was significant, $F(3, 18) = 5.78$, MSE = .03, p = .01. The number-of-speakers variable remained significant, β = .38, p = .05, the hours-of-Hebrew-use variable was still not robust, β = .25, p = .17, and an independent contribution of the children's age was found, β = .40, p = .03.

Discussion

These results confirm that picture-naming ability in the HL is improved by interaction with a broad range of HL speakers and demonstrate this number-of-speakers effect in multiple bilingual groups (Chinese–English, Spanish–English, and Hebrew–English), using both retrospective self-report of frequency of HL use during childhood in university students and parent report of children's current HL use in their 6- to 10-year-old children's daily lives. Shown in Fig. 1, these results build on previously reported effects in demonstrating that it is possible to measure the number-of-speakers effect using a relatively simple method to quantify the size of the relevant HL-speaking social network, and with a simple and objective measure of HL performance—the ability to produce HL picture names. The relative simplicity of the measures used here narrows the range of possible underlying cognitive mechanisms for the observed number-of-speakers effect particularly in the dependent measure (i.e., picture naming), which is necessarily supported by fewer cognitive mechanisms than is production of connected speech in an oral proficiency interview (Gibbons & Ramirez, 2004).

The analyses reported here also suggest that number of speakers exerts an effect that is not a simple function of increased frequency of use. Even though these predictors were correlated (see Tables 2 and 4), the number-of-speakers effect was statistically independent of frequency of use. Some aspects of our data even seemed to suggest that the number-of-speakers variable might be more powerful than frequency of use for predicting HL picture-naming ability (e.g., total hours of Hebrew was marginally significant when competing with number of speakers for unique variance in a

Table 4 Pearson bivariate correlations between picture-naming ability in heritage language and English and parent history questionnaire responses in afternoon Hebrew school program ($n = 22$ Hebrew–English bilinguals)

	Percentage of correct pictures named in Hebrew	Percentage of correct pictures named in English	How often child speak Hebrew ats home	Child's spoken English proficiency	Child's spoken Hebrew proficiency	Number of people child speaks to regularly in Hebrew	Frequency of Hebrew reading summer prior to testing	Hours per week with Hebrew as primary language
Percentage of correct pictures named in English	0.09							
How often child speaks Hebrew at home	0.68**	-0.49*						
Child's spoken English proficiency	-0.36†	0.71**	-0.76**					
Child's spoken Hebrew proficiency	0.73**	-0.11	0.78**	-0.40†				
Number of people child speaks to regularly in Hebrew	0.51*	-0.11	0.63**	-0.42*	0.63			
Frequency of Hebrew reading summer prior to testing	0.62**	0.40†	0.14	0.04	0.30	0.18		
Hours per week with Hebrew as primary language	0.42*	-0.41†	0.60**	-0.44*	0.48*	0.32	0.07	
Age in years	0.47*	0.32	0.12	-0.14	0.30	0.11	0.37†	0.12

Note. Nonsignificant predictors not included in table include frequency of reading in Hebrew during the year, frequency of visits to Israel, generation of Hebrew speaker (all $rs \leq .27$, $ps \geq .36$). Variables shaded in gray included in regressions as predictors. Parent-rated proficiency, frequency of speaking Hebrew at home, and reading in Hebrew not included because of circularity (e.g., children who are speaking Hebrew frequently and can read in Hebrew are more proficient in Hebrew, but this does not reveal what factors led them to *be* proficient in Hebrew).

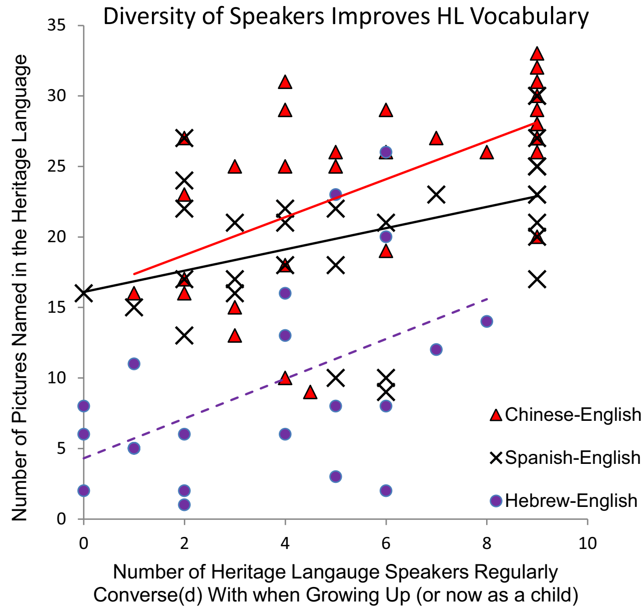

Fig. 1 The association between self-reported (in Experiment 1; for Chinese–English and Spanish–English bilinguals) and parent-reported (in Experiment 2; for Hebrew–English bilinguals) number of heritage language (HL) speakers regularly interacted with during childhood and current ability to name pictures in the HL

simultaneous regression in Experiment 2). However, further work is needed to determine how to most accurately elicit measures of the number-of-speakers and frequency-of-use variables (e.g., in Experiment 1, the measures was of global relative frequency throughout childhood, rather than absolute and current frequency of use, as in Experiment 2; additionally, frequency of use may be more difficult to report or remember retrospectively than number of speakers).

Finally, many factors that correlated positively with HL picture-naming performance correlated negatively with English picture-naming performance, suggesting a trade-off between HL and English proficiency (see Table 2, age of acquisition of English, frequency of English use, and the primary caregiver's knowledge of English). However, the number of speakers correlated positively with HL picture naming, while having no effect on English picture naming, in both college students and children. With standard concerns about interpreting null effects in mind, this could suggest that exposure to a larger number of HL speakers may be a way of improving HL proficiency without negatively affecting proficiency in the language dominant to the environment.[3] As

[3] A follow-up study with more than twice as many Hebrew–English bilingual children from the same population, and tested on the full MINT in both languages, confirmed the robust significant effect of the number-of-speakers variable on Hebrew and also demonstrated a small negative effect on English that was driven entirely by 3 Hebrew-dominant children with an extremely high reported number of Hebrew speakers in their environment (i.e., 16 HL speakers, which is nearly twice as many as the highest number reported here; see Table 3).

such, the number-of-speakers variable may be particularly important for supporting proficient bilingualism. Other variables that emerged as important for increasing HL proficiency in Experiment 1 were age of acquisition of English and the parent's proficiency level in English (see also Pearson, 2008, p, 141, on the importance of interaction with monolingual speakers of the HL), but such variables may be less easily controlled or changed than the size of the HL-speaking network (which could be purposely sought after and expanded).

A question for future investigation will be to determine the importance of distinguishing between actual use of the HL by children actively conversing with different HL speakers (as defined here), versus overhearing speech via exposure to different HL speakers in the surrounding environment, and to determine the cognitive mechanism(s) underlying the number-of-speakers effect on picture naming (as opposed to more complex measures in previous studies). This could include a few possibilities. Different speakers talk in different ways, and interaction with a variety of speakers will likely result in exposure to a broader variety of accents, speech rates, and syntactic structures and a larger number of HL words. Previous work has demonstrated a benefit to comprehension of speech with a foreign accent from exposure to multiple speakers with that same accent (Bradlow & Bent, 2008). The number-of-speakers effect resembles that effect, albeit in a different modality of response and processing level (single-word retrieval, instead of deciphering accented connected speech). Alternatively, using the HL with a greater number of speakers may lead to a greater diversity of contexts with which the HL words are associated. Contextual diversity leads to greater ease of retrieval in single-word recognition (and reading aloud) to a greater extent than does frequency of use (Adelman, Brown, & Quesada, 2006), and similarly, use of an HL in different places, with different people at different times of day, and in different locations may be more important to achieving proficient HL word production than the number of exposures to HL words. Additional influence may come from children's reluctance to rely on switches to English (which, in turn, would require them to make an effort to use only the HL) when conversing with HL speakers outside the home (because of lack of established social pacts on the extent to which switching is acceptable in these contexts). Broader implications of these results may be found if similar effects manifest in first- and second-language acquisition (in monolingual children and adults; for data on acquisition of English in HL-speaking children, see Place & Hoff, 2011; Hoff & Place, 2012); proficient word production in early stages of learning may benefit from diversity of speakers but then be influenced more by frequency of use as proficiency level increases. In all, this research suggests that acquiring and improving HL ability comes from more than what it takes to get to Carnegie Hall—practice, practice, practice. It comes also from gaining broad exposure to a diversity of HL speakers, an influence that may improve HL proficiency without any associated cost to dominant language proficiency. In a world where, more than ever, borders are crossed for living and working, proficiency and a diversity of experiences in the HL can foster the development of linguistic skills that maintain existing ties, while forging new ones.

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