J. Child Lang. **45** (2018), 498–510.
doi:10.1017/S0305000917000186

BRIEF RESEARCH REPORT

He said, she said: effects of bilingualism on cross-talker word recognition in infancy*

LEHER SINGH

National University of Singapore

(*Received* 29 *August* 2016 – *Revised* 6 *February* 2017 – *Accepted* 21 *April* 2017 – *First published online 30 May 2017*)

ABSTRACT

The purpose of the current study was to examine effects of bilingual language input on infant word segmentation and on talker generalization. In the present study, monolingually and bilingually exposed infants were compared on their abilities to recognize familiarized words in speech and to maintain generalizable representations of familiarized words. Words were first presented in the context of sentences to infants and then presented to infants in isolation during a test phase. During test, words were produced by a talker of the same gender and by a talker of the opposite gender. Results demonstrated that both bilingual and monolingual infants were able to recognize familiarized words to a comparable degree. Moreover, both bilingual and monolingual infants recognized words in spite of talker variation. Results demonstrated robust word recognition and talker generalization in monolingual and bilingual infants at 8 months of age.

INTRODUCTION

Most of the world is raised to speak more than one native language (Grosjean, 1989). This commonly invites a plethora of questions about how bilingual pathways to language may differ from that of monolinguals. Prior research suggests that bilingualism exerts early and potent influences on language and cognitive development, modifying native language processing as early as a few days after birth (Byers-Heinlein, Burns & Werker, 2010). Many questions remain, however, as to how bilinguals

[*] This research was supported by an HSS seed grant from the National University of Singapore to LS. We are very grateful to Felicia Poh for the recruitment and testing of participants. Address for correspondence: Leher Singh, Dept. of Psychology, AS 4, 03-40, National University of Singapore, 9 Arts Link, Singapore 117570. e-mail: psyls@nus.edu.sg

compare with monolinguals in their uptake of their native languages. A core question asked by parents, educators, and researchers is whether bilingual language development is equivalent in pace and productivity to monolingual development.

There are many differences between monolingual and bilingual environments that may motivate the prediction that monolingual and bilingual learners would demonstrate differences in their language learning trajectories (see Byers-Heinlein & Fennell, 2014, for a full articulation of these differences). For example, bilingual environments provide less single-language exposure than monolingual environments. They also incorporate greater phonological complexity on account of representing dual systems. Furthermore, bilinguals must discriminate their languages in order to avoid intrusion and confusion across languages. Finally, bilingualism introduces the potential for phonological conflict, as languages 'carve up' sound in different ways to specify meaning. A bilingual language environment therefore makes different provisions for and demands on young learners as they negotiate their native languages. Hypotheses predicting differences in the course of bilingual development are often predicted on the distinctiveness of the bilingual environment in relation to monolingual environments.

One might reason that the weight of demands on bilingual learners would delay or protract the course of language acquisition in bilingual children. It goes without saying that bilinguals do not receive a commensurate increase in waking hours, nor are they endowed at the outset with enhanced neurocognitive potential to offset the learning burden of mastering two languages. Does bilingual exposure limit single-language growth on account of reduced single-language exposure? One way in which this question has been answered has been by comparing vocabulary development in monolingual and bilingual children (see Lindsey, Manis & Bailey, 2003; Mahon & Crutchley, 2006; Oller & Eilers, 2002; Oller, Pearson & Cobo-Lewis, 2007; Pearson, Fernandez & Oller, 1993; Umbel, Pearson, Fernandez & Oller, 1992). The results of these investigations paint a complex picture. On the one hand, it is widely agreed upon that bilingualism does not introduce developmental risk for language delays or disorders (Paradis, 2010). Bilingual vocabulary development typically falls within the normal range of variation associated with monolingual children (e.g. Pearson *et al.*, 1993). On the other hand, there is an emerging consensus that bilingual children demonstrate slower single-language vocabulary growth than their monolingual peers (e.g. Bialystok & Feng, 2011; Bialystok, Luk, Peets & Yang, 2010; Hoff, Core, Place, Rumiche, Señor & Parra, 2012). However, when vocabulary growth is summed across both languages, bilinguals and monolinguals appear highly comparable to one another (Patterson, 2004; Pearson & Fernandez, 1994).

Moreover, when vocabulary is computed such that each referent for which a learner has a label in either language (conceptual vocabulary) and is compared across monolinguals and bilinguals, both groups exhibit similar conceptual vocabularies at 22 and 25 months. However, at 30 months, conceptual vocabularies appear to be lower in bilingual learners than single-language vocabulary in monolingual learners (Core, Hoff, Rumiche & Señor, 2013). In a recent study, Hoff and colleagues investigated vocabulary development at peak growth points in monolingual and bilingual children. As distinct from its predecessors, this study included a relatively large sample size and sampled from high and matched socioeconomic status (SES) populations (Hoff *et al.*, 2012). Hoff *et al.*, reported relative reductions in single-language vocabulary size and in the rate of vocabulary growth in bilingual children. Bilingualism exerted moderate to large effects on single-language vocabulary percentiles, suggesting that the growth of early word knowledge is influenced by bilingualism. It is possible that the origins of word knowledge in each language, are slower to emerge in bilingual infants. The purpose of the current study is to investigate one aspect of emergent word knowledge in monolingual and bilingual infants: spoken word recognition.

The ability to recognize the spoken word is essential to language development. Prior to linking sounds to meaning, all learners have to find the words. Due to the quasi-continuous nature of running speech, infants must carve up the speech stream into units corresponding to words. This ability – spoken word recognition – has been well documented in monolingual children. The ability to segment words from fluent speech predicts vocabulary size in early childhood (Cristia, Seidl, Junge, Soderstrom & Hagoort, 2014; Newman, Ratner, Jusczyk, Juszcyk & Dow, 2006; Singh, Reznick & Xuehua, 2012). In a seminal study conducted twenty years ago, Jusczyk and Aslin (1995) demonstrated the first laboratory evidence of word knowledge in monolingual infants. When conditioned to fixate on a visual stimulus accompanying repetitions of words, infants demonstrated a subsequent preference for sentences containing those words over those containing novel words. Likewise, when familiarized with passages, infants demonstrated a listening preference for words contained within those sentences relative to novel words.

Using variants of Jusczyk and Aslin's (1995) paradigm, several studies have demonstrated that the ability to track words in fluent speech is tractable between 7 and 8 months in monolingual infants (e.g. Altvater-Mackensen & Mani, 2013; Hohle & Weissenborn, 2003; Houston & Jusczyk, 2000; Kuijpers, Coolen, Houston & Cutler, 1998; Singh, 2008; Singh & Foong, 2012; Singh, Morgan & White, 2004; Singh, White & Morgan, 2008; van Heugten & Johnson, 2014; but see Bortfeld, Morgan, Golinkoff & Rathbun, 2005). The timing of word segmentation varies, however, based on factors such as native dialect exposure (see Nazzi, Mersad, Sundara, Iakimova & Polka, 2014), and certainly, word recognition at 7 to 8 months is not observed across all language communities and dialects (see Floccia *et al.*, 2016). Moreover, a limiting factor in early word segmentation is the presence of surface form variability. Although monolingual infants can recognize familiar words between 7 and 8 months, when words change in their surface forms (e.g. be it due to changes in pitch, affect, or talker gender), infants' abilities for spoken word recognition noticeably decline (Houston & Jusczyk, 2000; Singh *et al.*, 2004; Singh *et al.*, 2008). Although the capacity for basic word recognition and for generalization of familiarized words to novel forms both predict later vocabulary development (Singh *et al.*, 2012), the capacity for generalization is more closely tied to later vocabulary in monolingual infants (Singh *et al.*, 2012). Generalization is a crucial part of word recognition, as language environments do not offer the carefully engineered controls of the typical laboratory setting: words vary at each encounter from previous encounters due to changes in talker, changes in their emotional state, and placement of emphatic stress, amongst other factors. Furthermore, analyses of infant-directed speech suggest that surface form variability is possibly greater in speech to infants versus speech to adults (Fernald, Taeschner, Dunn, Papousek, de Boysson-Bardies & Fukui, 1989).

There have been a few prior investigations of word segmentation in bilingual infants; however, these studies have not assessed whether monolingual and bilingual infants differ in generalization across surface form variation. Polka and Sundara (2003) investigated word segmentation in French–English bilingual infants in each of their native languages. They found evidence that bilingual infants were able to recognize words across each language. Likewise, Singh and Foong (2012) demonstrated that Chinese–English bilingual infants were able to segment words across each of their languages. In a recent study, Polka, Orena, Sundara, and Worrall (2017) compared English–French bilingual, monolingual French, and monolingual English infants on their abilities to segment words in English and French. As expected, both groups of monolingual infants could segment words only in their native language. However, bilingual infants were only able to segment words in French, even though they were learning English as a native language as well. In a follow-up experiment, Polka *et al.,* demonstrated that when task demands were adapted so as to provide more exposure to English, bilingual infants successfully segmented words in English. In this instance, more exposure consisted of double the number of passages during familiarization, as well as double the number of word lists during the test phase. This study provides important insight into bilingual word segmentation. Specifically, bilingual infants appeared

https://doi.org/10.1017/S0305000917000186 Published online by Cambridge University Press

to require greater exposure to one of their languages (i.e. English) to segment words in that language in comparison to monolingual English infants.

While there have been no prior studies on effects of variability on speech processing in bilingual infants, there have been investigations of variability effects on bilingual visual categorization, which may inform predictions for the present study. In a study on visual feature generalization, Brito and Barr (2012, 2014) demonstrated that, as early as 6 months of age, bilingual infants demonstrated advantages in recognizing visual stimuli in spite of surface changes, an advantage also observed at 18 months. In a study of visual recognition memory, Singh *et al*. (2015) demonstrated that bilingual infants were more sensitive to differences in visual stimuli that cut across ontological categories (i.e. wolves versus bears). In combination with the findings of Brito and Barr (2012, 2014), this study suggests that bilingual infants demonstrate greater sensitivity to visual contrast, but also greater sensitivity to visual invariance that may enhance visual memory generalization. It remains to be seen whether such advantages in detecting stimulus invariance extend to speech perception, or whether bilingual infants demonstrate greater fragility in recognizing spoken words, which extends to generalization, a possibility invited by prior studies of word segmentation in bilingual infants (Polka *et al*., 2017).

In the present study, bilingual and monolingual infants were compared on their ability to recognize words in one of their languages when words matched between familiarization and test, and when words mismatched in talker gender. Talker gender has been shown to tax infants' abilities to recognize spoken words between 7 and 8 months (Houston & Jusczyk, 2000). As a consequence of this, infants were tested between 7 and 8 months. To investigate the effects of bilingualism on both processes, bilingual and monolingual infants were compared on basic word segmentation and word generalization.

METHODOLOGY

Participants

Forty 7- to 8-month-old infants (20 females and 20 males) were tested in the present study (mean age: 223 days; range: 212 to 243 days). Twenty infants were monolingual English exposed infants and twenty were bilingual English–Mandarin exposed infants (with at least 30% to one language). All infants were drawn from the Chinese community to maximize the probability that English accent exposure was similar across participants, in light of past research demonstrating strong sensitivities to accent in infants and toddlers (see Schmale, Hollich & Seidl, 2011; Schmale & Seidl, 2009). Mean exposure to each language for bilingual participants was 60% English, 40% Mandarin Chinese (range of English exposure: 47 to 74%).

Language exposure was computed by administration of the language exposure questionnaire (Bosch & Sebastián-Gallés, 1997). Thirteen additional infants were tested but excluded from the finaldata set for incomplete data due to fussiness (6) and inaccurate entries on the language exposure screen performed prior to testing (7).

Stimuli

Stimuli consisted of words and sentences that were identical in lexical–semantic content to those employed by Jusczyk and Aslin (1995). Words were 'bike', 'hat', cup', and 'feet'. For each word, fifteen tokens were used. Sentences were six simple sentences that contained target words in initial, medial, and final position in equal distribution. All sentences were drawn from Jusczyk and Aslin's study. Examples of sentences include: "His <u>bike</u> had big black wheels", "The <u>cup</u> was bright and shiny", "The <u>dog</u> ran around the yard", and "His <u>feet</u> get sore from standing all day". All of the stimuli were recorded by a bilingual English–Mandarin male and by a bilingual English–Mandarin female in infant-directed speech. Stimuli were matched for amplitude, duration, and speech rate. Visual stimuli consisted of a black and white checkerboard pattern on which random squares were colored in. The checkerboard pattern accompanied the auditory presentation of stimuli.

Procedure

The procedure was a single-screen adaptation of the Headturn Preference Procedure (HPP) guided by prior adaptations of the HPP to measure word segmentation (Altvater-Mackensen & Mani, 2013; Schreiner, Altvater-Mackensen & Mani, 2016). All infants were tested in a laboratory setting, seated on their parent's lap approximately 100 cm from a visual display. Parents wore headphones with masking music. Three cameras recorded the participant via closed-circuit TV, with the view from each camera observable from a neighboring experimental room where an experimenter administered the study. Auditory stimuli were presented over loudspeakers at approximately 70 db.

Each trial began with an attention getter (a flashing light with a ringing bell) to attract the infant's gaze to the screen. At the start of each trial, an experimenter ensured the infant was fixated on the screen to initiate a trial. The experiment was divided into an initial training phase followed by a test phase. During an initial training phase, infants were familiarized to passages containing two words (either 'bike' and 'hat', or 'cup' and 'feet'). Each trial consisted of one passage comprising six sentences. Passages were separated by 1 second of silence. Presentation of the passages continued for a maximum of 20 seconds or until the infant looked away for 2 seconds. There was a minimum fixation duration of 2 seconds to ensure that the target word could be heard even in final position for each trial. For half of the infants, passages were spoken by a male speaker, and for the other half of the infants, passages were spoken by a female speaker. We opted for a passages-to-words design for similar reasons to Polka *et al.* (2017), specifically, that this design may more closely approximate a child's natural environment. Passages alternated between trials. Familiarization continued until infants had accumulated 100 seconds of exposure. Following the familiarization phase, infants were presented with the test phase. During the test phase, they were presented with four words, each presented in repetitions of three trials. In each trial, fifteen tokens of each word were presented and separated by 1 second of silence. Trials were blocked so that each test block contained one trial of each of the four words in random order. During the test phase, one familiarized word was presented by a matched-gender speaker to familiarization and one was presented by a mismatched gender speaker. Control words were produced by a speaker that matched the familiarization phase. Fixation times were logged to the gender-matched familiarized word, to the gender-mismatched familiarized word, and to the two control words. Trials lasted until the infant looked away for 2 seconds or until the trial ended.

The nature of the design was such that the gender-mismatched trials were spoken in a distinct gender to all of the other test trial types. An alternative would have been to present each unfamiliar trial spoken by talkers of different genders. However, this would have led to a voice + word change in one unfamiliar trial and a word change in the other unfamiliar trial. Nevertheless, there exists the possibility that infants may demonstrate a novelty effect to the gender mismatch trial on account of a gender change. However, in results obtained in prior studies on talker generalization, specifically Houston and Jusczyk (2000), a visual comparison from data across experiments suggests that infants did not demonstrate an increase in attention to talker gender changes alone between training and test phases. Although we did not have cause to anticipate a novelty preference based on voice changes in the gender mismatched trials, we acknowledge that this aspect of our experimental design leaves open the possibility that voice changes may have elicited increased interest in the gender mismatched trial.

RESULTS

As in previous studies on infant spoken word recognition (e.g. Jusczyk & Aslin, 1995), fixation times to familiar words were compared to fixation times to unfamiliar words. As infants were familiarized with passages and tested on words, fixation to the visual target was compared for familiarized

https://doi.org/10.1017/S0305000917000186 Published online by Cambridge University Press

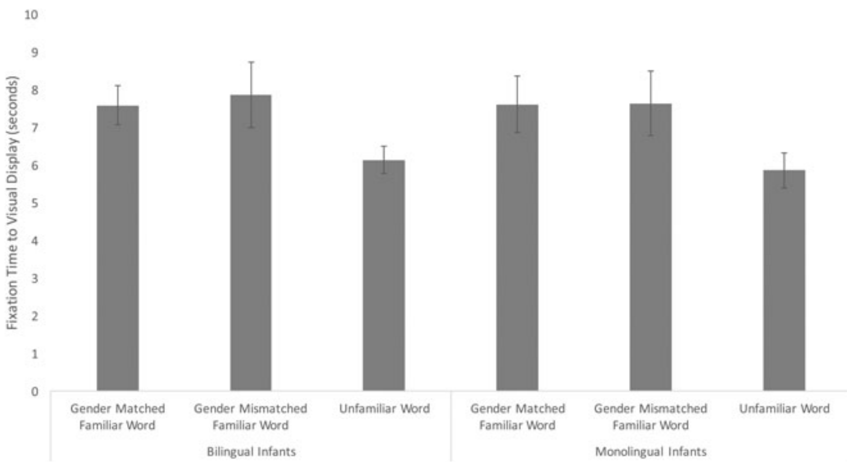

Fig. 1. Fixation times to gender-matched, gender-mismatched, and non-familiarized words (error bars reflect SEM).

(gender-matched and gender-mismatched) words and non-familiarized words. The dependent variable was fixation time to the visual stimulus when listening to words containing familiarized gender-matched, familiarized gender-mismatched, and non-familiarized words. Fixation durations did not differ significantly for the two control words ($p > \cdot 5$), so these words were averaged into a single value. Fixation durations above 2SD from the mean were excluded. Figure 1 depicts fixation times to the visual target for bilingual and monolingual infants respectively for gender-matched, gender-mismatched, and non-familiarized words.

An analysis of familiarization times was conducted to ensure that infants accrued exposure times to familiarization passages across groups, revealing no differences in total exposure times (monolinguals: 114·74 seconds; bilinguals: 114·92 seconds; $p > \cdot 8$). As half of the participants were familiarized with passages spoken by a female and half were familiarized with passages spoken by a male, an initial $3 \times 2 \times 2$ repeated-measures ANOVA was conducted with trial type (gender-matched/gender-mismatched/non-familiarized words), group (monolingual/bilingual), and gender of familiarization passages (male/female). As there were no effects or interactions with gender of familiarization passages ($p > \cdot 7$), subsequent analyses collapsed across the gender of familiarization passages. A 3×2 repeated-measures ANOVA was conducted with trial type (gender-matched/gender-mismatched/non-familiarized words) and group (bilingual/monolingual) as factors. The dependent variable was fixation times to test trials. Results revealed a main effect of trial type ($F(2,76) = 6 \cdot 44$, $p = \cdot 003$,

https://doi.org/10.1017/S0305000917000186 Published online by Cambridge University Press

partial eta-squared: ·15). Words spoken in both gender-matched and -mismatched trials were preferred relative to unfamiliar words. There was no interaction of trial type and group, nor was there any effect of group ($p > \cdot 8$).

Planned pairwise comparisons were conducted to examine evidence of word recognition within groups. In a comparison of fixation times to gender-matched words and non-familiarized words, both bilingual and monolingual infants demonstrated a significant increase in fixation to gender-matched words ($t(19) = 2{\cdot}84$, $p = \cdot 01$, and $t(19) = 2{\cdot}11$, $p = \cdot 05$, respectively), In comparing fixation times to gender-mismatched words and non-familiarized words, both monolingual and bilingual infants demonstrated an increase in fixation to gender-mismatched words ($t(19) = 2{\cdot}10$, $p = \cdot 05$, and $t(19) = 2{\cdot}26$, $p = \cdot 04$, respectively). Results demonstrated that both monolingual and bilingual infants were able to segment matched words from passages. Recognition scores were computed by subtracting fixation times during familiarized words (gender-matched) and non-familiarized words, and by subtracting familiarization times (gender-mismatched) and non-familiarized words. A comparison of recognition scores revealed no differences between monolingual and bilingual infants for gender-matched or -mismatched words ($p > \cdot 75$), suggesting that both groups of infants were equally successful at tracking familiarized words and maintaining generalizable memories for words.

DISCUSSION

The aim of this study was to explore two important linguistic processes in monolingual and bilingual infants: the ability to recognize spoken words, and the ability to generalize across dissimilar instances of words. Our study reveals three main findings. First, both groups of infants – monolingual and bilingual – were able to recognize words in English to which they had been exposed in equal measure in spite of having markedly different degrees of exposure to English. Second, both groups of infants – monolingual and bilingual – were able to generalize across words produced by talkers of different genders. Here, it should be noted that our generalization trials consisted of a novel voice, not introduced in familiarization trials. This introduces the possibility that infants may have exhibited a novelty preference for a new voice in the generalization trials, which merits further investigation. Third, there were no differences in the capacity for basic word recognition or in the capacity to generalize across dissimilar instances of words between monolingual and bilingual infants. These findings point to some similarities in word recognition and talker generalization in monolingual and bilingual infants.

When placed in the context of prior research on bilingual word segmentation, our findings contrast with those of Polka *et al.* (2017), who observed greater fragility in bilingual word segmentation in comparison to monolingual infants. In reconciling our findings with this study, we propose three explanations. First, our sample of bilinguals had between 47% and 74% exposure to English, the language in which they were tested, and as a result, the sample comprised near-balanced bilinguals and English-dominant bilinguals. In the sample reported by Polka *et al.*, there was a mix of English-dominant, French-dominant, and balanced bilinguals. It is therefore highly likely that our sample, on the whole, had greater exposure to English than the sample reported by Polka *et al.*, which may have reduced variance in our data attributable to differences in English exposure. Second, Polka *et al.,* observed a bilingual disadvantage in word segmentation only when English stimuli were reduced by half, such that infants were familiarized with one passage rather than two passages, and tested on two word lists rather than four. In a subsequent experiment, when the experimental set-up was modified to include greater exposure to English (commensurate with that of the present study), Polka *et al.,* reported similar results to monolingual peers. On account of this possible 'threshold effect' on bilingual word segmentation based on the amount of speech incorporated into the task, it is perhaps to be expected that we found comparable word segmentation in monolingual and bilingual infants. In our study, the precipitating conditions (i.e. halved exposure to the familiarization/test items) for a bilingual disadvantage were not present. Finally, our design used an adapted form of the Headturn Preference Procedure based on a study by Altvater-Mackensen and Mani (2013). It is possible that being absolved of an orienting response (i.e. a headturn) reduces task demands, facilitating performance for all infants. Additionally, one of the features of the current design is that the minimum amount of familiarization is greater than for the standard HPP (100 seconds versus 60 seconds). It is possible that increased exposure to speech during familiarization may facilitate segmentation abilities relative to the standard HPP.

One of the chief aims of our study was to examine the effects of bilingualism on the ability to generalize across encounters of a word. Our findings point to some similarities in talker generalization across monolingual and bilingual infants. A bilingual advantage may have been expected on the grounds that bilingual experience is associated with generalization across visual features (Brito & Barr, 2014). Moreover, bilingual children and adults demonstrate enhanced abilities to inhibit attention to task-irrelevant information and to filter out distracting cues, such as font color in the Stroop task (Bialystok, 2009). One might expect that this would lead to enhancement in filtering out surface form variation in speech perception, such as talker-specific details, selectively in bilinguals. This was not borne out by the present findings. It is possible that such advantages in generalization are domain-specific to visual stimuli in infancy. Alternatively, it is possible that an advantage may have been observed earlier in development when word segmentation is emergent, in traditional segmentation tasks, such as those using the conventional HPP, or in tasks that carry an additional requirement of mapping words onto referents (e.g. Rost & McMurray, 2009).

It should be noted that there are some differences in task demands between the current paradigm and prior paradigms used to measure spoken word recognition in infancy (e.g. Newman *et al.*, 2006; Singh *et al.*, 2012). In particular, previous links between generalization in word recognition and later language outcomes have focused on within-talker variability. It remains to be seen whether cross-talker variability in spoken word recognition predicts later vocabulary development as accurately as prior instantiations. Nevertheless, our study provides evidence for similarity in basic and more complex word segmentation tasks in bilingual and monolingual infants. This adds to an emerging narrative on early effects of bilingualism that aims to identify how bilingual and monolingual infants differ in their language development in infancy. The present study suggests that, with respect to the rudiments of early word knowledge – spoken word recognition and generalization – developmental processes may be quite similar in bilingual and monolingual infants.

REFERENCES

Altvater-Mackensen, N. & Mani, N. (2013). Word-form familiarity bootstraps infant speech segmentation. *Developmental Science* **16**, 980–90.

Bialystok, E. (2009). Bilingualism: the good, the bad, and the indifferent. *Bilingualism: Language and Cognition* **12**(1), 3–11.

Bialystok, E. & Feng, X. (2011). Language proficiency and its implications for monolingual and bilingual children. In A. Y. Durgunoglu & C. Goldenberg (eds), *Language and literacy development in bilingual settings*, 121–38. New York: Guilford Press.

Bialystok, E., Luk, G., Peets, K. F. & Yang, S. (2010). Receptive vocabulary differences in monolingual and bilingual children. *Bilingualism: Language and Cognition* **13**(4), 525–31.

Bortfeld, H., Morgan, J. L., Golinkoff, R. M. & Rathbun, K. (2005). Mommy and me: familiar names help launch babies into speech-stream segmentation. *Psychological Science* **16**(4), 298–304.

Bosch, L. & Sebastián-Gallés, N. (1997). Native-language recognition abilities in 4-month-old infants from monolingual and bilingual environments. *Cognition* **65**(1), 33–69.

Brito, N. & Barr, R. (2012). Influence of bilingualism on memory generalization during infancy. *Developmental Science* **15**(6), 812–6.

Brito, N. & Barr, R. (2014). Flexible memory retrieval in bilingual 6-month-old infants. *Developmental Psychobiology* **56**, 1156–63.

Byers-Heinlein, K., Burns, T. C. & Werker, J. F. (2010). The roots of bilingualism in newborns. *Psychological Science* **21**(3), 343–8.

Byers-Heinlein, K. & Fennell, C. T. (2014). Perceptual narrowing in the context of increased variation: insights from bilingual infants. *Developmental Psychobiology* **56**(2), 274–91.

Core, C., Hoff, E., Rumiche, R. & Señor, M. (2013) Total and conceptual vocabulary in Spanish–English bilinguals from 22 to 30 months: implications for assessment. *Journal of Speech, Language, and Hearing Research* **56**, 1637–49.

Cristia, A., Seidl, A., Junge, C., Soderstrom, M. & Hagoort, P. (2014). Predicting individual variation in language from infant speech perception measures. *Child Development* **85**(4), 1330–45.

Fernald, A., Taeschner, T., Dunn, J., Papousek, M., de Boysson-Bardies, B. & Fukui, I. (1989). A cross-language study of prosodic modifications in mothers' and fathers' speech to preverbal infants. *Journal of Child Language* **16**(3), 477–501.

Floccia, C., Keren-Portnoy, T., DePaolis, R., Duffy, H., Delle Luche, C., Durrant, S., White, L., Goslin, J. & Vihman, M. (2016). British English infants segment words only with exaggerated infant-directed speech stimuli. *Cognition* **148**, 1–9.

Grosjean, F. (1989). Neurolinguists, beware! The bilingual is not two monolinguals in one person. *Bilingualism and Neurolinguistics* **36**(1), 3–15.

Hoff, E., Core, C., Place, S., Rumiche, R., Señor, M. & Parra, M. (2012). Dual language exposure and early bilingual development. *Journal of Child Language* **39**(1), 1–27.

Hohle, B. & Weissenborn, J. (2003). German-learning infants' ability to detect unstressed closed-class elements in continuous speech. *Developmental Science* **6**(2), 122–7.

Houston, D. M. & Jusczyk, P. W. (2000). The role of talker-specific information in word segmentation by infants. *Journal of Experimental Psychology: Human Perception and Performance* **26**(5), 1570–82.

Jusczyk, P. W. & Aslin, R. N. (1995). Infants' detection of the sound patterns of words in fluent speech. *Cognitive Psychology* **29**(1), 1–23.

Kuijpers, C. T. L., Coolen, R., Houston, D. & Cutler, A. (1998). Using the head-turning technique to explore cross-linguistic performance differences. In C. Rovee-Collier, L. Lipsitt & H. Hayne (eds), *Advances in infancy research, 12*, 205–22. Stanford, CT: Ablex.

Lindsey, K. A., Manis, F. R. & Bailey, C. E. (2003). Prediction of first-grade reading in Spanish-speaking English-language learners. *Journal of Educational Psychology* **95**(3), 482–94.

Mahon, M. & Crutchley, A. (2006). Performance of typically-developing school-age children with English as an additional language on the British Picture Vocabulary Scales II. *Child Language Teaching and Therapy* **22**(3), 333–51.

Nazzi, T., Mersad, K., Sundara, M., Iakimova, G. & Polka, L. (2014). Early word segmentation in infants acquiring Parisian French: task-dependent and dialect-specific aspects. *Journal of Child Language* **41**(3), 600–33.

Newman, R., Bernstein Ratner, N., Jusczyk, A. M., Jusczyk, P. W. & Dow, K. A (2006). Infants' early ability to segment the conversational speech signal predicts later language development: a retrospective analysis. *Developmental Psychology* **42**(4), 643–55.

Oller, D. K. & Eilers, R. E. (Eds.) (2002). *Language and literacy in bilingual children, Vol. 2*. Bristol: Multilingual Matters.

Oller, D. K., Pearson, B. Z. & Cobo-Lewis, A. B. (2007). Profile effects in early bilingual language and literacy. *Applied Psycholinguistics* **28**(2), 191–230.

Paradis, J. (2010). The interface between bilingual development and specific language impairment. *Applied Psycholinguistics* **31**(2), 227–52.

Patterson, J. L. (2004). Comparing bilingual and monolingual toddlers' expressive vocabulary size: revisiting Rescorla and Achenbach (2002). *Journal of Speech, Language, and Hearing Research* **47**, 1213–5.

Pearson, B. Z. & Fernandez, S. C. (1994). Patterns of interaction in the lexical growth in two languages of bilingual infants and toddlers. *Language Learning* **44**(4), 617–53.

Pearson, B. Z., Fernandez, S. C. & Oller, D. K. (1993). Lexical development in bilingual infants and toddlers: comparison to monolingual norms. *Language Learning* **43**(1), 93–120.

Polka, L., Orena, A. J., Sundara, M. & Worrall, J. (2017). Segmenting words from fluent speech during infancy – challenges and opportunities in a bilingual context. *Developmental Science* **29**(1), online < doi:10.1111/desc.12419 > .
Polka, L. & Sundara, M. (2003). Word segmentation in monolingual and bilingual infant learners of English and French. In *Proceedings of the 15th international congress of phonetic sciences* (pp. 1021–1024). Barcelona: Causal Productions.
Rost, G. C. & McMurray, B. (2009). Speaker variability augments phonological processing in early word learning. *Developmental Science* **12**(2), 339–49.
Schmale, R., Hollich, G. J. & Seidl, A. (2011). Contending with foreign accent in early word learning. *Journal of Child Language* **38**(5), 1096–108.
Schmale, R. & Seidl, A. (2009). Accommodating variability in voice and foreign accent: flexibility of early word representations. *Developmental Science* **12**, 583–601.
Schreiner, M. S., Altvater-Mackensen, N. & Mani, N. (2016). Early word segmentation in naturalistic environments: limited effects of speech register. *Infancy* **21**(5), 625–47.
Singh, L. (2008). Influences of high and low variability on infant word recognition. *Cognition* **106**(2), 833–70.
Singh, L. & Foong, J. (2012). Influences of lexical tone and pitch on word recognition in bilingual infants. *Cognition* **124**(2), 128–42.
Singh, L., Fu, C. S. L., Rahman, A. A., Hameed, W. B., Sanmugam, S., Agarwal, P., Jiang, B., Chong, Y. S., Meaney, M. J. & Rifkin-Graboi, A. (2015). Back to basics: a bilingual advantage in infant visual habituation. *Child Development* **86**(1), 294–302.
Singh, L., Morgan, J. L. & White, K. S. (2004). Preference and processing: the role of speech affect in early spoken word recognition. *Journal of Memory and Language* **51**(2), 173–89.
Singh, L., Reznick, J. S. & Xuehua, L. (2012). Infant word segmentation and childhood vocabulary development: a longitudinal analysis. *Developmental Science* **15**(4), 482–95.
Singh, L., White, K. S. & Morgan, J. L. (2008). Building a word-form lexicon in the face of variable input: influences of pitch and amplitude on early spoken word recognition. *Language Learning and Development* **4**(2), 157–78.
Umbel, V. M., Pearson, B. Z., Fernandez, M. C. & Oller, D. K. (1992). Measuring bilingual children's receptive vocabularies. *Child Development* **63**(4), 1012–20.
van Heugten, M. & Johnson., E. K. (2014). Learning to contend with accents in infancy: benefits of brief speaker exposure. *Journal of Experimental Psychology: General* **143**(1), 430–50.