Journal of Experimental Child Psychology 164 (2017) 87–100

Contents lists available at ScienceDirect

Journal of Experimental Child Psychology

journal homepage: www.elsevier.com/locate/jecp

Input matters: Speed of word recognition in 2-year-olds exposed to multiple accents

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ARTICLE INFO

Article history:
Received 21 September 2016
Revised 15 May 2017

Keywords:
Word recognition
Speech perception
Language acquisition
Accents
Multicultural
Multilingual

ABSTRACT

Although studies investigating language abilities in young children exposed to more than one language have become common, there is still surprisingly little research examining language development in children exposed to more than one accent. Here, we report two looking-while-listening experiments examining the impact of routine home exposure to multiple accents on 2-year-olds' word recognition abilities. In Experiment 1, we found that monolingual English-learning 24-month-olds who routinely receive exposure to both Canadian English and a non-native variant of English are less efficient in their recognition of familiar words spoken in Canadian English than monolingual English-learning 24-month-olds who hear only Canadian English at home. In Experiment 2, we found that by 34 months of age all children recognize words equally quickly regardless of their accent exposure at home. We conclude that monolingual toddlers in some locations may form a less homogeneous population than past work has assumed, a factor that should be considered when drawing generalizations about language development across different populations.

Introduction

During recent years, there has been a sharp increase in the number of studies examining language acquisition in bilingual infants (e.g., Curtin, Byers-Heinlein, & Werker, 2011; Fennell & Byers-Heinlein,

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http://dx.doi.org/10.1016/j.jecp.2017.06.017
0022-0965/

2014; Kovács & Mehler, 2009; Sebastian-Galles, Albareda-Castellot, Weikum, & Werker, 2012; Werker & Byers-Heinlein, 2008). This increase has been in large part due to a growing awareness that most children learn language in a multilingual setting and that this has implications for theories of language acquisition. At the same time, language researchers have also become increasingly interested in how children cope with novel accents in the lab, in part for the same reason that there has been an increase in work with bilinguals (e.g., Cristia et al., 2012; Mulak, Best, Tyler, Kitamura, & Irwin, 2013; Schmale, Seidl, & Cristia, 2015; van Heugten & Johnson, 2014; White & Aslin, 2011). Surprisingly, however, there has been very little work examining language development in children exposed to more than one accent in their daily lives. The little work that does exist has focused on children exposed to one or two closely related regional variants of the same language (e.g., Floccia, Delle Luche, Durrant, Butler, & Goslin, 2012; van der Feest & Johnson, 2016). Here, we explored the impact of language input on early child development by asking how exposure to both a native and non-native variant of the native language affects monolingual children's language-processing skills (i.e., we compared word recognition abilities in monolingual children who receive only first-language [L1] input with word recognition in children who receive a substantial portion of their language input from a second-language [L2] speaker). Our findings suggest that the degree of accent variation children experience in their day-to-day environment is an important factor in shaping their word recognition performance in the lab.

Numerous laboratory studies have demonstrated that young infants initially have difficulties in coping with unfamiliar regional accents (i.e., native variants of a language spoken in different regions of the world such as Australian or British English). At 9 months of age, infants trained on word forms in a familiar American English accent readily recognize those words at test when they are produced in the same accent but fail to recognize those same words when they are produced in an unfamiliar Canadian English accent (Schmale, Cristia, Seidl, & Johnson, 2010). At 15 months, American children readily recognize lists of familiar words spoken in an American English accent but struggle to recognize those same words spoken in Jamaican English (Best, Tyler, Gooding, Orlando, & Quann, 2009; see, however, van Heugten & Johnson, 2014). At 20 months, Canadian English-learning children look to labeled target objects in an eye-tracking study when the labels are produced in Canadian English but fail to look to the targets when they are produced in Australian English (van Heugten, Krieger, & Johnson, 2015; see, however, Mulak et al., 2013). Children's difficulties with unfamiliar accents continue beyond infancy and toddlerhood. Even 4- to 7-year-olds still struggle to understand unfamiliar regional accents (Nathan, Wells, & Donlan, 1998; Newton & Ridgway, 2016).

A growing body of literature has also documented children's difficulties in processing non-native accents (i.e., variants of a language spoken by L2 learners such as Spanish- or Polish-accented English). Not surprisingly, research suggests that children notice non-native accents more readily than regional accents (Floccia, Butler, Girard, & Goslin, 2009; Wagner, Clopper, & Pate, 2014) and also have more difficulty in understanding L2 speech than unfamiliar regional accents (Bent, 2014). Children's difficulties with non-native accents, much like their difficulties with regional accents, are evident during infancy. At 5 months of age, monolingual English-learning infants confuse Spanish-accented English with Spanish (Paquette-Smith & Johnson, 2015). At 9 months, infants trained on words in a familiar American accent readily recognize those words when they are produced at test in the same accent but fail to recognize those same words when they are produced in Spanish-accented English (Schmale & Seidl, 2009). Monolingual English-learning 17-month-olds learn minimal pair labels only if they are produced by a native English speaker (not if they are produced by a French–English bilingual with a subtle accent; Fennell & Byers-Heinlein, 2014). And 2-year-old English learners struggle to learn new words when they are spoken in a Spanish accent (Schmale, Hollich, & Seidl, 2011; see, however, Schmale, Cristia, & Seidl, 2012).

Importantly for the current study, despite all of the laboratory evidence that children have difficulty in coping with both regional and non-native accents that are unfamiliar, we are aware of only three published studies specifically aimed at understanding how multi-accent exposure at home affects early language development in monolingual children, and all three of these studies examined word recognition in children exposed to one versus two regional (as opposed to non-native) variants of the native language.

The first of these studies tested 20-month-olds who had parents (or at least one parent) who spoke a native variant of British English that differed from the regionally dominant variant of British English (Floccia et al., 2012). When tested on words that were pronounced differently in the variant of English that their parents spoke and the variant of English spoken in the town where they were living, children recognized only the words spoken in the regionally dominant accent. That is, they failed to recognize the words when pronounced in a manner that resembled their parents' pronunciation, leading the authors to conclude that children were preferentially acquiring the socially dominant accent in their environment. The second study examined word recognition in this same population and found that although the multi-accent 20-month-olds recognized words in the regionally dominant variety of English, they differed from the children who were exposed only to the regionally dominant variant of English in that they readily accepted both correct and incorrect pronunciations of familiar words (Durrant, Delle Luche, Cattani, & Floccia, 2014). Thus, taken together, these studies could be seen as evidence that multi-accent children are somewhat compromised in their ability to process both their parents' variant of the native language and the socially dominant variant of the native language.

The third study to examine language development in children exposed to one versus two variants of the native language tested Dutch-learning 24-month-olds' detection of mispronunciations (van der Feest & Johnson, 2016). Children in this study were exposed in their day-to-day life to only the local socially dominant variant of Dutch or to this variant plus a second variant of Dutch (the latter spoken by the children's parents who were originally from another region of The Netherlands). Both groups of children were tested on the socially dominant variant of Dutch familiar to all children in the study as well as the other variant of Dutch familiar only to the multi-accent children. The multi-accent children readily detected mispronunciations of familiar words regardless of accent. However, the mono-accent children were sensitive to mispronunciations only in the familiar socially dominant variant of Dutch. Interestingly, after brief exposure to the unfamiliar variant of Dutch, the mono-accent children were also able to detect mispronunciations in the previously unfamiliar accent. The authors of this study concluded that multi-accent children are adept at recognizing words in more than one variety of their native language and that all children have the ability to rapidly adapt to novel variants of the native language.

The few existing studies investigating how exposure to multiple accents contributes to individual differences in children's speech perception capabilities do not paint an entirely clear picture, and additional research is clearly needed to tease apart the somewhat divergent findings. The studies with English-learning 20-month-olds suggest that there is a cost associated with being exposed to multiple variants of the native language (i.e., words are preferentially recognized in one accent over the other and sensitivity to mispronunciations may be compromised), whereas the study with Dutch-learning 24-month-olds suggests that children have no trouble in handling exposure to multiple accents in their input. Indeed, these authors even briefly speculated that multi-accent exposure may impart some cognitive benefits in a fashion analogous to multilingualism (e.g., Kovács & Mehler, 2009).

With only three studies in existence comparing multi-accent and mono-accent input children, it is difficult to draw any firm generalizations from these findings. Moreover, all of the existing studies with multi-accent children have focused on exposure to more than one regional variant of the native language. No study that we are aware of has examined language development in monolingual children who are exposed to the socially dominant regional variant of English as well as a non-native variant of English. Finally, existing work on children exposed to multiple accents has focused on children between 20 and 24 months of age. No study has examined how long any possible effects of multi-accent exposure on word recognition persist during development. This too is an important question to consider. Although multi-language input early in life has a lasting effect on speakers' linguistic and cognitive abilities, this is not necessarily true of multi-accent exposure early in life. Thus, the research presented in this study addresses a crucial gap in the literature. Understanding how different types of multi-accent exposure affect language development has important theoretical implications; it may also have practical applications for improving the early detection of language delays in children growing up in multilingual environments.

In the current study, we examined the impact of multi-accent exposure on language development in monolingual English-learning 2-year-olds. In Experiment 1, we compared word recognition in mono-accent 24-month-olds who had regular exposure to only the socially dominant variant of

English (i.e., Canadian English) with word recognition in children who received exposure to both the socially dominant variant of English and at least one non-native variant of English (e.g., Canadian English plus Ukrainian-accented English). In Experiment 2, we examined word recognition in mono-accent and multi-accent 34-month-olds. Taken together, the findings reported here highlight the fact that early in toddlerhood monolingual children do not form a homogeneous language-learning population and provide a new perspective on how exposure to accent variation affects language development.

Experiment 1: 24-month-olds

We used the looking-while-listening procedure (Fernald, Zangl, Portillo, & Marchman, 2008; Johnson & Zamuner, 2010) to ask whether exposure to non-native English affects 24-month-olds' recognition of words spoken in native Canadian English. Two groups of monolingual English-learning children were tested. One group was exposed to almost entirely native Canadian English. The other group lived in the same community as the first group and, thus, had regular exposure to native Canadian English. However, these children also had substantial exposure to a non-native accented variant of English spoken by parents (at least one parent) or full-time caregivers.

All children were tested on their recognition of familiar words produced by a native Canadian English speaker. On each trial, children were presented with two images and asked to look at one image or the other (e.g., the child would see a book and a ball and hear "Wow. Look at the ball. Do you like it?"). Children's looks to the target and non-target object were coded frame by frame, with the prediction that children who had exposure to both Canadian English and a non-native variant of English might recognize the target words less efficiently or more slowly than children with exposure to only Canadian English.

Method

Participants

A total of 32 monolingual English-learning toddlers between 22 and 26 months of age were tested. Of the 32 participants, 16 had primary caregivers who learned English in North America before 5 years of age (5 girls; M_{age} = 722 days, range = 688–769). The other 16 participants had parents (at least one parent) or full-time caregivers (e.g., a nanny working at least 40 hours per week) who learned English during adolescence or later and had a perceptible accent (8 girls; M_{age} = 740 days, range = 686–788). The perceptibility of the accent was verified by the experimenter if the accented caregivers accompanied the children to the lab. Otherwise, the accompanying caregivers confirmed that people could readily recognize that English was not the native language of the other caregivers based on how they speak. Non-native accents of parents and primary caregivers included Filipino, Chinese, Indian, Portuguese, French, Ukrainian, Spanish, and Egyptian accents. All participants were monolingual, being exposed to at least 80% English (Canadian English group: M = 97%; non-native accent group: M = 93%).

Family income and parental education data were collected as indicators of socioeconomic status. Family income was measured on a 4-point scale—less than $30,000, $30,000 to $59,999, $60,000 to $90,000, and >$90,000. Among the sample, 13 participants in the Canadian English group and 11 participants in the non-native accent group provided family income information. A Mann–Whitney test indicated that family income did not differ between children in the Canadian English group (*Mdn* = $60,000–$90,000) and children in the non-native accent group (*Mdn* = $60,000–$90,000), U = 60.5, p = .49. Parental education was measured on a 7-point scale: some high school education, high school graduate, some college education, college graduate, some university education, university graduate, or postgraduate education. Note that in Canada colleges offer vocational programs rather than academic programs of universities. Values for both parents were summed, providing a parental education score with a value between 1 and 14. Among the sample, 15 participants in each accent group provided parental education data. There was a trend toward higher parental education in the non-native accent group (*Mdn* = 12) than in the Canadian English group (*Mdn* = 10), U = 67.5, p = .06.

The MacArthur–Bates Communicative Development Inventory (CDI) Words and Sentences (Fenson et al., 1993) was completed and returned by all 16 children in the Canadian accent group and by 15 of the 16 children in the non-native accent group. There was no significant difference in reported vocabulary size between the two groups (M_{Can} = 47%, SE = 6.39; $M_{Non\text{-}native}$ = 38%, SE = 6.57), $t(29)$ = 1.07, p = .29, d = 0.40.

During the second half of the study, 3 of the 16 children exposed only to Canadian English and 4 of the 16 children exposed to a non-native accent became bored and stopped watching the video, presumably due to the repetitive nature of the video. For these children, we analyzed only their first 16 trials. The data from an additional 30 participants were never coded and dropped from the study due to fussiness (n = 4), experimenter or technical error (n = 4), parental interference (n = 1), a diagnosed speech/language delay (n = 1), or failure to fit the strict language criteria for the study (n = 20). There is a high rejection rate for failure to fit the language criteria due to our strict criteria and method of screening participants. Participants were screened lightly on the phone before being invited to participate, and more in-depth screening was conducted in person during their visits. This was done after the children had participated in the study. This detailed posttest screening gave a more complete picture of the children's language environment and often revealed accent exposure that had not been mentioned on the phone.

Materials, design, and procedure

Target words consisted of 16 nouns commonly known by 2-year-olds. Questionnaires administered at the time of the experiment confirmed that parents believed that their children knew the majority of the words in the study, and the number of words known by the two groups did not differ (M_{Can} = 12.06, SD = 4.54; $M_{Non\text{-}native}$ = 10.75, SD = 4.72), $t(30)$ = 0.80, p = .43, d = 0.29. All target words were recorded in the sentence frame "Can you find the ________?" To make the stimuli more engaging for children, each request to find a target was also preceded by an attention-getting statement (e.g., "Look") and followed by a short positive remark (e.g., "Isn't it pretty?"). Recordings were made in a child-directed voice by a monolingual English speaker who had lived in the Greater Toronto Area of Canada her entire life.

Participants sat on a caregiver's lap facing a large-screen TV in a dimly lit sound-attenuating IAC booth (IAC Acoustics, North Aurora, IL, USA). Caregivers listened to masking music over headphones to ensure that they did not influence the participants' behavior. On each trial, two pictures would appear on the screen and one of the two pictures would be labeled (the target image). Target pairs included dog/duck, car/ball, cup/book, key/shoes, turtle/giraffe, plant/soup, lion/sheep, and strawberry/carrot. Images were placed side by side against a white background (e.g., a child would hear "Look! Can you find the car? Isn't it pretty?" while viewing an image of a car and a ball). Half of the time the target image appeared on the right side of the screen, and half of the time the target image appeared on the left side. The 16 trials were presented in a pseudorandom order within one of two blocks of trials (the 16 images were each labeled once in each block), with the stipulation that the target image could not appear more than three times in a row on the same side. The target word onset occurred precisely 3 s after the pictures appeared, and the trials lasted exactly 7 s. An attention-getting star zoomed against a black background for 1.7 s between each trial to center the child between trials and to provide a visual marker of trial onset to coders (Johnson & Zamuner, 2010).

After the experiment was completed, parents were asked to complete a MacArthur–Bates CDI form for their children (Fenson et al., 1993). Parents also answered detailed questions on the language input that their children heard. Children who did not clearly fit the specified language criteria were excluded from the study (e.g., children who heard less than 80% English, received less than 40 h per week of accented English exposure, or had substantial exposure to not only a non-native variant of English but also a regional variant of English other than Canadian; this latter group included children who, e.g., had a day-care provider who spoke a non-native variant, whereas one of the parents spoke a regional variant).

Coding

Children's looking behavior was videotaped for subsequent offline coding (29.97 frames per second). Coding was done using SuperCoder (Hollich, 2003) with the volume of the videos muted, and coders were unaware of which side the target occurred on for any given trial. Each frame was coded as a look to the left, the right, or away. Four of the videos were randomly chosen and recoded by a second coder, and the duration of individual fixations was compared. Agreement between coders was high (97%).

Two primary analyses were conducted. The first analysis was proportion of looking time to target. Proportion Target Looking (PTL) was calculated as the time spent looking at the target (T) divided by the time spent looking at the target and distractor (T + D). Mean PTL was calculated for each participant during the first second following the onset of the target word, including a 300 ms delay to allow participants to program and execute an eye movement guided by the auditory stimuli (i.e., analysis window of 300–1300 ms post-target onset). PTL is frequently used in preferential looking studies with young children (e.g., Swingley & Aslin, 2000; Zangl & Fernald, 2007). Although longer windows of 1500–2000 ms are often taken as the window of analysis, shorter windows of 1000 ms are also attested (e.g., Buckler & Fikkert, 2016; Creel, 2012; Paquette-Smith, Fecher, & Johnson, 2016). We chose to use a shorter window due to the age of our participants and because we expected any differences in gaze behavior between the two groups of participants to be early and short-lived. The second analysis was speed of gaze shift to target (e.g., Fernald, Pinto, Swingley, Weinberg, & McRoberts, 1998). This Reaction Time (RT) analysis was conducted only on trials where the participants were looking at the distractor image at the onset of the target word and where they shifted their gaze to the target image in the 300 to 2300 ms interval following the onset of the target word. This upper cutoff was imposed because previous research showed that later shifts are less likely to be related to the stimulus heard and more likely reflect spontaneous refixations (cf. Fernald et al., 2008; Swingley & Aslin, 2000; Zangl & Fernald, 2007). Data were included from 152 trials (of a possible 464) in the Canadian accent group and from 159 trials (of a possible 448) in the non-native accent group. Mean RT of these trials was calculated per participant and compared across the two accent groups.

We predicted that children in the non-native accent group would recognize words less efficiently than children in the Canadian accent group. Therefore, children in the non-native accent group were predicted to have a lower PTL and a slower RT than children in the Canadian accent group.

Results and discussion

t Tests were conducted comparing mean PTL of children in the Canadian accent group and the non-native accent group during the first 1000-ms post-target word onset. These data are presented in Fig. 1. We found a significant effect of accent group, $t(30) = 2.30$, $p = .01$, $d = 0.77$, one-tailed. As

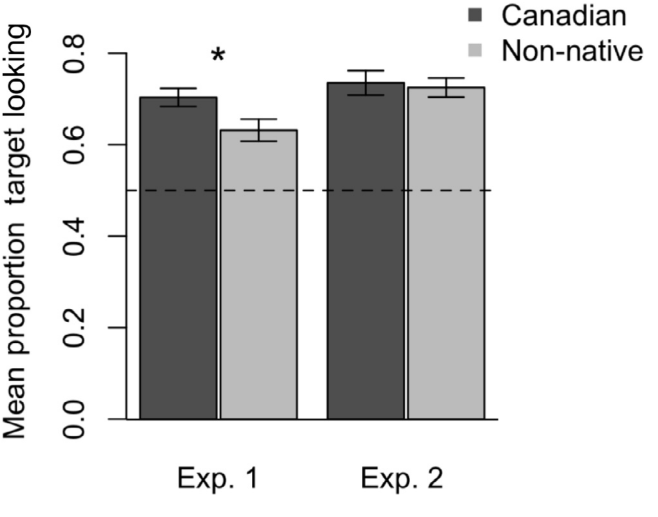

Fig. 1. Mean proportion target looking (PTL) during the first 1000 ms following target word onset for participants in the Canadian accent group and the non-native accent group in Experiment 1 (24-month-olds) and Experiment 2 (32-month-olds). Higher PTL indicates more robust word recognition.

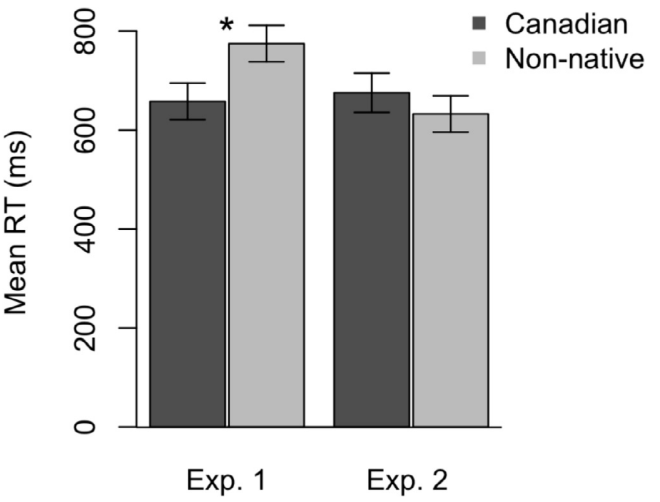

Fig. 2. Mean reaction time (RT) data for participants in Experiment 1 (24-month-olds) and Experiment 2 (32-month-olds). This analysis measured the time taken for participants to shift their gaze to the target image in trials where they were looking at the distractor image at the onset of the target word. Lower RT reflects more efficient processing.

predicted, children in the Canadian accent group looked to the target more than children in the non-native accent group (M_{Can} = .70, *SD* = .08; $M_{Non\text{-}native}$ = .63, *SD* = .10). PTL of both groups was significantly above chance, indicating word recognition by both groups of participants within the first second: Canadian $t(15) = 10.20$, $p < .001$, $d = 2.55$; Non-native $t(15) = 5.46$, $p < .001$, $d = 1.37$. Analysis of RT data (Fig. 2) also elicited a significant effect of accent group, $t(30) = -2.24$, $p = .02$, $d = 0.79$, one-tailed. Again, in line with our prediction, participants in the Canadian accent group were faster to shift their gaze to the target image than participants in the non-native accent group (M_{Can} = 657.85 ms, *SD* = 147.64; $M_{Non\text{-}native}$ = 774.48 ms, *SD* = 147.5).

Additional information collected about participants indicated no significant differences between the two groups in age, the amount of English exposure they received, socioeconomic status, or vocabulary size. To further assess the influences of these factors on our data, we analyzed correlations between each of these measures and participants' PTL scores (Fig. 3). There was no correlation between PTL and age in days, $r(30) = -.18$, $p = .33$, percentage exposure to English, $r(30) = .26$, $p = .15$, or parental education score, $r(28) = -.05$, $p = .80$. Vocabulary size correlated with PTL considering all participants together, $r(29) = .37$, $p = .04$; however, for participants in the Canadian accent group, this correlation was only marginally significant, $r(14) = .47$, $p = .07$, and there was no significant correlation with vocabulary size for participants in the non-native accent group, $r(13) = .19$, $p = .49$. We discuss the possible influence of vocabulary size in the General discussion.

Results from Experiment 1 indicate that word recognition in 24-month-olds with exposure to non-native accents of English is slightly delayed relative to children exposed to only Canadian English. Both groups of children recognized the target words; however, children in the Canadian accent group did so more efficiently and faster than children in the non-native accent group. Importantly, however, children in the two groups looked to the target greater than chance level, indicating that all of the children understood and recognized the words used in the study.

Experiment 2: 34-month-olds

In Experiment 1, we showed that at 24 months of age children receiving exposure to a non-native variant of English other than Canadian English are slightly less efficient in their recognition of Canadian-accented words. In Experiment 2, we asked how multi-accent exposure affects word recognition in children who are nearing their third birthday. The materials and procedure were very similar

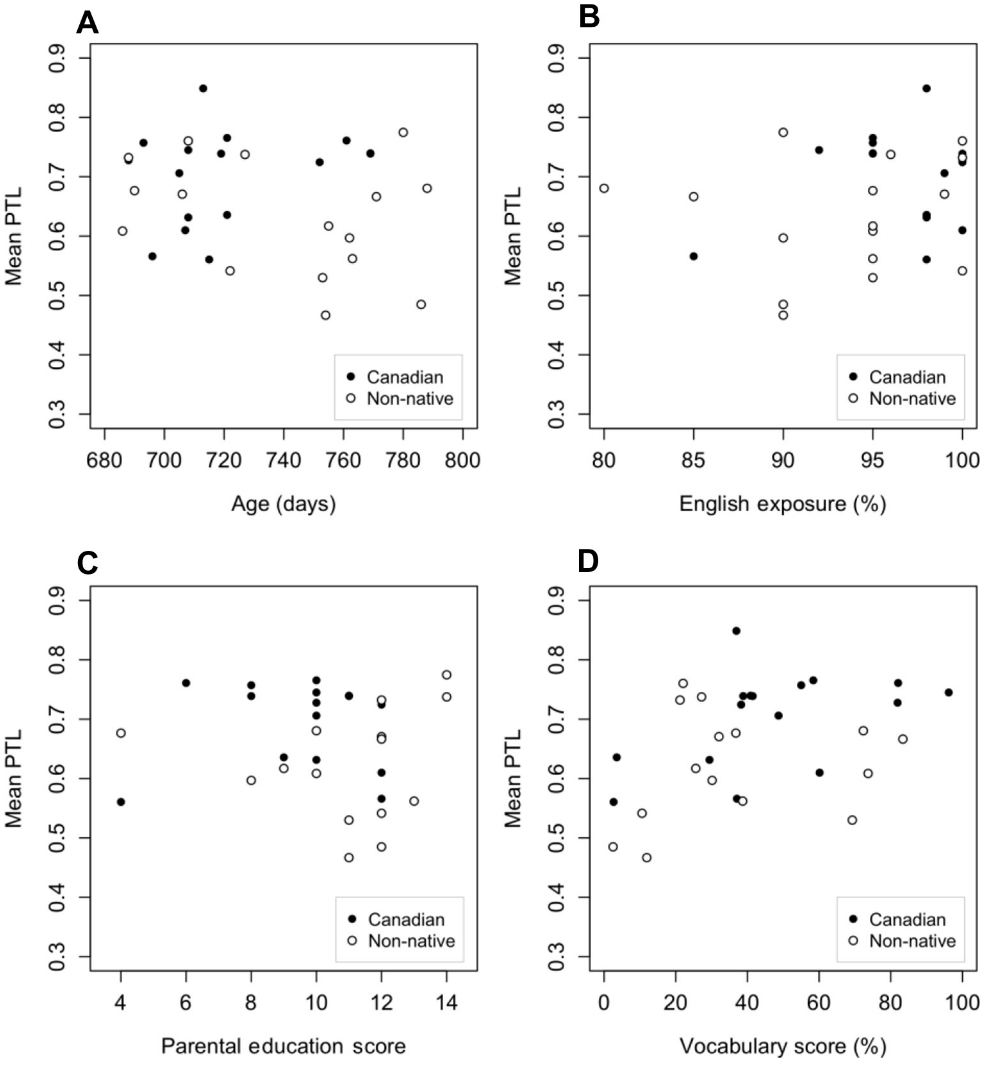

Fig. 3. Relation between mean proportion target looking (PTL) during the first second following target word onset for 24-month-old participants in Experiment 1 and the children's age in days (A), percentage exposure to English (B), parental education levels (C; see Method section for details), and productive vocabulary according to the MacArthur–Bates Communicative Development Inventory (CDI) Words and Sentences (D).

to those used in Experiment 1. The only difference was that we reduced the number of trials from 32 to 16 and added some filler videos to keep the children's interest. These adjustments were necessary because piloting with this age group revealed that the older children would not sit through the study otherwise.

Method

Participants

A total of 32 monolingual English-learning toddlers between 32 and 36 months of age were tested. Of the 32 participants, 16 had primary caregivers who spoke Canadian English (8 girls; M_{age} = 1066 days, range = 1025–1097) and 16 had parents (at least one parent) or full-time caregivers who spoke a non-native variant of English; that is, they had learned English during adolescence or later and had a perceptible accent (9 girls; M_{age} = 1034 days, range = 989–1081). Non-native accents spoken by parents and caregivers included Polish, French, Guajarati, Arabic, Filipino, Bosnian, Italian, and Chinese. All participants were monolingual, being exposed to at least 80% English (Canadian accent group: M = 98%; non-native accent group: M = 97%). As in Experiment 1, parental education and family income, as indicators of socioeconomic status, were similar between the two groups. Parental education information was provided by 14 participants in the Canadian accent group and 15 participants in the non-native accent group (Mdn_{Can} = 10.0, $Mdn_{Non\text{-}native}$ = 10.9), U = 79.5, p = .27. Family income information was provided by 11 participants in the Canadian accent group and 13 participants in the non-native accent group. The median family income in both groups was $90,000 or higher, U = 70.5, p = .97.

The MacArthur–Bates CDI III (Fenson et al., 1993) was completed and returned by all 32 participants. There was no difference in reported vocabulary size between children in the Canadian accent group and children in the non-native accent group (M_{Can} = 57%, SE = 5.99; $M_{Non\text{-}native}$ = 61%, SE = 6.61), $t(30) = -0.49$, p = .63, d = 0.17.

The data from an additional 25 participants was never coded and not included due to fussiness (n = 2), experimenter error (n = 5), parental interference (n = 1), a speech/language delay (n = 1), or failure to fit the language criteria for the study (n = 16).

Materials, design, and procedure

The materials, design, and procedure were identical to those in Experiment 1, with adjustments being made to help maintain children's interest. We reduced the number of trials from 32 to 16, added variability in color of the attention-getting star at the start of each trial, and added some short silent cartoon clips between some trials.

Results and discussion

As in the previous experiment, we analyzed PTL during the first 1000 ms post-target word onset (with a 300 ms delay for the initiation of a linguistically mediated eye movement) and the time taken for children to shift their gaze from the distractor to the target image on hearing the target word (RT). A t test was conducted comparing mean PTL between accent groups in the time window of analysis. These data are presented in Fig. 1. There was no significant difference in PTL between the two accent groups, $t(30)$ = 0.30, p = .77, d = 0.10, two-tailed), indicating that children in both accent groups recognized the target equally well (M_{Can} = .74, SD = .11; $M_{Non\text{-}native}$ = .73, SD = .08). Participants in both groups recognized the target, indicated by a PTL score greater than chance, Canadian $t(15)$ = 8.82, $p < .001$, d = 2.20; non-native $t(15)$ = 10.80, $p < .001$, d = 2.70. RT, illustrated in Fig. 2, also did not differ by accent group, $t(29) = -0.80$, p = .43, d = 0.29, two-tailed. In trials where the participants were looking at the distractor image at the onset of the target word, children in both accent groups were equally fast to shift their gaze to the target image (M_{Can} = 675.28 ms, SD = 153.63; $M_{Non\text{-}native}$ = 632.5 ms, SD = 146.58).

There were no significant correlations between participants' PTL and age in days, $r(30) = -.20$, p = .26, percentage exposure to English, $r(30)$ = .08, p = .68, or parental education score, $r(27)$ = .30, p = .12. There was a correlation between vocabulary size and PTL, $r(30)$ = .40, p = .02. Considering the Canadian accent group only, there was no correlation between vocabulary size and PTL, $r(14)$ = .34, p = .19, but there was for the non-native accent group, $r(14)$ = .50, p = .05. These data are illustrated in Fig. 4.

General discussion

Although language research is increasingly focused on acquisition in multilingual contexts, most studies of early language development still fail to consider the impact of multi-accent exposure on early speech processing capabilities. In the current study, we addressed this issue by examining word

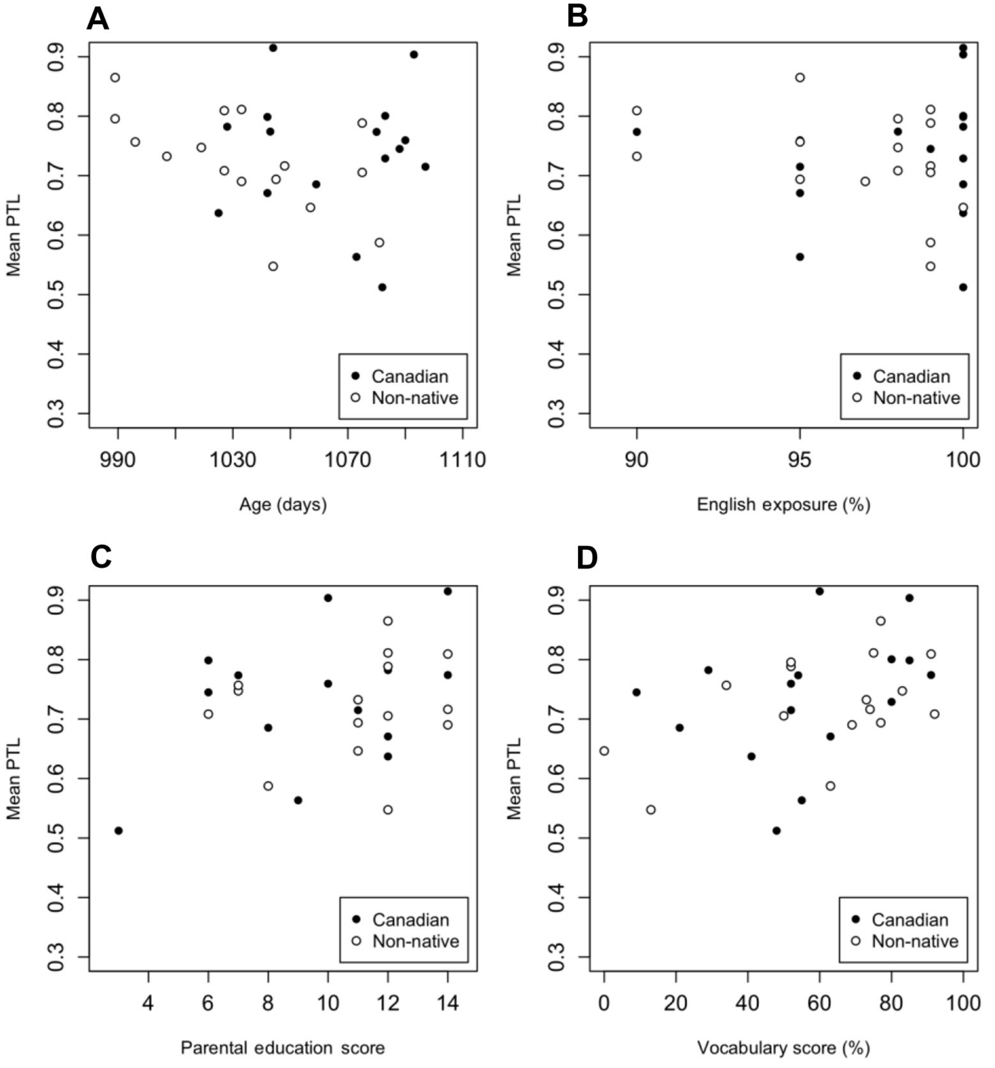

Fig. 4. Relation between mean proportion target looking (PTL) during the first second following target word onset for 34-month-old participants in Experiment 2 and the children's age in days (A), percentage exposure to English (B), parental education levels (C; see Method section of Experiment 1 for details), and productive vocabulary according to the MacArthur–Bates Communicative Development Inventory (CDI) III (D).

recognition in English-learning monolingual 2-year-olds exposed to Canadian English or Canadian English plus a non-native variant of English. We found that multi-accent 24-month-olds were slower than their mono-accent peers to recognize familiar words spoken in the regionally dominant Canadian variant of English. By 32 months of age, as children neared their third birthday, the difference in the speed of word recognition between mono-accent and multi-accent children appeared to dissipate. Thus, we observed an effect of multi-accent input that was transient on two levels: over the course of recognizing an individual word and over the course of development.

It is useful to consider how our findings fit into the previously existing literature on language processing in mono-accent and multi-accent children. Three previous studies working with bi-accented versus mono-accented populations all reported differences between the groups, but the differences were not identical to those reported in the current study (Durrant et al., 2014; Floccia et al., 2012; van der Feest & Johnson, 2016). At first glance, it may seem as if our results are not compatible with the existing findings. However, the previous studies used different methodologies, used different populations, and were aimed at addressing different questions. Significantly, none of the three previous studies on multi-accent versus mono-accent children examined word recognition in children exposed to non-native variants of their language, instead examining only children exposed to regional variants of the language. Furthermore, the previous studies tested different age groups and used different experimental designs compared with the current study (e.g., mispronunciation detection, presenting stimuli in multiple varieties of English within the same experiment). Thus, our study examined a previously unexamined aspect of language development, and our findings complement (and certainly do not contradict) the small previously existing literature on this topic.

Although our findings add depth to our understanding of how children cope with multi-accent exposure, our findings still leave many questions unanswered. For example, why would monolingual 24-month-olds who receive exposure to multiple variants of their native language recognize words more slowly in the socially dominant variant of the native language than children who receive exposure to only one variant of the native language? There are at least two obvious explanations.

One possibility is that for 24-month-olds lexical representations are at least partially exemplar based (see Cutler (2010), for a discussion of why adult lexical representations are likely not exemplar based). Because the input that multi-accent children receive is split between different accents, they have likely been exposed to fewer Canadian-accented tokens of the target words used in the study. Therefore, their representations of these words may be less robust than those of their mono-accent peers, so they do not recognize the words as quickly as children exposed to only Canadian-accented English. This notion certainly fits with the findings that multi-accent children are less sensitive to mispronunciations than mono-accent children (Durrant et al., 2014). Moreover, perhaps the speed of processing differences we observed at 24 months of age were no longer reliably observed at 34 months because multi-accent children simply require a few extra months of language input to build up robust enough representations to support fast word recognition. An interesting prediction of an exemplar-based explanation is that multi-accent children may initially have broader, and thus more flexible, lexical representations than mono-accent children (see Schmale et al. (2015), for a discussion). This could be adaptive for children growing up in an environment where they routinely encounter different accents, and one can imagine a laboratory scenario where this sort of representation might be advantageous. For example, multi-accent children may recognize words in an unfamiliar accent faster than their mono-accent peers. This is a hypothesis that we are currently exploring.

A second possibility, and the one that we favor, is that mono-accent 24-month-olds recognize familiar words slightly faster than multi-accent children because the two groups are using slightly different strategies for recognizing words. Perhaps the mono-accent children receive less variation in their daily input and, thus, speed word recognition by making assumptions about the way words will sound. Multi-accent children, on the other hand, may be more conservative in accessing lexical representations because in their experience pronunciations of familiar words can vary greatly. An important difference between this explanation and the exemplar-based explanation is that this explanation does not require that children's lexical representations be exemplar based (thereby allowing continuity between early and adult lexical representations; see van Heugten and Johnson (2014), for a related discussion). Perhaps the processing differences are less apparent by 34 months of age because by this time multi-accent children have fine-tuned their ability to adapt to different accents. It is possible that a more challenging task might reveal subtle differences in the word recognition capabilities of multi-accent versus mono-accent children beyond 24 months.

Our data indicate differences in speed of word recognition at 24 months of age, and we attribute this to differences in the amount of exposure to non-native accents that the toddlers receive in their everyday lives. We have discussed two possible explanations for the effects observed in Experiment 1 (i.e., multi-accent children may differ in the way they represent and/or access words in their lexicon). But there are other factors known to correlate with children's language abilities and performance in word recognition tasks that could also be contributing to our results such as vocabulary size, exposure to other languages besides English, socioeconomic status, and age (e.g., Bates & Goodman, 1997; Fernald, Swingley, & Pinto, 2001; Hoff et al., 2012; Munson, 2001; Newman, 2011; Place & Hoff, 2016; Werker, Fennell, Corcoran, & Stager, 2002; Zangl, Klarman, Thal, Fernald, & Bates, 2005). Although our groups did not differ significantly on any of these factors, we cannot say with certainty that one or more of these did not contribute to our results. Take, for example, the fact that the multi-accented 24-month-olds tested in Experiment 1 had a slightly, although nonsignificantly, smaller vocabulary score than the mono-accented children (see, e.g., Fernald et al. (2001), Munson (2001), and Zangl et al. (2005), for evidence that smaller vocabularies are linked with slower word recognition). If one were to focus specifically on this trend toward a smaller vocabulary in the multi-accent children, a possible explanation for our data could be that exposure to multiple accents, particularly non-native accents, leads to slower vocabulary growth. However, the causal relationship among accent exposure, vocabulary size, and speed of word recognition cannot be determined based on the available data. Perhaps exposure to accented speech influences the structure of the children's lexical representations and/or processing strategies (cf. the two explanations above), which affects their vocabulary development. Or perhaps lower vocabulary in our multi-accent population leads to slower processing. The current data cannot tease these two possibilities apart; indeed, it does not even strongly suggest that there is a vocabulary difference between the two populations. To better understand this possible relationship, we are currently conducting a larger-scale study investigating how exposure to non-native speakers influences vocabulary development in monolingual children (see Hammer et al. (2012) and Place and Hoff (2011, 2016), for comparable studies in a bilingual population). This will provide data that allow us to better identify the source of differences in word recognition abilities at 24 months of age.

As well as the link between exposure to accented speech and vocabulary growth, the current research raises a number of additional questions and directions for future research. For example, future studies should compare additional subpopulations of multi-accent children. In the current study, we considered word recognition in mono-accent and multi-accent children with exposure to non-native variants English (i.e., English produced by parents or caregivers who were L2 speakers of English). Is the difference that we find at 24 months of age being driven by exposure to accent variability or specifically by exposure to non-native variants of English? Non-native speech differs from native speech because the speaker is influenced by the phonological systems of two (or more) languages. Pronunciations tend to be more variable than native pronunciations, with inconsistency in how closely they resemble the target language pronunciation (Hanulíková & Weber, 2012; Wade, Jongman, & Sereno, 2007). Furthermore, studies with a bilingual population have found that input from non-native speakers negatively affects vocabulary development (Place & Hoff, 2011, 2016). One way of teasing this question apart would be to compare groups of multi-accent children who are exposed to either non-native or regional variants of the language alongside the socially dominant variety. Speakers of regional variants of the socially dominant language are native speakers, and as such their speech is predicted to exhibit greater internal consistency than non-native speech, but their children are still exposed to accent variation. If routine exposure to different variants of English causes children to adopt a different processing strategy, then the type of accent should not matter and multi-accent children with exposure to regional and non-native varieties should exhibit similar patterns of word recognition.

Multi-accent children also differ in the source of accent exposure and the number of accented speakers to which they are exposed. Future studies should also consider variation in subpopulations of multi-accent children along these dimensions. For example, does it make a difference whether children receive most of their language input from a single accented speaker (e.g., their mother) or whether they receive it from many different speakers (e.g., many members of extended families or several different day-care workers) (see Rost and McMurray (2009), for a suggestion that speaker variation may affect the formation of children's lexical representations)? And does it make a difference whether the exposure comes from home (mothers and/or fathers) or whether it comes from outside the home (e.g., a day-care facility) (see Kinzler, Shutts, DeJesus, and Spelke (2009) and Souza, Byers-Heinlein, and Poulin-Dubois (2013), for discussions of accent-based social preferences during childhood)?

In conclusion, we have shown that English-learning monolingual children with multi-accent input demonstrate a slight temporal delay relative to their mono-accent peers in recognizing familiar words spoken in the socially dominant accent. However, this effect appears to dissipate before the third birthday (at least given the test circumstances used in the current study). Our findings highlight the importance of considering variation in accent input as a possible predictor of individual differences in young children's performance on speech processing tasks and argue for a more nuanced approach to defining monolingual English-learning populations in developmental studies.

Acknowledgments

This research was funded by an NWO (Netherlands Organisation for Scientific Research) Rubicon grant awarded to Helen Buckler and Social Sciences and Humanities Research Council (SSHRC) and Natural Sciences and Engineering Research Council of Canada (NSERC) grants awarded to Elizabeth K. Johnson.

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