Title
Accent detection and social cognition: evidence of protracted learning

Journal
Developmental Science, 21(2)

ISSN
1363-755X

Author
Creel, Sarah C

Publication Date
2018-03-01

DOI
10.1111/desc.12524

Peer reviewed

Accent detection and social cognition: evidence of protracted learning

Sarah C. Creel

screel@ucsd.edu

7854 words in main text

Acknowledgments. Thanks to Neil Bardhan for assistance obtaining Dutch-accented materials, to Gail Heyman for reading an earlier draft of the manuscript and aiding in design of the control experiment, to Jennifer Windsor for work on the control experiment, and to Emilie Seubert and Nicolle Paullada for collecting data. Research was supported by NSF CAREER Award BCS-1057080 to SCC.

HIGHLIGHTS

- Previous studies suggest that accent is a salient, early-developing social signal.
- US children do not use accent (US vs. Dutch) to inform sentence processing.
- US children show increasing social preference for US accents through age 7 years.
- Accent detection may require protracted perceptual learning of native speech patterns.

Abstract

How and when do children become aware that speakers have different accents? While adults readily make a variety of subtle social inferences based on speakers' accents, findings from children are more mixed: while one line of research suggests that even infants may be acutely sensitive to accent unfamiliarity, other studies suggest that 5-year-olds have difficulty identifying accents as different from their own. In an attempt to resolve this paradox, the current study assesses American children's sensitivity to American vs. Dutch accents in two situations. First, in an eye-tracked sentence processing paradigm where children have previously shown sensitivity to a salient social distinction (gender) from voice cues, 3-5-year-old children showed no sensitivity to accent differences. Second, in a social-decision-making task where accent sensitivity has been found in 5-year-olds, an age gradient appeared, suggesting that familiar-accent preferences emerge slowly between 3 and 7 years. Counter to claims that accent is an early, salient signal of social group, results are more consistent with a protracted learning hypothesis that children need extended exposure to native-language sound patterns in order to detect that an accent deviates from their own. *184 words*

Keywords: foreign accent; accent stereotypes; stereotype formation; accent recognition

How early, and in what situations, are children sensitive to speakers' accents? Studies of social processing suggest very early accent sensitivity (Kinzler, Dupoux, & Spelke, 2007, 2012; Kinzler, Shutts, DeJesus, & Spelke, 2009), yet other research suggests that recognizing the presence of an accent different from one's own may be difficult (e.g. Floccia, Butler, Girard, & Goslin, 2009; Girard, Floccia, & Goslin, 2008; Wagner, Clopper, & Pate, 2014). However, studies differ in the questions asked of children and in the accents used. The current study tests American children's processing of Dutch-accented speech in two contexts: real-time sentence processing and social decision-making. Assessing children's sensitivity to the same accent in multiple contexts will shed light on the factors shaping these seemingly-discrepant findings, contributing to a more unified picture of children's developing awareness of accents.

Previous research

Children's social awareness of accents. Recent research has documented that adults are sensitive to a variety of indexical properties (Abercrombie, 1967) in the speech signal, which provide clues to the speaker's identity (Van Lancker, Kreiman, & Emmorey, 1985; Van Lancker, Kreiman, & Wickens, 1985), age and sex (Peterson & Barney, 1952), sexual orientation, (Campbell-Kibler, 2011; Munson & Babel, 2007), and regional or foreign accent (e.g. Clopper & Pisoni, 2004; Flege, 1988). While some of adults' social evaluations of accents may be (perhaps undeservedly) positive, such as American English speakers thinking that standard British English speakers sound intelligent, adults often make negative social evaluations of non-standard speakers (e.g. Blair & Conner, 1978; Lambert, 1967), such as thinking that speakers with Southeastern US accents sound less educated (Campbell-Kibler, 2007).

Some researchers have argued that the antecedents of adult accent stereotyping appear in young children (Kinzler et al., 2007), and that language sound characteristics may be an innate social signal of group membership (Pietraszewski & Schwartz, 2014). Using a variety of testing paradigms, researchers have found sensitivity to accent in children across a range of very early ages. For example, Kinzler and colleagues (2007, 2011, 2012) have found that 5-6-year-olds prefer to be friends with (fictitious) children who speak their own accent or language (US English) over those who speak with a different accent or language (French or Spanish). Social accent and language sensitivity also appear in even younger children: Preschool-aged children select unfamiliar-looking dwellings and clothing, rather than familiar-looking ones, to go with an unfamiliar language (Portuguese, vs. the familiar English; Hirschfeld & Gelman, 1997) or an unfamiliar accent (Wagner, Clopper, & Pate, 2014). Children as young as 3 years appear to be sensitive to native-speaker status when choosing informants in a word-learning task (Corriveau, Kinzler, & Harris, 2013; Kinzler, Corriveau, & Harris, 2011), and 2.5-year-olds prefer to give and receive toys from native English speakers than Spanish speakers (Kinzler et al., 2012).

Some evidence is even consistent with *infant* social sensitivity to language differences. Six-month-olds prefer to look at a face that has been previously associated with a voice speaking a familiar language or accent, rather than a foreign language or accent (Kinzler et al., 2007; see also Kinzler et al., 2012). Of course, infant findings are also explicable in terms of a perceptual familiarity preference (e.g. Mehler, Jusczyk, Lambertz, Halsted, Bertoncini, & Amiel-Tison, 1988; see also Butler, Floccia, Goslin, & Panneton, 2011; Cristiá, Minagawa-Kawai, Egorova, Gervain, Filippin, Cabrol, & Dupoux, 2014; Nazzi, Jusczyk, & Johnson, 2000) rather than a social response. To sum up, researchers have reported accent-based responding in a variety of tasks down to infancy. This is consistent with language or accent as an early, salient cue to group membership.

Children's detection of accents. Research on children's abilities to *detect* accents paints a different picture. Children around age 5 have difficulty recognizing which speakers have which accents (Floccia et al., 2009; Girard et al., 2008; Wagner et al., 2014), even when one of the accents is their own, with somewhat better performance in slightly older children (Floccia et al., 2009; Girard et al., 2008) and with foreign rather than regional accents. Note that adults in these studies (Floccia et al., 2009; Girard et al., 2008; Wagner et al., 2014) performed at or near ceiling. This suggests an age gradient in detecting accents.

Findings of weak accent recognition contrast strikingly with children's apparently strong accent-based social biases (e.g. Kinzler et al., 2007). However, they pattern with a broader class of phenomena in which perceptual learning seems to extend through at least several years of early childhood, referred to here as *protracted perceptual learning*. This includes recognition of voices (Creel & Jimenez, 2012; Mann, Diamond, & Carey, 1979), faces (e.g. Carey, Diamond, & Woods, 1980), vocal emotion (Nelson & Russell, 2011; Quam & Swingley, 2012), and certain speech sound characteristics (e.g. Ohde & Haley, 1997). Protracted learning accounts contrast with early learning accounts (e.g. Werker & Tees, 1984) which postulate that children converge on native perceptual categories by one year of age. On a protracted learning account, detecting accents—minimally, detecting that someone's accent is different from one's own—should become easier as the listener's native phonetic and phonological knowledge becomes entrenched.

It is not clear why these two sets of findings—precocious social accent sensitivity on the one hand, and late accent identification on the other—differ. It should be acknowledged that the spoken materials used vary from study to study, meaning that particular sentences, particular accent characteristics, or differences in accent strength might drive differences across studies. The current study aimed to address two other possible resolutions to the seemingly discrepant findings across studies. One possibility is that children are more sensitive to accents when directly asked to make a social judgment than when they are not asked to make a social judgment. Focusing children on social processing may be a more naturalistic way of assessing accent sensitivity. Second, the tasks used have different memory demands. For example, Kinzler et al.'s (2007) task with 5-year-olds asked children to listen to two speakers, and then select one who they want as their friend. This required that children maintain speaker-to-picture associations only for the duration of a trial. On the other hand, Floccia et al. (2009) asked 5-year-olds to press one button when hearing a local speaker and the other when hearing an "alien" (accented speaker). This required that 5-year-olds remember the associations between each of two response buttons and two accent categories for the duration of the *entire experiment*. Thus the Floccia et al. (2009) task has higher memory demands. On this basis one might argue that memory differences—not differences in children's underlyingly good accent sensitivity—drive the difference in results. These discrepancies call for studies that explore multiple measures of children's sensitivity using the same spoken materials, to discern how multiple lines of research relate to each other and provide a more unified picture of the development of accent recognition.

Children's awareness of talker identity. A third line of research that is relevant here explores children's sensitivity to vocal cues, but focuses on speaker identity rather than accents (Borovsky & Creel, 2014; Creel, 2012, 2014; Creel & Jiménez, 2012). These studies have assessed children's sensitivity to voice differences while processing sentences. In one study, Creel (2012) presented 3-5-year-old children with information that one talker liked one color (say, blue) and the other liked a different color (say, pink). The two talkers then alternated asking the child to show them shapes depicted on the screen ("Can you show me the square?"), which were either one or the other talker's favorite color. When the two talkers differed on the salient social dimension of gender, children visually fixated shapes of the talker's favorite color prior to hearing the actual shape name. However, when talkers were matched in age, gender, and dialect, children did not use talker information. In a similar paradigm, Borovsky and Creel (2014) showed that children interpreted sentences differently ("I want to hold the [wand/sword]") when they were spoken by speakers differing in gender and role, for example, a princess vs. a pirate. In both Creel (2012) and Borovsky and Creel (2014), children could have performed with perfect accuracy without using voice information. Thus, their sensitivity to voice information suggests that they *spontaneously* used talkers' identities when processing sentences. Finally, Creel and Jiménez (2012) found that children readily learned to map voices to novel cartoon characters if voices differed in gender (male/female) or age (child/adult), but showed weaker performance if voices were matched in age, gender, and dialect.

These studies together suggest that children readily detect salient social categories conveyed by vocal information and use them spontaneously while comprehending sentences. If accent differences (familiar vs. unfamiliar), like gender differences and age differences, are also salient social category cues that children readily use in person recognition and comprehension, then children should also use different accents as a cue to talker identity. Finding accent sensitivity in a natural sentence processing task that does not require an explicit social judgment but permits use of social category information would represent converging evidence in favor of accent as an early, salient social cue.

The current study

The literatures on social accent processing and accent recognition present somewhat divergent pictures. If children show early social sensitivity to accents (e.g. Kinzler et al., 2007), why can't children more easily recognize that someone *has* an accent (Floccia et al., 2009; Girard et al., 2008; Wagner et al., 2014)? Are the apparent differences in findings driven by differences in tasks used (memory demands), or are the studies tapping different sets of knowledge (social vs. cognitive)?

In an attempt to clarify the various factors affecting children's accent sensitivity, the current study tests children's sensitivity to a familiar accent (American-accented English) vs. an unfamiliar accent (Dutch-accented English) in two different situations. Experiment 1 represents the first assessment of 3-5-year-old listeners' use of accent differences in a sentence processing task (Borovsky & Creel, 2014; Creel, 2012). Experiment 2 tests children's sensitivity to the same pair of accents in a social decision-making task like that of Kinzler et al. (2007, 2009), across a wider age range than previously tested (3 to 7 years), and unlike previous work, assesses effects of age.

These studies speak to three questions. First, do vocal cues to accent—like vocal cues to gender or age—represent a salient social distinction to children? If so, 3-5-year-old children (and adult controls) should use accent characteristics to inform sentence processing, much as they use vocal cues to gender (Borovsky & Creel, 2014; Creel, 2012). Second, does social decision-making better assess accent sensitivity by focusing the child on socially-relevant characteristics? If so, accent sensitivity should be evident earlier in development for social decision-making tasks than sentence processing tasks, even using the same accented materials. Third, is accent sensitivity present from very early in development, or does it emerge over a more protracted developmental time course? If so, older children (and adults) should be more sensitive to accents than younger children, regardless of the nature of the task.

Experiment 1

This experiment asked whether children can associate different accents with different individuals. In previous research using two voices differing in gender (Creel, 2012), when children heard one speaker request a shape, they looked more to shapes of that speaker's favorite color than other-color shapes, even before the shape word was spoken. This suggests that children readily use voice gender as a cue to speaker identity. The current experiment explored whether children could use accent (Dutch vs. American) in an analogous way. That is, are children aware enough of accents to use accent information in the voice to infer different preferences depending on accent?

Method

Participants. Monolingual English-speaking children (n = 30; 15 female) aged 3-5 years (M = 4.75, SD = 0.57, range: 3.29-5.91) took part, and were tested in a quiet area in each child's preschool or day care facility. Monolingual English-speaking adults (n = 31) also took part in the lab. Three additional adult participants took part but were removed from eye tracking analysis due to exceptionally poor eye tracking. Three additional children took part but were removed from analyses due to high error rates (25% or greater).

Stimuli. Twelve Dutch speakers of English, as well as two native speakers of English from the Western United States, were recorded speaking a variety of materials. Dutch was selected for a set of planned studies in a larger project, for two reasons. First, Dutch is unlikely to be familiar to children in the United States. Second, Dutch is very well-characterized in terms of its phonetics and phonology (driven in part by a large psycholinguistics presence in the Netherlands), so we knew what to expect in terms of specific accent-related sound changes. Recordings included a set of sentences like those used in Creel (2012) to explore children's sensitivity to talker identity in sentence processing, and took the form "Can you show me the X?" where X was one of four shapes (star, square, triangle, circle). Other materials included a set of elicitation vowels, and words that contained speech sounds where two English categories map to a single Dutch category (see Adank, van Hout, & Smits, 2004; Booij, 1995).

Adult monolingual native speakers of English (*N*=15) rated the degree of accent for spoken sentences and passages by the 12 Dutch-accented speakers and the two US-accented speakers (1 female, 1 male). This is important because phonological similarities between Dutch and English might impose a ceiling on the strength of Dutch accents: Both Dutch and English are stress-timed Germanic languages with fairly large vowel inventories, potentially limiting the maximal degree of accentedness of Dutch speakers of English (see Bradlow, Clopper, Smiljanic, Walter, 2010, on Dutch-English sound similarities).

Results confirmed that adult native English speakers had no difficulty detecting the Dutch speakers' accents (Figure 1), verifying that the stimuli contained sufficient acoustic-phonetic features to permit accent detection. Dutch speakers' foreign accents were all highly detectable (more foreign-accented than either of the US speakers, $p < .0001$ in all cases). Findings also indicated that some Dutch speakers had stronger accents than others. To maximize accent detectability in child experiments, the initial goal was to select the most-accented male and most-accented female speaker. However, the most-accented female speaker was judged to have a strong idiolect—distinctive speech characteristics unrelated to the Dutch accent. Since the aim here was to study children's awareness of foreign accents, not idiosyncratic voice characteristics, the second-most-accented female speaker was used instead, along with the most-accented male speaker.

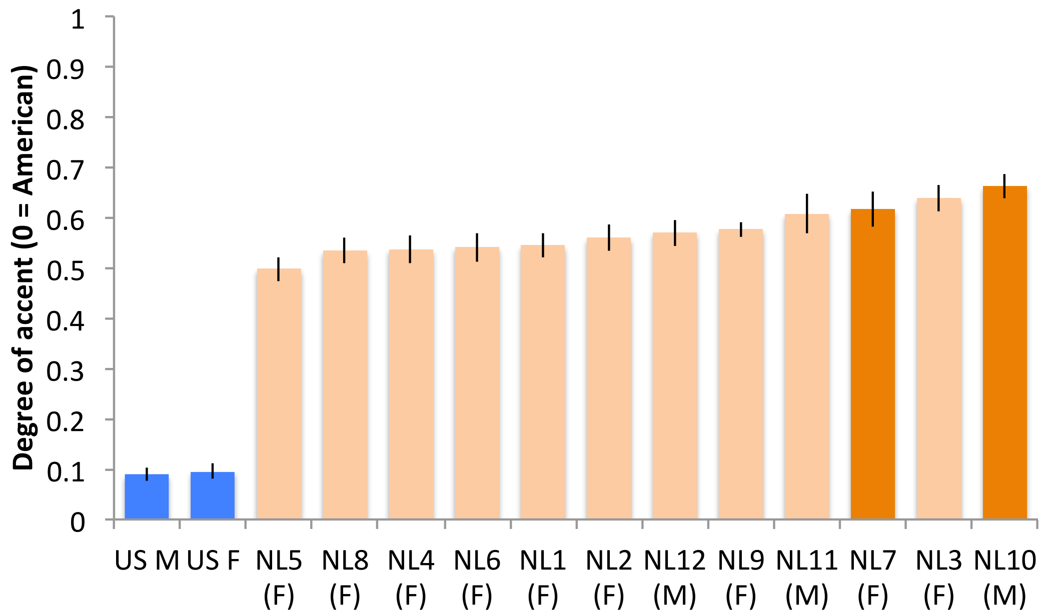

Figure 1. Accentedness ratings from 15 monolingual American English speakers. 0 = "No accent (American)"; 1 = "Strong accent." Dark bars on right indicate selected Dutch-accented speakers.

Thus, the final spoken materials included passages and sentences from 2 Dutch-accented and 2 US-accented talkers (1 female, 1 male in each set). Half of the participants heard two female talkers (one Dutch-accented, one US-accented), the other half heard two male talkers (one Dutch, one US). The average time of target word onset was 754 milliseconds (ms; SD = 112 ms). US speakers spoke more slowly (word onset time 848 ms ± 76 ms) than Dutch speakers (661 ms ± 34 ms; $t(14) = 6.33$, $p < .0001$, $d = 3.18$), perhaps because the two US speakers were more expert at speaking in a child-directed manner. Stimuli were also acoustically analyzed to characterize accent features. Analyses are detailed in the Appendix, but in brief, Dutch-accented speakers differed markedly from US-accented speakers in their “s” and “sh” productions, and they collapsed certain English vowel contrasts that are absent in Dutch (the vowels in “bet” and “bat”; the vowels in “look” and “Luke”; see Adank et al., 2004). Dutch speakers also spoke faster and had lower mean, minimum, and maximum pitch (but not pitch *range*, the ratio between maximum and minimum pitch).

Procedure. Children first heard two *favorite-color trials*, where each talker introduced herself verbally and stated her favorite color, either black or white. (Technically white and black differ in lightness, not hue, but the word “color” is used for simplicity.) Each talker was depicted as a cartoon character surrounded by objects of their favorite color (Figure 2a-b), and in the passage they named three favorite-color objects in the scene. The two speakers differed in accent but matched in gender. Half of children heard the two female speakers, half heard the two male speakers. Next were 8 color-selection trials, where two shapes differing only in color appeared, and each speaker asked, “Where’s the white/black one?” Each speaker asked only for shapes of their favorite color. In addition to reinforcing voice-color associations, this verified that children knew color names well enough to do the task. If a child did not achieve 7 or 8 correct (only one child), they repeated the color-selection trials. Next, the two favorite-color trials repeated. Last were 32 test trials. Each test trial (Figure 2c) depicted four shapes (circle, square, triangle, star): two white, two black. As children viewed these shapes, they heard a speaker request one shape: Anna might say “Can you show me the circle?” The child’s task was simply to point to the requested shape.

It was not expected that children would show much difficulty in recognizing shape names, as the shape names are not very phonologically similar, even in Dutch accents. Of greater theoretical interest were eye movements: would children visually fixate shapes of the speaker’s preferred color, prior to hearing the shape word itself? If so, this would indicate that they had recognized the speaker's accent and were making on-line inferences about which shapes might be mentioned.

Figure 2. Experiment 1, (a, b) characters on favorite-color trials; (c) test trial display (character spoke but was not visible).

Results

Accuracy. Children's accuracy[1] was nearly at ceiling (US speakers: 96.7%, SD = 5.1%; Dutch speakers: 94.4%, SD = 7.8%). Children's data were analyzed in a logistic regression model (lme4, Bates, Maechler, Bolker, & Walker, 2014) with factors Talker Gender (male talker pair, female talker pair; between subjects) and Talker Nationality (Dutch, American). Both factors were sum-coded (i.e., centered on the mean) to allow ANOVA-like interpretation of effects. Shape (square, star, triangle, circle) was included as a random effect (intercept plus effects and interaction). The full random effects structure justified by the model was specified initially (as recommended by Barr, Levy, Scheepers, & Tily, 2013), but because the model was unidentifiable, the random-effects correlations were dropped (see Barr et al., 2013). Effects were tested by maximum likelihood comparison in R (R Core Team, 2014). Specifically, the full model was compared to a model with the fixed effect of interest removed, to determine whether

[1] As adults only made five errors (an error rate of 0.3%), low enough to preclude model fitting, their accuracy data were not analyzed.

the effect of interest contributed significant variance with all other factors accounted for. The model also included an offset of logit(.25), so that the intercept term assessed whether the grand mean differed from .25 (chance of 1/4) rather than the default .5.

The model intercept was significant ($\beta = 4.67$, SE = 0.34; $\chi^2 = 20.26$, $p < .0001$), suggesting that children were far more accurate than chance. Despite numerically higher accuracy for American-accented sentences, the effect of Talker Nationality on accuracy did not reach significance ($\beta = 0.28$, SE = 0.17; $\chi^2 = 2.18$, $p = .14$), suggesting that the Dutch accent did not cause much comprehension difficulty. Neither Talker Gender nor the interaction term approached significance.

Eye movements. The criterion for including an eye tracking trial was that the participant had to be looking at an object on the screen (four shapes or central fixation cross) at least 50% of time in the window. To be included in eye tracking analyses, the participant had to have at least 8 usable trials per accent (50%). This excluded three adult participants. For included participants, 16% of trials were dropped for low looking proportions (15.4% for adults, 16.7% for children). One further adult participant was excluded because they looked only at the central fixation cross for the entire window of analysis.

The pre-target analysis window was set to 200-950 ms. This was based on two considerations. First, this time window encompassed the average sentence duration prior to target word onset (0-754 ms), and thus looks were not influenced by the target name itself. In principle, participants might visually fixate shapes of the same color as the target once they know what the target is. Second, as is standard, the window included a forward shift in time of 200 ms, which is roughly how fast listeners are thought to be able to plan and execute a speech-based eye movement (Salverda, Kleinschmidt, & Tanenhaus, 2014).

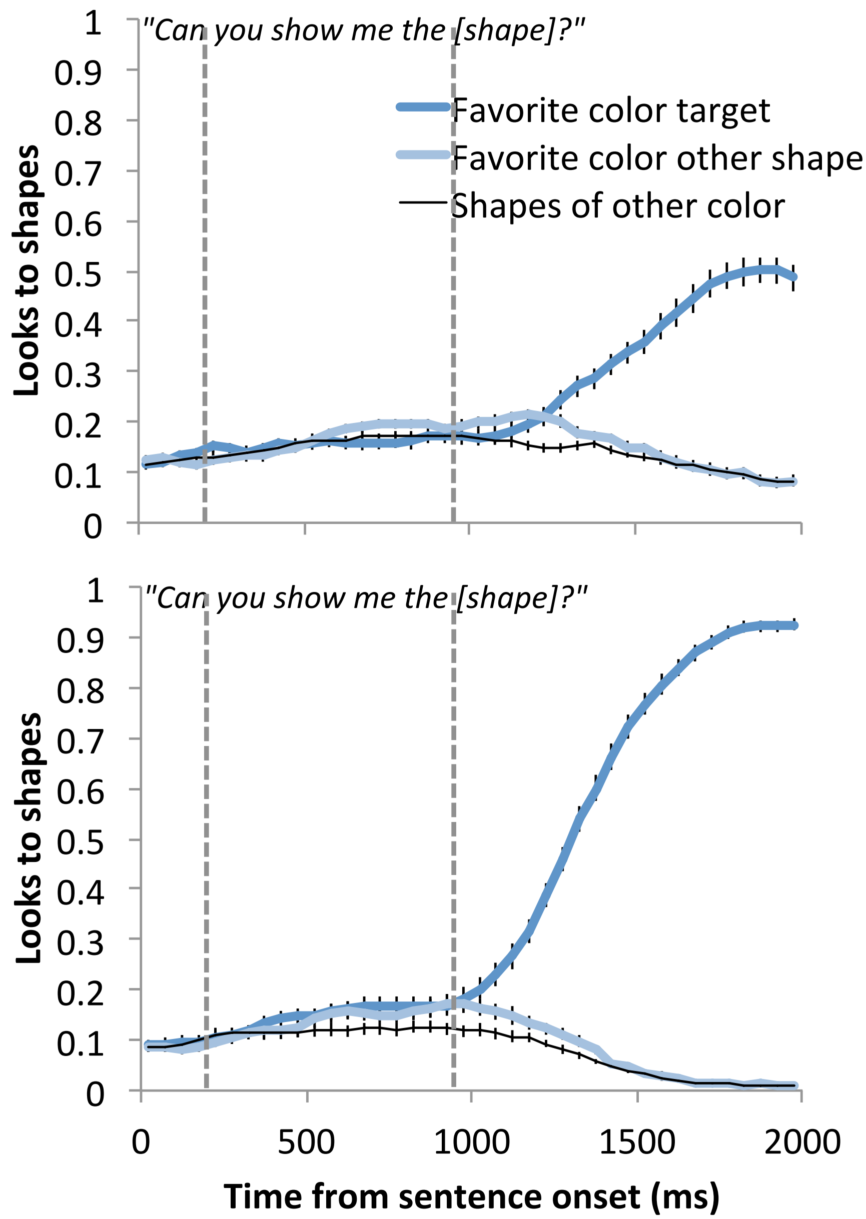

Figure 3. Experiment 1, eye movements to pictures (upper: children; lower: adults). Dashed lines indicate analyzed time window from start of trial to just prior to target word onset, shifted forward 200 milliseconds to allow for time to execute speech-based eye movements.

Looking proportions to favorite-color shapes and to other-color shapes were calculated for each subject and each condition during the pre-target-name window (200-950 ms). These proportions were empirical-logit transformed (Barr, 2008) and used to compute a difference score (favorite – other). If this is positive, it reflects that participants are visually fixating favorite-color shapes more than other shapes prior to shape word onset.

Children's eye movements reflected no substantial deviations toward favorite-color shapes. The color-looking preference was the dependent measure in an ANOVA with Talker Gender (between-subjects) and Talker Nationality (within subjects) as factors. Children showed an effect of Talker Gender ($F(1,28) = 5.45$, $p = .03$, $\eta^2_P = .16$). This was driven by a color-looking preference for the male talker pair ($t(14) = 2.48$, $p = .03$, $d = .64$), but a nonsignificantly negative color-looking preference for the female talker pair ($t(14) = -1.42$, $p = .18$, $d = -.37$). Neither Talker Nationality nor the interaction approached significance. Collapsed across talker gender, children's color-looking preference did not differ from zero ($t(29) = 0.528$, $p = .60$, $d = .10$),[2] suggesting that overall, children did not look preferentially to colors based on accent.

Control adult participants showed a different pattern. In the ANOVA, neither of the effects nor the interaction approached significance. However, the *t*-test comparing color-looking preference to zero *was* significant ($t(30) = 2.60$, $p = .01$, $d = .47$; Figure 3, lower), indicating that adults, unlike children, looked preferentially to talkers' favorite-color shapes prior to the target being named. Adults showed marginally greater preferred-color looking than children did ($t(59) = 1.74$, $p = .09$, $d = .41$), perhaps reflecting a numerical tendency toward preferred-color looks in children, or instead, the subtlety of the adult effect. In any case, there is strong evidence for adults' use of accents in sentence processing, but little evidence for children.

Discussion

---

[2] Adjusting the window to 200-1200 ms to match the window used in Creel (2012) did not shift this to significance ($t(29) = 1.27$, $p = .21$, $d = .23$).

While both groups showed good comprehension of accented talkers, only adults used accent differences to guide interpretation of spoken sentences. Children showed no evidence of doing so. This finding suggests that differently-accented speakers may not be as distinct to young children as are different-gender or different-age speakers (Creel, 2012; Creel & Jiménez, 2012).

Children's excellent comprehension might indicate that the accents used were too mild to impact comprehension. On the other hand, it may simply reflect that, of the four salient response options on each trial (square, circle, star, triangle), the pictures' names were sufficiently phonologically distinct that the presence of a foreign accent did not impede comprehension.[3] This is perhaps not surprising given findings of good accented speech comprehension in even younger children (Van Heugten & Johnson, in press, in 28-month-olds; Mulak, Best, Tyler, Kitamura, & Irwin, 2013, in 19-month-olds).

The major finding here, thus, is that 3-5-year-old children do not use accent differences spontaneously while processing sentences. One account of these findings is that children have difficulty even detecting the presence of the accent, and are therefore unable to use accentedness to differentiate speakers. This account fits with evidence that children have difficulty identifying (at least some) accents (Floccia et al., 2009; Girard et al., 2008; Wagner et al., 2014). Interestingly, those earlier studies suggested that regional accents are more difficult to detect than foreign accents, while the current study suggests that at least one *foreign* accent may be hard for young children to detect. In any case, the sentence processing task here patterns with

[3] A follow-up experiment verified that children had difficulty distinguishing words produced by the same Dutch-accented speakers in the presence of what one might call "accent mergers." Selecting the correct pictured referent for Dutch-accented pairs bed/bat, head/hat, and hook/hug proved nearly impossible (accuracy 52% ± 20% for 24 children, vs. 92% ± 15% for US-accented trials), due to lack of distinction in vowel quality and coda voicing.

earlier accent identification studies in suggesting that accent sensitivity takes many years of development to emerge—in this case, somewhere between age 5 and young adulthood.

However, the current data seem inconsistent with the collection of findings of perceptual and social accent sensitivity across a range of very young ages (Corriveau et al., 2013; Hirschfeld & Gelman, 1997; Kinzler et al., 2007, 2011, 2012). Thus, a different account of the current findings is that children are capable of detecting accents at this age, but Experiment 1's shape-selection paradigm was not optimized for detecting accent sensitivity, for one of two reasons. First, it required children to maintain the association of accent to color preference for the entire duration of the experiment. Second, children's attention may have been focused on choosing shapes rather than inspecting the two speakers' social characteristics. A paradigm more like the one used by Kinzler et al. (2007, 2009) with 5-year-olds might be more sensitive because memory demands are milder (they only need to remember which of two speakers is accented for the duration of each trial), and because it focuses children's attention on social processing. To assess this possibility, the next experiment tested children's sensitivity to accent in a friend selection task closely modeled on Kinzler et al. (2007), using the same materials as in Experiment 1.

Experiment 2

Children completed a friendship-judgment task patterned on Kinzler et al. (2007), using the same recordings as were used in Experiment 1. If children can detect accents but did not show this ability in Experiment 1's more memory-demanding test conditions, or because Experiment 1 did not focus children on social processing, then they should show an own-accent bias in friend selection, as found in previous research (Kinzler et al., 2007, 2009). After the main friend-selection task, children additionally completed a location-judgment task where they were asked, after hearing a single sentence, whether the speaker was “from here” or “not from here.” This location judgment requires overt knowledge of geographical correlates of accent variability. It might be expected to pattern with the friendship judgments if friendship judgments reflect awareness of accent unfamiliarity. On the other hand, if friendship judgments are calculated more implicitly based on a speaker “sounding weird” relative to the child’s native-language sound representations, then friendship judgments may show stronger effects than geography judgments.

Method

Participants. Children ranging in age from 3.07-7.97 years (M=5.47 years ± 1.34 years; *N*=68; 31 female) took part. An initial group of children in the same preschool age range as in Experiment 1 (ages 3.1-5.4 years) showed statistically significant (χ^2 = 6.99, p = .008, β = 24, SE = .09) but numerically unimpressive (56% ± 14%) accent biases. Therefore, a second wave of older children was recruited (5.5-7.97 years) to test for the possibility of an age trajectory. Six additional children took part but declined to finish the experiment (5) or were inattentive (1).

Stimuli. Auditory stimuli were those used in Experiment 1. Visual stimuli were pictures of children’s faces (8 female, 8 male), selected from Creative-Commons licensed photographs on the web site flickr.com. Photos were cropped and edited to show only the face and hair of each child, and resized to 350 x 350 pixels. Faces that appeared side by side were matched for gender, eye color, approximate hair color and style, and approximate skin tone.

Procedure. Because hypotheses centered mainly around the friend selection task, it always occurred first. This task closely followed Kinzler et al.’s (2007) study. During the friend selection task (16 trials), the experimenter controlled the sequence of events on a trial, as outlined in Table 1. On each trial, two faces appeared, each looming as it “spoke” in turn. One face spoke in a US accent, the other spoke in a Dutch accent. Children indicated their friendship preferences by pointing. Each face appeared twice, and each voice occurred equally often for a particular child and equally often as the first voice and the second voice. For each child, the order of the sound files (US English, Dutch-accented English) was counterbalanced. Face pairs were yoked so that each character appeared with the same other face on two different trials, but with voice assignments reversed on the second occurrence. Trials using the same face pair never occurred consecutively. Eight lists were created; four of them presented the characters in the mirror-reverse positions of the other four. Nonetheless, each child heard each voice in each order equally often during the experiment. Order of trials in each list was prerandomized with the constraints that: the same character pair did not appear on consecutive trials; no more than three trials of the same character gender occurred in a row; no more than three trials of the same picture name occurred in a row; no more than three trials with the same accent presentation order occurred in a row. For a given child, a particular face occurred twice, once with each accent, meaning that responses based on preferring a particular face should generate chance responding.

Following the friend selection task, children completed a location judgment task (32 trials). This began with asking children where they lived. Most (76%) replied “California” or “America.” Those who did not (13/16 were under age 5) were corrected. They were then asked to say whether a speaker on a given trial was “from here” or “not from here.” On each of 32 trials, a cartoon character appeared (similar to that in Figure 2), and it “spoke” one of the sentences from the friend-selection task. Children responded verbally, and an experimenter entered the response by keyboard.

Table 1. Experiment 2, friend selection task, order of events in a trial.

Event	Outcome
Keypress	Two pictures appear, 200 x 200 pixels each
	Experimenter: "let's listen to this one (point left)"
Keypress	Left face enlarges (350 x 350 pixels) and speaks
Keypress	Left face returns to 200 x 200 size
	Experimenter points to right face
Keypress	Right face enlarges (350 x 350 pixels) and speaks
Keypress	Right face returns to 200 x 200 size
	Experimenter: "Who do you want to have as your friend?"
Child points	
Keypress: 1 OR 2	Experimenter presses 1 (left) or 2 (right) key to indicate child's selection

Results

Predictions were tested in logistic regression models with Age (scaled and mean-centered) as a predictor. Random effects included intercepts for Participant and Sound File (for the friendship selection task, this was which Dutch-accented sound file was heard on a trial, but for the geography task, this was which exact sound file was heard). Two models were computed: one with Native-Accent Preference as the dependent variable (select own-accent speaker = 1, select other-accent speaker = 0), and one with Location Judgment as the dependent variable (correct = 1, incorrect = 0). Effects again were tested by maximum likelihood comparison. The intercept term assessed whether the grand mean differed from chance (.5).

Native-accent preference. As already noted, the younger half of children showed a significant own-accent preference (($\chi^2 = 6.99$, $p = .008$, $\beta = 24$, SE = .09)—suggesting that the social-processing task may in fact be more sensitive than the sentence processing task in Experiment 1. However, this effect was risibly weak (56% own-accent choices), motivating the collection of data from older children.

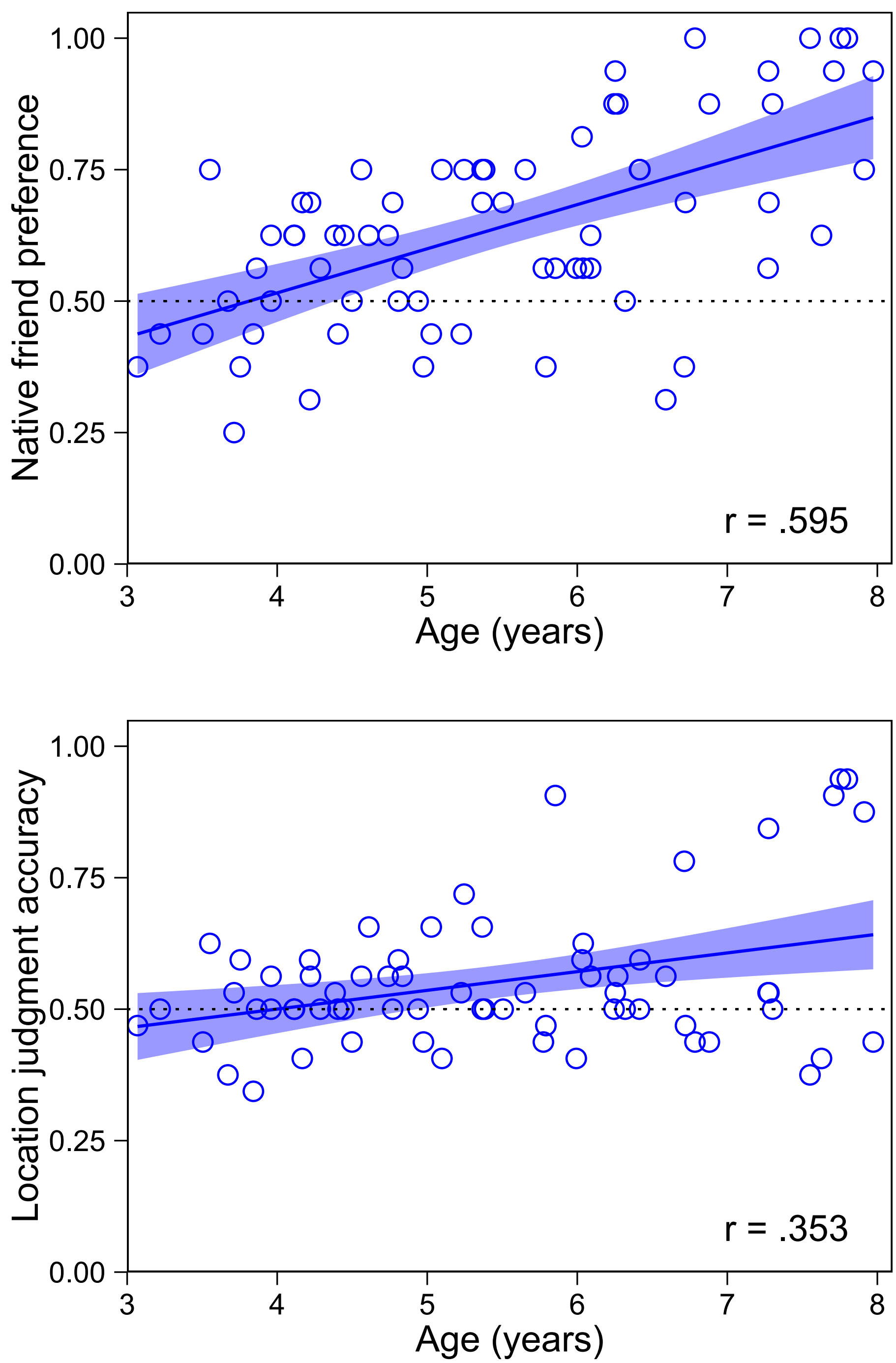

Figure 4. Experiment 2, age effect on (a) friendship selections and (b) location task. Dashed line = chance performance. Hollow circles are individual participants. Shaded regions around regression lines are 95% confidence intervals.

In the full sample, children selected US-accented talkers as friends 64% (SD=19%) of the time (Figure 4a, Table 2). This was greater than chance ($\chi^2 = 15.30$, $p < .0001$; $\beta = .66$, SE = .11), but weaker than other studies with 5-6-year-olds, which report rates of native-friend selection as high as 80%-90% (Kinzler et al., 2007, 2009). To gauge whether accent bias increased with age, we used age as a centered continuous predictor of own-accent preference. Native-accent preference increased with age (Figure 4a; Age effect, $\chi^2 = 31.03$, $p < .0001$; $\beta = .57$, SE = .10). In raw accuracy values, this represents a correlation of $r = .595$. This strong relationship with age suggests that, at least for the Dutch accent used here, there is a change over development such that the use of accent cues to make friendship decisions emerges gradually between ages 3 and 7 years.

Table 2. Experiment 2, performance (SD) by age group, for comparison to previous studies.

Age	**N**	**Native friend preference**	**Geography knowledge**
3-year-olds	11	0.477 (0.135)	0.494 (0.086)
4-year-olds	18	0.571 (0.117)	0.523 (0.062)
5-year-olds	13	0.620 (0.138)	0.555 (0.143)
6-year-olds	15	0.700 (0.206)	0.548 (0.086)
7-year-olds	11	0.847 (0.161)	0.662 (0.234)

Location judgment. Children showed limited awareness of which voices are "from here" vs. "not from here" (55%±14%, Figure 4b, Table 2; low but above chance, ($\chi^2 = 6.93$, $p = .008$; $\beta = .23$, SE = .08). There was an effect of Age ($\chi^2 = 4.73$, $p = .002$; $\beta = .21$, SE = .07), reflecting a correlation with raw accuracy values of $r = .353$. Note that the age correlation appears to be driven by a small number of high scores in the older children. If scores more than 2.5 *SD*s above the mean are removed (those > .890; $n = 4$), the correlation misses significance. Additionally, a model comparing own-accent preference to location knowledge (without items random effects, because items are not comparable across the two tests) showed that the own-accent preference was stronger than location accuracy ($\chi^2 = 12.71$, $p = .0004$; $\beta = -.20$, SE = .05). Native-accent bias and location knowledge were mildly positively correlated ($r = .25$, $p = .04$), but a linear regression model predicting native-accent bias from age and location-task score showed no effect of location knowledge ($p = .70$; $\beta = .01$, SE = .02) and a very large effect of age ($p < .0001$; $\beta = .11$, SE = .02). This suggests that knowledge about geographical differences in accents does not drive social biases.

Discussion

Children's use of accent to make decisions about friendship changes markedly with age between 3 and 7 years. Like Experiment 1, this is consistent with research suggesting that children as old as age 5 have difficulty identifying that a speaker has an accent, with better performance by age 7 years (Floccia et al., 2009; Girard et al., 2008).

Results are somewhat less congruent with findings from the social accent literature (Kinzler et al., 2007, 2009). Specifically, the results in the current paper suggest that accent sensitivity may emerge slowly as age increases, rather than being present from infancy. Of course, the current study tested younger children than those tested in Kinzler et al. (2007, 2009), raising the possibility that the apparent lack of accent sensitivity in the youngest children actually reflects task difficulty instead. That is, perhaps this task only "works" for children aged 5 and older.

To assess whether the youngest children failed to show accent effects because they did not understand the task or what it means to have a friend, we performed a control experiment with 3-4-year-olds, the youngest ages tested in Experiment 2 ($N = 30$; 15 3-year-olds, 15 4-year-olds, M = 4.05 ± 0.47 years; range: 3.19-4.97). Visual stimuli and instructions were identical to Experiment 2, but instead of speakers with two different accents on each trial, the two speakers differed in a quality that young children are known to be sensitive to, niceness (e.g., Wellman, & Gelman, 2013; see also Kinzler & DeJesus, 2013). One speaker said something nice (e.g. "I like to help people!") and the other said something similar but mean ("I like to hurt people!"; order of nice and mean statements was counterbalanced across trials; there were four different phrase pairs). As before, children were then asked who they wanted to be friends with. If they cannot do the task, then friend preferences should be at chance. However, if they do understand the task but could not (or did not) use accent to make decisions in Experiment 2, they should show friend preferences here.

These young children selected the nice speaker 78% (SD = 41%) of the time (3-year-olds: 69%; 4-year-olds: 88%), which is above chance ($\beta = 2.12$, SE = .47; $\chi^2 = 27.61$, $p < .0001$) and is also much stronger than the 54% own-*accent* preference that 3- and 4-year-olds showed in Experiment 2 ($\beta = .71$, SE = .12; $\chi^2 = 35.66$, $p < .0001$).

This suggests that even 3- and 4-year-olds comprehend the task used in Experiment 2, ruling out a task-misunderstanding account of the weak-to-absent accent effects in children. It is still consistent with an account that children do not detect the presence of an accent. The possibility remains that the youngest children understand the task and can detect the accent, but do not think it is relevant to friendship. However, if this is true, it undermines the accent-as-early-social-signal account.

Returning to discussion of Experiment 2's results, there is also a hint that children's accent sensitivity may reflect *perceptual mismatch* rather than detection of outgroup status. Specifically, children's responses as to whether speakers were "from here" were less deterministic than responses in the friend-selection task: even many of the oldest children had difficulty identifying the non-Californians. Further, performance on the location task did not predict native-accent bias in a model where age was controlled for. This is more consistent with a perceptual-mismatch account of accent bias than a world-knowledge account. Other research suggests that children may have fairly limited geographical knowledge at this age (e.g. Bourchier, Barrett, & Lyons, 2002), implying that geography may be a weak point in children's knowledge about other cultures. It is also possible that our child participants, while monolingual, may have experienced accented speakers in the diverse city they live in, which would suggest to them that an unfamiliar accent is not correlated with a different geographical location. Perhaps other cultural differences (foods, clothing, houses) are more salient earlier on (see Hirschfeld & Gelman, 1997), a fruitful topic for future consideration.

General Discussion

Two experiments tested young children's sensitivity to accents. In Experiment 1, 3-5-year-olds did not show different interpretations of sentences (looks to the speaker's favorite color) according to accent, in a paradigm where children previously showed sensitivity to speaker gender (Creel, 2012). Experiment 2 tested whether a social decision-making task would reveal stronger sensitivity to accents, and it did not do so to an impressive degree: while children at the age of those tested in Experiment 1 showed significant accent bias, the effect was quite small (56%). The more striking effect was the strong increase in own-accent preference across the entire age range (3 years to 7 years).

The findings here make several novel contributions to the literature. First, accent categories may not represent a salient social distinction to preschool-aged children in the same way that gender or age are salient distinctions (Creel, 2012; Creel & Jiménez, 2012). While children in previous studies readily used talker gender to facilitate speech processing (Borovsky & Creel, 2014; Creel, 2012) and used gender and age differences in recognizing voices (Creel & Jiménez, 2012), categories based on accent differences may not be available in the same way. Second, social-decision-making tasks are not substantially more sensitive than less explicitly-social tasks. While this does not rule out a task's memory demands as a factor in previous findings of weak accent sensitivity in young children (Floccia et al., 2009; Girard et al., 2008; Wagner et al., 2014), it suggests that even social decision-making is constrained by how readily an accent is detected. Finally, detection of accentedness, rather than being available early in life, may emerge slowly during development, consistent with a protracted perceptual learning account of speech processing. That is, children become better at detecting that an accent is different from their own as their native phonological knowledge becomes more and more entrenched, which may take a substantial amount of time. This protracted learning account would fit with children's relatively slow-developing abilities to differentiate voices (Creel & Jimenez, 2012; Mann, Diamond, & Carey, 1979) and to recognize vocal cues to affective state (Nelson & Russell, 2011; Quam & Swingley, 2012).

Protracted perceptual learning

The current research suggests that accent sensitivity increases with age. The author's preferred explanation is that listeners may need extended perceptual exposure to—*protracted learning* of—their own accent patterns in order to recognize deviations from that pattern. However, there have been demonstrations of infants detecting accent changes at 5 months (Butler et al., 2011; Cristiá et al., 2014; Nazzi et al., 2000). How does this fit with children aged

5 years having difficulty detecting accents (Floccia et al., 2009; Girard et al., 2008; Wagner et al., 2014)? One might posit a U-shaped function in accent sensitivity, with the bottom of the U occurring in early childhood, perhaps because young children are working to learn words, and so temporarily "tune out" accent variability in order to focus on meaningful sound variation. However, a more continuous account of developmental change in accent sensitivity is that tasks used with infants are specialized to reduce memory demands (see Creel & Quam, 2015, for discussion), which gives the superficial appearance of better performance, but in reality accent sensitivity shows slow, steady increases. The protracted learning hypothesis suggests that, were it possible to test young children in a dishabituation paradigm (with the same memory support as paradigms used with infants), those young children should show better accent sensitivity than infants.

Limitations and future directions

The account here suggests that accent sensitivity develops slowly, based on the finding that even in an explicitly-social task (Experiment 2), the youngest children show weak accent biases, despite good understanding of the task. However, an alternative explanation raised earlier is that children may still be detecting accents, but do not find it relevant to selecting friends. This bears further exploration: perhaps children are more responsive to accents in other situations (see, e.g., Corriveau et al., 2013; Kinzler, Corriveau, & Harris, 2011). However, to the extent that children care little about accents in at least one social decision-making task, it tends to weaken the case for accent as an early social signal of group membership. If effects only appear in a limited range of tasks, it seems less likely that accent is a salient social signal than that accent is one of a variety of social signals that are available to children, whose effects can be modulated by cue strength and cue competition.

A number of additional open questions remain. First, the role of accent strength needs to be addressed, as this may explain some variance across previous studies. Second, effects of accent *familiarity* remain largely unexplored. For example, if children grow up regularly hearing an accent that is not their own, are they better at recognizing this accent? Are they more positively disposed to this and other, unfamiliar accents (see Souza, Byers-Heinlein, & Poulin-Dubois, 2013, for evidence that they are not)? A third question concerns ease of comprehension. While some studies suggest that nonnative speech sound properties on their own are sufficient to trigger social judgments (e.g. Hirschfeld & Gelman, 1997; Kinzler et al., 2011), it would be surprising if children did *not* factor in comprehensibility in their accent-based social decision-making: ease of communication is a desirable quality in a social partner. Finally, how much are children's judgments driven by a speaker sounding atypical—predicting that someone with, say, a robot-like or hyper-nasal voice would be a less appealing social partner—vs. someone sounding like they are from a different culture? Given the small number of voices used here, it is possible that children were responding to some idiosyncratic voice properties in addition to, or even related to, accent (see Gick, Wilson, Koch, & Cook, 2004 on language-specific articulatory settings; and Mennen, Scobbie, de Leeuw, Schaeffler & Schaeffler, 2010, on effects of articulatory setting on second-language production). Future work should explore a larger range of voices of each accent to make certain that effects generalize over voices. Answering these questions will help us understand when and why young children prefer familiar accents or languages (Kinzler et al., 2007, 2009), and how these preferences evolve into more nuanced language-based social judgments that sometimes disfavor their own language group (Campbell-

Kibler, 2007; Kinzler, Shutts, & Spelke, 2012; Lambert, Hodgson, Gardner, & Fillenbaum, 1960).

Conclusion

Two experiments explored American children's responsiveness to American-accented vs. Dutch-accented English. Unlike earlier studies of voice gender (Borovsky & Creel, 2014; Creel, 2012), 3-5-year-old children did not use accent differences to inform sentence processing. A social-decision-making task suggested that this may have been driven by younger children failing to detect the accent, with a strong increase in accent bias from age 3 years to age 7 years. Results are more consistent with a protracted perceptual learning account of accent sensitivity than with an account that accent is a salient, early social signal.

Appendix A

Pitch and timing. Pitch and duration measurements were made on target words. Due to excessive creaky voice in phrase-final position, one mean token was dropped for the Dutch-accented female. Americans showed higher mean, minimum, and maximum pitch, and a slower rate of speech, than Dutch speakers. However, Creel and Jiménez (2012) found that children ages 3-5 had difficulty differentiating same-gender voices that were even more distinct in their prosodic characteristics, suggesting that this was not likely to have driven effects.

Table A1. Characteristics of speakers' target word pitches and

		Pitch (Hz)			Range	Duration	Center of gravity		Spectral skew	
		Mean	Min	Max	(Max/Min)	(s)	/s/	/ʃ/	/s/	/ʃ/
US	female	301	195	473	1.582	0.717	7851	4368	-0.79	1.30
	male	208	129	316	1.534	0.713	6387	3950	-0.16	0.88
Dutch	female	251	176	341	1.343	0.607	5244	5297	1.54	0.68
	male	108	72	183	1.707	0.640	5016	4896	0.74	0.55
US ≠ Dutch		**	**	***	ns	**	***	***	***	*

* $p < .05$; ** $p < .01$; *** $p < .001$. T-tests are unpaired because pairing correspondences are unclear, and this is a more conservative test.

Fricatives. The two voiceless sibilant fricatives /s/ and /ʃ/ were prominent in the tested sentences (the word "show" occurred in each sentence, and three of the four shape names began with /s/). These two sounds are phonemic in English, with many minimal pairs (sell/shell, sock/shock, etc.). Those fricatives also occur in Dutch, but are allophonic (conditioned by the surrounding sounds) and have somewhat different acoustic characteristics (Evers, Reetz, & Lahiri, 1998). Thus one might expect Dutch sibilants—prominent in the test sentences—to differ from American English sibilants. Following Jongman, Wayland, and Wong (2000), properties of the fricatives were measured. Each speaker provided three /s/ tokens (circle, star, square) and four /ʃ/ tokens (four instances of the word "show"). Americans showed higher spectral center of gravity and skew for /s/ than Dutch speakers did, and *lower* spectral center of gravity and skew for /ʃ/ than Dutch speakers did.

In fact, Dutch speakers did not differentiate /s/ from /ʃ/ in terms of spectral center of gravity ($t(12) = 0.14$, $p = .89$, $d = 0.08$), while Americans did ($t(12) = 8.37$, $p < .0001$, $d = 4.20$). While Dutch speakers did distinguish the sounds in terms of spectral skew ($t(12) = 2.48$, $p = .03$, $d = 1.31$), this went in the opposite direction of Americans (/s/ > /ʃ/; $t(12) = 5.66$, $p = .0001$, $d = 3.06$), who were consistent with Jongman et al.'s (2000) findings.

The sentences used for testing were not optimized for assessing vowel spaces, so the additional vowel elicitation stimuli recorded from the same speakers were used (exception: the US female speaker was not available so an additional US female speaker was used). Because female speakers reliably have higher formants than males generally, and because the male Dutch speaker had very low formants, formant values were *z*-scored within each speaker to compare phonetic properties (Figure A1; see Clopper, 2009, on various normalization schemes). These stimuli showed distinct differences between the US and Dutch speakers. For example, American speakers differentiated the vowel pairs /æ, ɛ/ and /u, ʊ/, while Dutch speakers did not. This is consistent with Dutch containing only a single vowel in each of those regions of F1-F2 space (Adank et al., 2004), whereas English contains two vowels in each region. Across accents, US speakers showed higher /ɛ/ and lower /æ/ and /a/ relative to Dutch speakers. US speakers also appeared to show more centralized /ɪ/ and /ɛ/ relative to Dutch speakers.

Dutch speakers, unlike US speakers, tended to produce the consonant in the word "the" as a stop rather than a fricative ("the" was produced as /də/). Acoustically, this was evident from visible release bursts in all 8 cases for Dutch speakers' spectrograms, which were rarely visible (2/8) for US speakers.

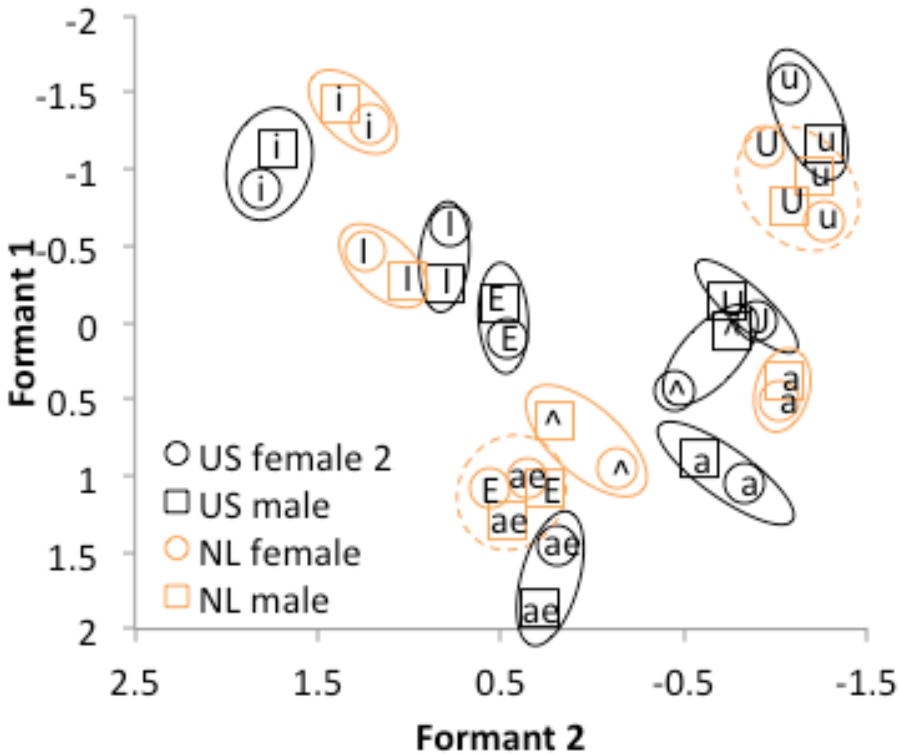

Figure A1. Normalized vowel spaces of US and Dutch-accented speakers (original US female was replaced with a second US female). Ellipses encompass vowels within an accent. Dashed ellipses indicate loss of contrast.

References

Abercrombie, D. (1967). *Elements of general phonetics*. Chicago: Aldine Publishing.

Adank, P., van Hout, R., & Smits, R. (2004). An acoustic description of the vowels of Northern and Southern Standard Dutch. *Journal of the Acoustical Society of America*, *116*(3), 1729. doi:10.1121/1.1779271

Barr, D. J. (2008). Analyzing "visual world" eyetracking data using multilevel logistic regression. *Journal of Memory and Language*, *59*(4), 457–474. doi:10.1016/j.jml.2007.09.002

Barr, D. J., Levy, R., Scheepers, C., & Tily, H. J. (2013). Random effects structure for confirmatory hypothesis testing: Keep it maximal. *Journal of Memory and Language*, *68*(3), 255–278. doi:10.1016/j.jml.2012.11.001

Bates, D,. Maechler, M., Bolker, B., and Walker, S. (2014). *lme4: Linear mixed-effects models using Eigen and S4*. R package version 1.1-7, URL: http://CRAN.R-project.org/package=lme4

Blair, L. M., & Conner, H. S. (1978). Black and rural accents found to lessen job opportunities. *Monthly Labor Review*, (May), 35–36.

Booij, G. (1995). *The phonology of Dutch*. New York: Oxford UP.

Borovsky, A., & Creel, S. C. (2014). Children and adults integrate talker and verb information in online processing. *Developmental Psychology*, *50*(5), 1600–13. doi:10.1037/a0035591

Bourchier, A., Barrett, M., & Lyons, E. (2002). The predictors of children's geographical knowledge of other countries. *Journal of Environmental Psychology*, *22*, 79–94. doi:10.1006/jevp.2002.0247

Bradlow, A. R., Clopper, C. G., Smiljanic, R., & Walter, M. A. (2010). A Perceptual Phonetic Similarity Space for Languages: Evidence from Five Native Language Listener Groups. *Speech Communication*, *52*(11-12), 930–942. doi:10.1016/j.specom.2010.06.003

Butler, J., Floccia, C., Goslin, J., & Panneton, R. (2011). Infants' Discrimination of Familiar and Unfamiliar Accents in Speech. *Infancy*, *16*(4), 392–417. doi:10.1111/j.1532-7078.2010.00050.x

Campbell-Kibler, K. (2007). Accent, (ing), and the social logic of listener perceptions. *American Speech*, *82*(1), 32–64. doi:10.1215/00031283-2007-002

Campbell-Kibler, K. (2011). Intersecting variables and perceived sexual orientation in men. *American Speech*, *86*(1), 52–68. doi:10.1215/00031283-1277510

Carey, S., Diamond, R., & Woods, B. (1980). Development of face recognition: A maturational component? *Developmental Psychology*, *16*(4), 257–269. doi:10.1037//0012-1649.16.4.257

Clopper, C. G. (2009). Computational methods for normalizing acoustic vowel data for talker differences. *Language and Linguistics Compass, 3*(6), 1430–1442. doi:10.1111/j.1749-818X.2009.00165.x

Clopper, C. G., & Pisoni, D. B. (2004). Homebodies and army brats: Some effects of early linguistic experience and residential history on dialect categorization. *Language Variation and Change, 16*(1), 31–48. doi:10.1017/S0954394504161036

Corriveau, K. H., Kinzler, K. D., & Harris, P. L. (2013). Accuracy trumps accent in children's endorsement of object labels. *Developmental Psychology*, *49*(3), 470–9. doi:10.1037/a0030604

Creel, S. C. (2012). Preschoolers' use of talker information in on-line comprehension. *Child Development*, *83*(6), 2042–56. doi:10.1111/j.1467-8624.2012.01816.x

Creel, S. C. (2014). Preschoolers' flexible use of talker information during word learning. *Journal of Memory and Language, 73*, 81–98.

Creel, S. C., & Jimenez, S. R. (2012). Differences in talker recognition by preschoolers and adults. *Journal of Experimental Child Psychology*, *113*, 487–509.

Creel, S. C., & Quam, C. (In press). Apples and oranges: Developmental discontinuities in processing? *Trends in Cognitive Sciences*. doi:10.1016/j.tics.2015.09.006

Cristià, A., Minagawa-Kawai, Y., Egorova, N., Gervain, J., Filippin, L., Cabrol, D., & Dupoux, E. (2014). Neural correlates of infant accent discrimination: An fNIRS study. *Developmental Science*, *17*(4), 628–635. doi:10.1111/desc.12160

Cristià, A., Seidl, A., Vaughn, C., Schmale, R., Bradlow, A. R., & Floccia, C. (2012). Linguistic processing of accented speech across the lifespan. *Frontiers in Psychology*, *3*(November), 479. doi:10.3389/fpsyg.2012.00479

Evers, V., Reetz, H., & Lahiri, A. (1998). Crosslinguistic acoustic categorization of sibilants independent of phonological status. *Journal of Phonetics*, *26*, 345–370.

Flege, J. E. (1988). Factors affecting degree of perceived foreign accent in English sentences. *Journal of the Acoustical Society of America, 84*(1), 70–79.

Floccia, C., Butler, J., Girard, F., & Goslin, J. (2009). Categorization of regional and foreign accent in 5- to 7-year-old British children. *International Journal of Behavioral Development*, *33*(4), 366–375. doi:10.1177/0165025409103871

Fuertes, J. N., Gottdiener, W. H., Martin, H., Gilbert, T. C., & Giles, H. (2012). A meta-analysis of the effects of speakers' accents on interpersonal evaluations. *European Journal of Social Psychology*, *42*, 120–133.

Gick, B., Wilson, I., Koch, K., & Cook, C. (2004). Language-specific articulatory settings: Evidence from inter-utterance rest position. *Phonetica, 61*, 220–233. doi:10.1159/000084159

Girard, F., Floccia, C., & Goslin, J. (2008). Perception and awareness of accents in young children. *British Journal of Developmental Psychology*, *26*(3), 409–433. doi:10.1348/026151007X251712

Hirschfeld, L. A., & Gelman, S. A. (1997). What young children think about the relationship between language variation and social difference. *Cognitive Development*, *12*(2), 213–238. doi:10.1016/S0885-2014(97)90014-9

Jongman, A., Wayland, R., & Wong, S. (2000). Acoustic characteristics of English fricatives. *Journal of the Acoustical Society of America, 108*(3), 1252–1263.

Kinzler, K. D., & DeJesus, J. M. (2013). Children's sociolinguistic evaluations of nice foreigners and mean Americans. *Developmental Psychology, 49*(4), 655–64. doi:10.1037/a0028740

Kinzler, K. D., Corriveau, K. H., & Harris, P. L. (2011). Children's selective trust in native-accented speakers. *Developmental Science*, *14*(1), 106–11. doi:10.1111/j.1467-7687.2010.00965.x

Kinzler, K. D., Dupoux, E., & Spelke, E. S. (2007). The native language of social cognition. *Proceedings of the National Academy of Sciences*, *104*(30), 12577–80. doi:10.1073/pnas.0705345104

Kinzler, K. D., Dupoux, E., & Spelke, E. S. (2012). “Native” objects and collaborators: infants’ object choices and acts of giving reflect favor for native over foreign speakers. *Journal of Cognition and Development*, *13*(1), 67–81.

Kinzler, K. D., Shutts, K., & Spelke, E. S. (2012). Language-based social preferences among children in South Africa. *Language Learning and Development*, *8*(3), 215–232. doi:10.1080/15475441.2011.583611

Kinzler, K. D., Shutts, K., DeJesus, J., & Spelke, E. S. (2009). Accent trumps race in guiding children’s social preferences. *Social Cognition*, *27*(4), 623–634. doi:10.1521/soco.2009.27.4.623

Koenig, M. A., & Harris, P. L. (2005). Preschoolers mistrust ignorant and inaccurate speakers. *Child Development*, *76*(6), 1261–1277.

Koenig, M. A., & Woodward, A. L. (2010). Sensitivity of 24-month-olds to the prior inaccuracy of the source: possible mechanisms. *Developmental Psychology*, *46*(4), 815–26. doi:10.1037/a0019664

Lambert, W. E. (1967). A Social Psychology of Bilingualism. *Journal of Social Issues*, *23*(2), 91–109. doi:10.1111/j.1540-4560.1967.tb00578.x

Lambert, W. E., Hodgson, R. C., Gardner, R. C., & Fillenbaum, S. (1960). Evaluational reactions to spoken languages. *Journal of Abnormal and Social Psychology*, *60*(1), 44–51.

Lane, J. D., Wellman, H. M., & Gelman, S. A. (2013). Informants’ traits weigh heavily in young children’s trust in testimony and in their epistemic inferences. *Child Development*, *84*(4), 1253–1268. doi:10.1111/cdev.12029

Mann, V. A., Diamond, R., & Carey, S. (1979). Development of voice recognition: Parallels with face recognition. *Journal of Experimental Child Psychology*, *27*(1), 153–165. doi:10.1016/0022-0965(79)90067-5

Mehler, J., Jusczyk, P. W., Lambertz, G., Halsted, N., Bertoncini, J., & Amiel-Tison, C. (1988). A precursor of language acquisition in young infants. *Cognition*, *29*, 143–178.

Mennen, I., Scobbie, J. M., de Leeuw, E., Schaeffler, S., & Schaeffler, F. (2010). Measuring language-specific phonetic settings. *Second Language Research, 26*(1), 13–41.

Mulak, K. E., Best, C. T., Tyler, M. D., Kitamura, C., & Irwin, J. R. (2013). Development of phonological constancy: 19-month-olds, but not 15-month-olds, identify words in a non-native regional accent. *Child Development*, *00*(0), 1–15. doi:10.1111/cdev.12087

Munson, B., & Babel, M. (2007). Loose lips and silver tongues, or, projecting sexual orientation through speech. *Language and Linguistics Compass*, *1*(5), 416–449. doi:10.1111/j.1749-818X.2007.00028.x

Nelson, N. L., & Russell, J. A. (2011). Preschoolers' use of dynamic facial, bodily, and vocal cues to emotion. *Journal of Experimental Child Psychology*, *110*(1), 52–61. doi:10.1016/j.jecp.2011.03.014

Ohde, R. N., & Haley, K. L. (1997). Stop-consonant and vowel perception in 3- and 4-year-old children. *Journal of the Acoustical Society of America*, *102*(6), 3711–22. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/9407663

Pasquini, E. S., Corriveau, K. H., Koenig, M., & Harris, P. L. (2007). Preschoolers Monitor the Relative Accuracy of Informants, *43*(5), 1216–1226. doi:10.1037/0012-1649.43.5.1216

Peterson, G. E., & Barney, H. L. (1952). Control methods used in a study of the vowels. *Journal of the Acoustical Society of America, 24*, 175–184.

Pietraszewski, D., & Schwartz, A. (2014). Evidence that accent is a dimension of social categorization, not a byproduct of perceptual salience, familiarity, or ease-of-processing. *Evolution and Human Behavior*, *35*(1), 43–50. doi:10.1016/j.evolhumbehav.2013.09.006

Quam, C., & Swingley, D. (2012). Development in children's interpretation of pitch cues to emotions. *Child Development*, *83*(1), 236–50. doi:10.1111/j.1467-8624.2011.01700.x

R Core Team (2014). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL http://www.R-project.org/.

Salverda, A. P., Kleinschmidt, D., & Tanenhaus, M. K. (2014). Immediate effects of anticipatory coarticulation in spoken-word recognition. *Journal of Memory and Language*, *71*(1), 145–163. doi:10.1016/j.jml.2013.11.002

Souza, A. L., Byers-Heinlein, K., & Poulin-Dubois, D. (2013). Bilingual and monolingual children prefer native-accented speakers. *Frontiers in Psychology*, *4*(December), 953. doi:10.3389/fpsyg.2013.00953

van Heugten, M., & Johnson, E. K. (In press). Toddlers' word recognition in an unfamiliar regional accent: the role of local sentence context and prior accent exposure. *Language and Speech*, 1–11. doi:10.1177/0023830915600471

Van Lancker, D., Kreiman, J., & Emmorey, K. (1985). Familiar voice recognition: Patterns and parameters. Part I. Recognition of backward voices. *Journal of Phonetics, 13*, 19–38.

Van Lancker, D., Kreiman, J., & Wickens, T. (1985). Familiar voice recognition: Patterns and parameters. Part II: Recognition of rate- altered voices. *Journal of Phonetics, 13*, 39–52.

Vitevitch,

Vanderbilt, K. E., Heyman, G. D., & Liu, D. (2014). In the absence of conflicting testimony young children trust inaccurate informants. *Developmental Science*, *3*, 443–451. doi:10.1111/desc.12134

Wagner, L., Clopper, C. G., & Pate, J. K. (2014). Children's perception of dialect variation. *Journal of Child Language*, *41*, 1062–1084. doi:10.1017/S0305000913000330

Werker, J. F., & Tees, R. (1984). Cross-language speech perception: Evidence for perceptual reorganization during the first year of life. *Infant Behavior and Development*, *7*(1), 49–63. doi:10.1016/S0163-6383(84)80022-3