# Children's early perceptual and late-emerging social sensitivity to accented speech

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**Abstract**

How early in life, and in what situations, are children sensitive to speakers' accents? Some researchers have suggested that accent is an early-developing, perhaps intrinsic, signal of group membership. However, other studies find little sensitivity to or awareness of accent in young children. Three experiments reported here examine 3-5-year-olds' comprehension of, and social decision-making with, a familiar (US English) accent and a foreign (Dutch) accent. Dutch accents were comprehended less well, particularly when salient phonological competitors were present, but social sensitivity was fairly weak until age 6-7 years. The latter finding contrasts with accounts positing early (perhaps innate) social sensitivity to accents.

**Keywords:** language development, accent, social stereotyping, word recognition, eye tracking

## Introduction

How early, and in what situations, are children sensitive to speakers' accents? Studies of social processing suggest very early accent sensitivity (infants and 5-6-year-olds; Kinzler et al., 2007), and studies of comprehension suggest that accents affect word recognition (4-year-olds; Nathan et al., 1998). However, other research suggests that recognizing accents themselves, especially regional accents (vs. foreign), may be difficult (e.g. Floccia et al., 2009). Are these results truly divergent, or simply due to variability in the accents used across studies? The current study is the first to examine social and comprehension effects using the same accent. American children's processing of Dutch-accented speech was assessed in three contexts: friend selection, perceptual discrimination, and word recognition.

### Previous research

**Comprehending accented speech** A major area of active research concerns effects of accents on speech comprehension. Some research suggests that children by 12 months of age, or shortly thereafter, can recognize a word form even over a change in accent (Schmale & Seidl, 2009; Schmale et al., 2010). Work by Swingley and Aslin (2002), originally intended to demonstrate that 15-month-olds can detect subtle mispronunciations of familiar words, might be reinterpreted to suggest that mild phonetic-feature deviations to a familiar word are to an extent recognized as that word. Further work suggests that 19-month-olds readily adapt to accent-like variability in vowel pronunciations (White & Aslin, 2011), similar to adults (Maye et al., 2008). However, contradicting these early-comprehension accounts, Nathan et al. (1998) found that 4-year-olds have difficulty recognizing words in an unfamiliar accent. Creel (2012), using deliberate mispronunciations of familiar words, found that preschoolers' word recognition suffers more when the mispronounced ("accented") form is more featurally distant from the child's (native-accent) sound representation of the word.

Another aspect of accented word recognition that is somewhat less well-studied is the role of context. That is, is accented word recognition easier when there are many supporting contextual cues? Such cues might include broader discourse context, the semantic content of a sentence, or the presence of a small, limited set of possible referents. If only one of the candidate referents (e.g. a fish, a car, a house, and a bear) sounds at all similar to the word that is spoken (e.g. "fesh"), then children may have relatively little difficulty in selecting the correct meaning. On the other hand, if multiple candidate referents bear some similarity to the spoken for (e.g. both a fish and a fez are present), children may have more comprehension difficulty.

**Recognizing accents and making social decisions** A very different line of research examines children's sensitivity to, and awareness of, the accents around them. Adults are highly sensitive to accent as a social signal, making negative social evaluations of non-standard speakers (e.g. Blair & Conner, 1978; Lambert, 1967). Some have argued that the antecedents of adult accent stereotyping appear in children as young as 6 months (Kinzler et al., 2007), and that accent may be an innate social signal of group membership (Pietraszewski & Schwartz, 2014). 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) rather than someone who speaks with a different accent or language (French or Spanish. Children as young as 3 years appear to be sensitive to native-speaker status when choosing informants in a word-learning task (Corriveau et al., 2013; Kinzler et al., 2011), and 2.5-year-olds prefer to give and receive toys from native English speakers than Spanish speakers (Kinzler et al., 2012). At 6 months, infants prefer to look at a face that has been previously associated with a familiar voice (Kinzler et al., 2007).

Of course, some of the infant results have close parallels in infant speech perception research (e.g. Mehler et al., 1988), leaving open the possibility that seemingly-social

effects may be driven by perceptual familiarity preferences. Yet, given adults' sensitivity to accent as a social signal, it seems clear that these effects, if not initially social, become so by adulthood. The child studies taken together imply that children may be sensitive to accent differences as early as infancy and certainly by early childhood.

Research on children's abilities to *detect* accents paints a different picture. Children around age 5 seem to 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. 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. All of these researchers find that children's detection of foreign accents exceeds their detection of native, regional accents. However, it is not clear if the foreign-accent advantage is due to greater overall accent strength, or to foreign accents making sound changes that are more easily detected than changes in regional accents (see Floccia et al., 2009).

Findings of weak accent recognition contrast strikingly with children's apparently strong accent-based social biases. However, they pattern with a broader class of phenomena in which perceptual learning seems to extend through at least several years of early childhood. This includes recognition of voices (Creel & Jimenez, 2012; Mann et al., 1979), faces (e.g. Carey et al., 1980), and certain speech sound characteristics (e.g. Ohde & Haley, 1997). Such *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.

### The current study

The literatures on accented-speech comprehension, social accent processing, and accent recognition present somewhat divergent pictures. If accents affect children's comprehension, why don't they allow recognition that someone *has* an accent? Why are accent-based social decisions more precocious than accent identification? Are the apparent differences in these phenomena driven by differences in the properties of the accents used (e.g. some are stronger accents), or are the phenomena themselves truly generated by different underlying knowledge or biases?

Here, we use the same accent—Dutch-accented English—to test both comprehension and social decisions. Using the same accent across studies controls for differences in accent strength, and reveal the extent to which comprehension and social cognition effects are truly distinct from one another. Experiments 1 and 2 address 3-5-year-olds' speech comprehension and word recognition in Dutch accents (vs. control US-accented speakers). Experiment 3 asks whether 3-5-year-olds and older children show biases to be friends with native-accented over Dutch-accented speakers.

## Materials

A set of 12 Dutch speakers of English (9 female, 3 male), as well as two native speakers of English from the Western United States (1 female, 1 male), were recorded speaking a various materials including sentences and isolated words.

Adult monolingual native speakers of English (*N*=15) rated the degree of accent for spoken sentences and passages for the Dutch and US speakers. Dutch speakers were all detectably more foreign-accented than each of the US speakers ($p < .0001$ in all cases), and some Dutch speakers had stronger accents than others (Figure 1). To maximize effects of accentedness on results, we selected two highly-accented speakers, one male, one female. The most-accented male speaker was chosen. Since the most-accented female speaker was judged to have a strong idiolect, the second-most-accented female speaker was chosen.

## Experiment 1

This experiment asked whether children can associate different accents with different individuals. Previous research (Creel, 2012) demonstrated that children readily associated color preferences with voices of different genders (e.g. Billy likes white, Anna likes black). Children heard sentences like "I want to see the triangle" while viewing a display of four shapes—two white, two black. Their eye movements were tracked. When children heard Billy speak, they looked more at white shapes (Billy's favorite) than black shapes (Anna's favorite), and vice versa, 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. US) in an analogous way. That is, are children aware enough of accents to associate different color preferences with differently-accented individuals?

### Method

**Participants** Monolingual English-speaking children (*N*=32) aged 3-5 years from area preschools and daycares took part. Monolingual English-speaking adults (*N*=27) also took part in the lab.

**Stimuli** Spoken materials included passages and sentences from 2 Dutch-accented and 2 US-accented talkers (1 female, 1 male in each set). Each listener heard either two female talkers (one Dutch-accented, one US-accented) or two male talkers (one Dutch, one US).

**Procedure** Children first heard two favorite-color trials, where each talker introduced herself verbally and stated her favorite color. Each talker was depicted as a cartoon character surrounded by objects of her favorite color (Figure 1). Next were 8 color-selection trials, where two shapes differing only in color appeared, and each speaker asked, "Where's the white/black one?" This verified that children knew color names well enough to do the task. Next, favorite-color trials repeated. Last were 32 test trials. Each test trial depicted four shapes (circle, square, triangle, star): two white, two black. As children viewed these shapes, they heard a speaker request one shape: Billy might say "Can you show me the circle?" The child's task was simply to

point to the requested shape. Of greater theoretical interest were eye movements: would children visually fixate shapes of the speaker's preferred color, indicating that they had recognized the speaker's accent and were making on-line inferences about which shapes might be mentioned?

Figure 1: Experiment 1, characters on favorite-color trials

### Results and Discussion

**Accuracy** Children's accuracy was nearly at ceiling (US speakers: 95%; Dutch speakers: 92%), though they were slightly less accurate on the Dutch-accented trials ($t(31)=2.12$, $p=.04$). Adults performed at ceiling throughout.

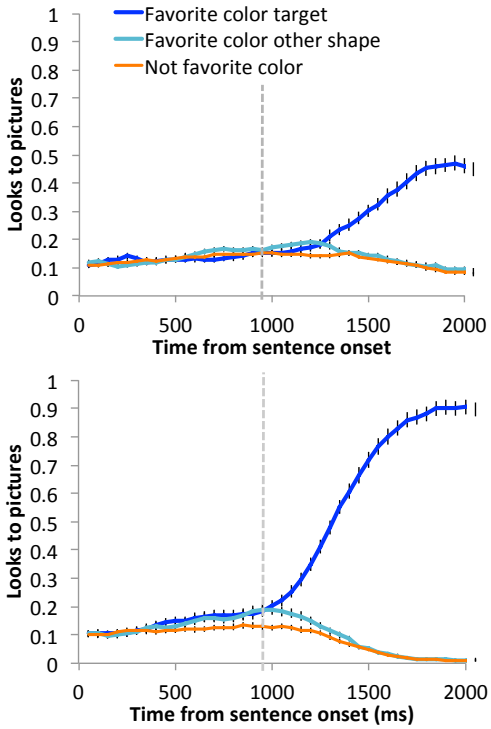


Figure 2: Experiment 1, eye movements to pictures (upper: children; lower: adults). Dashed line indicates target word onset, plus 200 milliseconds to execute an eye movement.

**Eye movements** Children's eye movements reflected no substantial deviations toward favorite-color shapes, and looks to the target itself only rose above looks to other shapes after the target name was mentioned (Figure 2, upper), with no differences between favorite-color shapes and other-color shapes in the pre-name window (200 ms-950 ms; $t(31)=0.21$, $p=.84$). Adults, on the other hand, did show looks to favorite-color shapes prior to the target being named ($t(26)=2.50$, $p=.02$; Figure 2, lower), indicating that they were sensitive to the accent.

While adults were able to use accent differences to guide interpretation of talkers, children showed very weak evidence of doing so. Both groups showed good comprehension of accented talkers, with little recognition advantage for US talkers over NL talkers. For children, this excellent comprehension might indicate that the accents used were quite mild, and thus too weak to afford accent detection. 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 very phonologically distinct, even in the presence of a foreign accent. This raises the question of whether children's comprehension might be more affected by accented speech when phonological competitors were present among the response options. This was addressed in Experiment 2.

## Experiment 2

Does accented speech affect comprehension more when phonological competitors are salient choices? As in Experiment 1, children completed a picture recognition task. However, unlike Experiment 1, the words depicted had more similar names. Names were especially similar when produced with Dutch accent characteristics (Table 1).

On each trial, a Dutch-accented or US-accented voice would speak a word. Children then pointed to the picture that had been named. If children are more affected by accent differences when making more fine-grained phonological distinctions, then comprehension accuracy (pointing to targets) and visual fixations to targets should be lower for Dutch accents than US accents, especially on phonologically-similar trials. However, if the Dutch accents here were too mild to affect word recognition, then accuracy should be equivalent for US and Dutch accents.

### Method

**Participants** A new group of 3-5-year-old participants ($N=24$) took part.

**Stimuli** Words were drawn from the original set of Dutch- and US-accented recordings. Selected words (Table 1) were ones that contained particular Dutch accent features of vowel changes (merging of /æ/ and /ɛ/, similarity of /u/ and /ʊ/; see Adank et al., 2004), diminished contrastive vowel duration before voiced codas (bed and bet having similar vowel durations), and sibilant fricatives (Dutch /s/ has a lower frequency center than English /s/). On "similar" trials, pictures with similar-sounding names in the Dutch accent were paired together. On "dissimilar" trials, the same pictures were used, but were paired so that pictures with less similar-sounding names appeared together.

**Procedure** Eye movements were tracked as children viewed picture pairs and heard one of the pictures named. Pointing responses were also recorded.

Table 1. Pictured words with names that sounded similar in Dutch accent. **Bolded** were especially similar.

| Word pair | | Similar in accent |
|---|---|---|
| **hat** | **head** | Vowels |
| **soup** | **shoe** | Fricatives |
| **hook** | **hug** | Vowels, coda |
| bell | boy | No coda |
| foot | spoon | Vowels; similar onsets |
| apple | egg | Vowels |
| **bat** | **bed** | Vowels, coda |
| **book** | **boots** | Vowels |

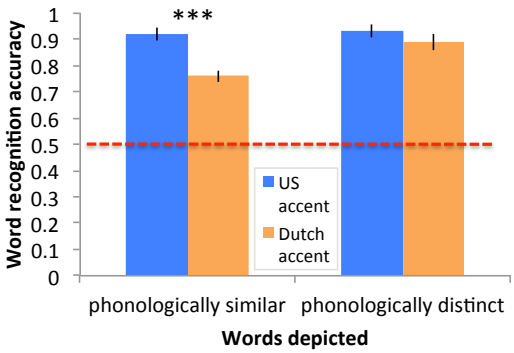


Figure 3: Experiment 2, accuracy with standard errors.

## Results and Discussion

**Accuracy** Children were more accurate for US accents than for Dutch accents (Figure 3), carried by the phonologically-similar trials ($t(23)=3.73$, $p=.001$).

**Eye movements** A target advantage score was computed by subtracting looks to the non-target picture from looks to the target (correct) picture. When this exceeds 0, children are looking more at the target (Figure 4). In a 1-second window after word onset (shifted by 200 ms to allow for time to execute eye movements), children showed a greater proportion of target fixations on US-accented trials than on Dutch-accented trials ($t(23)=4.68$, $p=.0001$). There was no interaction with Condition (similar word pair, distinct word pair), suggesting that words were recognized more slowly even when close phonological competitors were not present on a given trial.

These findings demonstrate that accented speech comprehension becomes more challenging when listeners must make finer phonetic discriminations. Such fine discriminations are required not only in laboratory scenarios where a few highly-salient competitors are present; they also happen more naturalistically whenever there is a wider range of potential referents, either referents in the listener's immediate environment or in decontextualized language—speaking about topics not in the here-and-now.

The results of Experiments 1 and 2 suggest that preschool-aged children may be less aware of accents as an identifying characteristic than adults are (Experiment 1), but their comprehension is nonetheless affected. Further, these two experiments suggest that good accent comprehension may partly be a function of contextual influences (in this case, visual displays), which can be used to rule out phonologically-plausible (but contextually absent) alternatives.

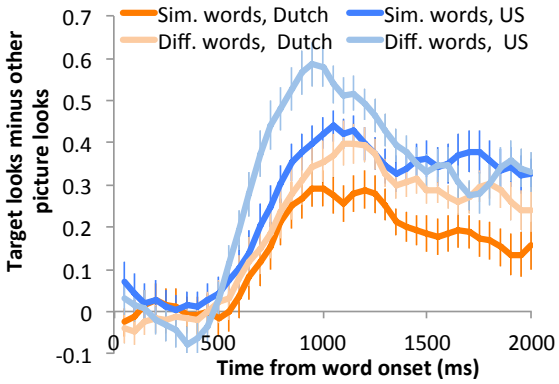


Figure 4: Experiment 2, eye movements.

What, then, do these results suggest about children's social processing of accents at this age? Experiment 1 would seem to suggest that children cannot make accent-based social decisions, at least for this accent. However, it is possible that social decisions are made on a more implicit basis than the sentence-processing task used in Experiment 1. Thus, the final experiment tested whether children hearing the same sentences as in Experiment 1 would show evidence of preferring native-accented "friends" over Dutch-accented "friends."

# Experiment 3

Children completed a friend-selection task patterned after Kinzler et al. (2007). If children are socially sensitive to our Dutch-accented speakers, then they should show an own-accent bias in friend selection, as found in previous research. If they are unable to use the Dutch accent to make social decisions, then they should be at chance in selecting friends of one accent or another.

The friend-selection task was immediately followed by a location-judgment task, in order to more clearly tap overt awareness of accentedness. If friend selections are calculated on a conscious basis, then accuracy in the location task might be expected to pattern with the friend selection biases. On the other hand, if friendship judgments are calculated more implicitly, then friendship judgments may show stronger effects than location judgments.

## Method

**Participants** A sample of 33 new child participants ages 3-5 years (range: 3.1-5.5 years) took part. Following these results, an additional 8 older children (6-7 years) were recruited to assess the age trajectory of the effects.

**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 flickr.com. Faces that appeared side by side were matched for gender and approximate hair and skin color.

**Procedure** This largely followed Kinzler et al.'s (2007) study. There were 16 trials. 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. Face pairs were yoked so that each character appeared with the same other face on two different trials. For each child, the order of the accents (US, Dutch) was counterbalanced. Order of trials in each list was prerandomized with the constraints that: the same character pair did not appear on consecutive trials.

For the location task, children were first asked where they lived. Most replied "California." Those who did not 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.

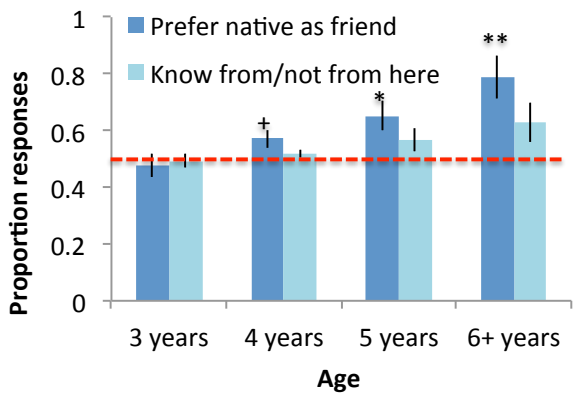


Figure 5. Experiment 3, age effect on friendship selections and location knowledge.

## Results and Discussion

Children showed increasing social sensitivity to accent with age, with no biases shown by 3-year-olds ($M$=.48; $t(10)$=0.56, $p$=.59) but strong biases seen in 6-7-year-olds ($M$=.79; $t(7)$=3.82, $p$=.007). The effect of age on nativeness bias was significant ($r(39)$=.64, $p$<.0001). Interestingly, location judgment accuracy was marginally weaker than friendship biases ($t(40)$=2.02, $p$=.051).

While children overall showed social sensitivity to accented speech, effects were not as strong as seen in previous studies (e.g. Kinzler et al., 2007) and seemed to emerge over a lengthier developmental time frame.

Further, overt awareness of geographic correlates of accentedness speech was quite low. This suggests that, even for children who do make negative social evaluations of foreign-accented speakers, they may not be fully aware of the real-world concomitants of accented speech.

# General Discussion

Three 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, but their word recognition was mildly affected. In Experiment 2, the presence of salient strong phonological competitors decreased 3-5-year-olds' word recognition in the accent more markedly. Finally, Experiment 3 showed that children at age 3 do not make social judgments based on accent, with a strong increase in own-accent preference with age, through age 7. Thus, for younger children, accent appeared not to be socially salient, but affected comprehension nonetheless.

These results suggest three things. First, accents can be strong enough to affect children's comprehension (Experiments 1, 2) without children registering the accented speaker as socially different (Experiment 3). Second, social responsiveness to accents may develop somewhat slowly (Experiment 3), though more research is clearly needed. Third, social responsiveness to accents may occur in the absence of full awareness of other correlates of accentedness such as living in a different geographical region.

## Development of sensitivity to accented speech

One question raised here is how children's sensitivity to accented speech develops. Are they sensitive from birth to accent properties? Infants seem to decrease in sensitivity to phonetic deviation in word recognition (e.g. Schmale & Seidl, 2009; Schmale et al., 2010). Why, if children increasingly tolerate phonetic deviations, might they show *increasing* social awareness of accents?

There are at least two possibilities. One possibility is that young children are working to learn words, and so temporarily "tune out" accent-like variability in order to focus on meaningful sound variation. This would imply a U-shaped function in accent sensitivity, with the bottom of the U in early childhood. A second possibility is that children may need extended perceptual exposure to—*protracted learning* of—their own accent patterns in order to recognize deviations from that pattern. It is clear that extensive experience with accents facilitates their recognition, in that even adults are rather inaccurate at identifying accents to which they have had relatively little exposure (e.g. Clopper & Pisoni, 2004). Future work should explore the roles of accent strength and child age in order to understand how accent awareness develops.

## Accent strength and the regional/foreign distinction

These results contribute to debates between the roles of accent strength vs. the regional/foreign accent distinction. Recall that previous findings suggest better identification of foreign accents than regional ones. The current study used a foreign accent, but showed weak accent awareness in social decision-making. This somewhat resembles age-based changes in social sensitivity to American *regional* accent variability (e.g. Kinzler & DeJesus, 2013). This similarity between regional and foreign accent findings suggests that

regional/foreign may be a less relevant distinction than accent strength. An account based on accent strength is more parsimonious in predicting effects on both accent identification and word recognition.

Note that the Dutch-accented voices used here were rated in the "moderate accent" range by adult listeners, not "strong accent". This may mean that the accents, while readily detectable to adults, were not as detectable to young children, thus blocking children from making social judgments based on accent. Another possibility is that Dutch, like English, is a Germanic language with a similarly large vowel system to English (e.g. Adank et al., 2004), leading to fairly preserved English vowels in Dutch accents.

Important differences between regional vs. foreign accents may nonetheless exist (see, e.g., Floccia et al., 2009, for acoustic analyses). However, such effects are likely to be intertwined with effects of accent strength, accent familiarity, and idiosyncratic accent properties.

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