



Original Articles

And then I saw her race: Race-based expectations affect infants' word processing

Drew Weatherhead*, Katherine S. White

Department of Psychology, University of Waterloo, Ontario, Canada



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ABSTRACT

How do our expectations about speakers shape speech perception? Adults' speech perception is influenced by social properties of the speaker (e.g., race). When in development do these influences begin? In the current study, 16-month-olds heard familiar words produced in their native accent (e.g., "dog") and in an unfamiliar accent involving a vowel shift (e.g., "dag"), in the context of an image of either a same-race speaker or an other-race speaker. Infants' interpretation of the words depended on the speaker's race. For the same-race speaker, infants only recognized words produced in the familiar accent; for the other-race speaker, infants recognized both versions of the words. Two additional experiments showed that infants only recognized an other-race speaker's atypical pronunciations when they differed systematically from the native accent. These results provide the first evidence that expectations driven by unspoken properties of speakers, such as race, influence infants' speech processing.

1. Introduction

Speech perception is often thought of as a bottom-up process, relying only on acoustic information in the speech signal. However, there are many "unspoken" properties of speakers that impact our perception of their speech, such as gender (Strand & Johnson, 1996), sexual orientation (Munson, Jefferson, & McDonald, 2006), age (Drager, 2011), and nationality (Hay, Nolan, & Drager, 2006; Niedzielski, 1996). In the current study, we investigate for the first time whether infants' word recognition is shaped by expectations linked to unspoken properties of speakers. In particular, we ask whether infants have expectations about how a speaker will talk based on their race.

Adult speakers invoke their knowledge of socially linked variation during language processing. The same speech sequence can be interpreted differently, and be better or worse understood, based on known or inferred properties of the speaker. These effects are seen even when listeners are primed very subtly. For example, Hay and Drager (2010) exposed New Zealander participants to either a stuffed kangaroo (associated with Australia) or a stuffed kiwi bird (associated with New Zealand) prior to completing a vowel perception task. They found that participants' vowel perception shifted as a function of the exposure toy, such that those who saw the kangaroo were more likely to classify vowels as Australian-like than those who saw stuffed kiwis. Similarly, visual cues like race can impact the way speech is perceived. For example, American listeners understand native-accented English better

when it is paired with a picture of a Caucasian face than with a Chinese face (Kang & Rubin, 2009; Rubin, 1992; consistent with Babel & Russell, 2015). Likewise, Mandarin-accented English is better understood when it is paired with a Chinese face than with a Caucasian face (McGowan, 2015). Together, these studies suggest that adult listeners form associations between properties of social groups and linguistic variation, which in turn lead to expectations that affect speech processing.

Although there is evidence that speech perception in adults is affected by top-down knowledge about the speaker, there is no research addressing whether this type of knowledge affects *infants'* speech perception. It may seem unlikely that it would, given that infants do not have the specific, learned associations that adults have. But even so, infants do have language experience that could potentially shape their expectations in more general ways. Because infants are exquisitely sensitive to race, a natural place to start this investigation is by exploring the effect of a speaker's race on infants' word recognition.

By 3 months, infants prefer to attend to familiar-race faces over unfamiliar-race faces (Bar-Haim, Ziv, Lamy, & Hodes, 2006; Kelly et al., 2005). With age, infants become less capable of discriminating or recognizing unfamiliar-race faces; by 9 months, infants categorize faces by race, and are significantly better at recognizing individual familiar-race faces (Anzures, Quinn, Pascalis, Slater, & Lee, 2010; Kelly et al., 2007; Kelly et al., 2009), and their scanning patterns for familiar-race and unfamiliar-race faces differ (Wheeler et al., 2011).

* Corresponding author at: Department of Psychology, University of Waterloo, 200 University Ave W, Waterloo, ON N2L 3G1, Canada.
 E-mail address: deweathe@uwaterloo.ca (D. Weatherhead).

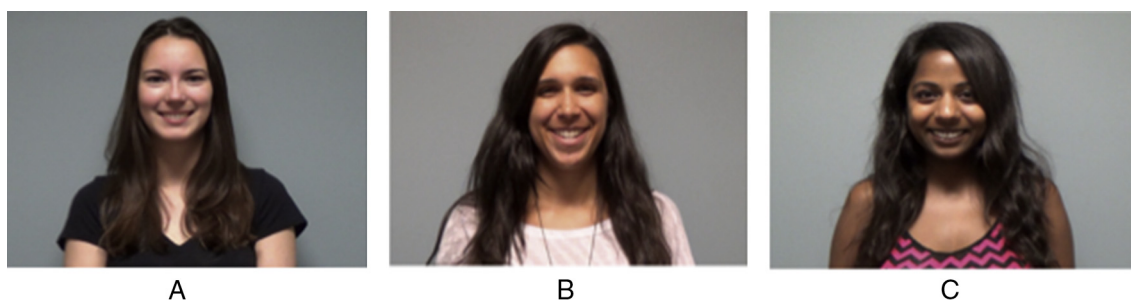


Fig. 1. (A) Same-race speaker (Experiment 1). (B) Other-race speaker (Experiments 1 and 2). (C) Other-race speaker (Experiment 3).

Although no work has asked whether a speaker's race affects infants' word processing, infants do make some very general assumptions about the relationship between a speaker's productions and their physical characteristics. For example, 5-month-old infants match the vocalizations of humans and monkeys to the appropriate faces (Vouloumanos, Druhen, Hauser, & Huizink, 2009). Six-month-olds also match other-race faces with non-native languages, though not with backwards speech (Uttley et al., 2013). Thus, infants not only have species-level associations, but also appear to have some understanding of same-race and other-race speakers as separate groups, and different beliefs about how these groups speak – in particular, that same-race individuals speak in a familiar way, and other-race individuals speak in a novel way. However, these studies do not indicate whether infants' speech processing is affected by factors such as speaker race.

In the current study, we explore how a speaker's race impacts infants' recognition of words that are pronounced in a familiar or unfamiliar accent. Young language learners often have difficulty recognizing words when they are produced in an unfamiliar accent, at least in the absence of a learning period (Best, Tyler, Gooding, Orlando, & Quann, 2009; Van Heugten & Johnson, 2014; Van Heugten, Krieger, & Johnson, 2015; White & Aslin, 2011). For example, without prior exposure to an unfamiliar accent, 15-month-olds do not look preferentially at a target object when its label is produced in that accent (Mulak, Best, Tyler, Kitamura, & Irwin, 2013). This difficulty with unfamiliar pronunciations is perhaps unsurprising, given the narrow range of speaker variation that infants have been exposed to in their input. If speech processing is constrained by a listener's prior experience (Kleinschmidt & Jaeger, 2015), and infants have little experience with variability in general, then they should initially expect new speakers to talk in familiar ways. Encountering an unfamiliar accent should lead to processing difficulty because it violates these expectations.

But importantly, just as infants have only heard words produced in a narrow range of pronunciations, most have only heard words produced by a narrow range of (in many cases, same-race) people. If infants' beliefs about word pronunciations are tied to the types of speakers who say them, then an expectation that words should be pronounced in familiar ways should not necessarily extend to unfamiliar, other-race speakers. Instead, infants may wait for evidence from speakers to determine the specific accent.

In the present study, we tested infants' comprehension of familiar words produced in their familiar native accent (e.g. "dog") and in an unfamiliar accent involving a vowel shift (e.g. "dag") using the intermodal preferential looking procedure (in which infants are presented with objects on a screen and hear corresponding audio). These words were presented following an image of either a same-race speaker or an other-race speaker (for brevity, we hereafter refer to the familiar-accented words as "unaccented" and the unfamiliar-accented words as "accented", although we recognize that there is no such thing as "unaccented" speech). If infants' word processing is affected by expectations about speakers based on race, then infants should interpret the two types of words differently depending on the speaker's identity.

2. Experiment 1

2.1. Method

2.1.1. Participants

Forty 16-month-old infants were tested (23 females; mean age: 16 months 0 days; age range: 15;16–16;16). Nine additional participants were tested, but not included due to non-completion (3), failure to attend to both objects during the baseline period for at least half of each trial type in each block of trials (3), or an overall difference score exceeding 2.5 standard deviations from the mean for either trial type (3).

Infants were randomly assigned to one of two conditions: Same-race speaker or Other-race speaker. Participants in both conditions were monolingual English-learners and Caucasian. Overall, participants had very minimal exposure to people who spoke a foreign language, had an accent, or were of a different race (average exposure per week was 2.6%, 7.2%, and 7.3%, respectively, as indicated by parental reports; by condition: Same-race Condition – 3.1%, 7.2%, and 7.2%, respectively; Other-race Condition – 2.1%, 6.5%, and 7.5%, respectively).

2.1.2. Stimuli

2.1.2.1. Audio stimuli. The test words were six words highly familiar to 16-month-olds, all containing the same vowel, /a/: "ball", "block", "bottle", "car", "dog", and "sock". All of these words are comprehended by 67–95% of children by 15-months of age, according to the MacArthur Communicative Development Inventories (Dale & Fenson, 1996). Additionally, parental reports in the current study indicate that for each test word individually, 78–97% of children had "seen the object before and understand the word very well", and across all words, the average was 88.5%. A female native speaker of English (from the same geographic region as the participants) produced each word four times, twice unaccented and twice accented, in which the /a/ vowel was shifted to /æ/ (i.e., "bottle" to "battle", "sock" to "sack", etc.).¹ Acoustic measurements confirmed that the /a/ and /æ/ versions were realized as intended. These measurements are provided in Appendix A. Each version was produced in each of two sentence contexts, "Do you see the X" or "Find the X". All sentences were naturally produced in an infant-directed-manner. Importantly, the same audio stimuli were used for both conditions.

2.1.2.2. Visual stimuli. Depending on the condition, participants either saw a still image of a same-race woman or an other-race woman (Fig. 1). The same-race woman was a 22-year-old Caucasian with pale skin and long brown hair. The other-race woman was a 23-year-old mixed-race female of Black, Caucasian and Native-Canadian heritage. Like the same-race woman, she had long brown hair. The object

¹ It should be noted that although this is an existing vowel shift in the Northern US, it is not one that participants in this study were reported to have exposure to. Additionally, a previous study (White & Aslin, 2011) using the same shift in a nearby geographic region found that toddlers did not recognize words in this accent without experimental exposure to it.

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