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Perceptual dialect categorization by an adult cochlear implant user: a case study

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Abstract

Research on the perception of indexical properties of speech in normal-hearing listeners has revealed that speech perception and spoken word recognition involve not only encoding of the linguistic message, but also processing and storage of talker-specific "indexical" properties of the speech signal, such as age, gender, and dialect. The perceptual processing of talker-specific information in speech has also been shown to affect the speech perception abilities of pediatric and adult cochlear implant users. In the current study, "Mr. S.", a post-lingually deafened adult cochlear implant user with 8 years of implant experience participated in a six-alternative forced-choice perceptual dialect categorization task without training or feedback. Normal-hearing adults can categorize unfamiliar talkers by regional dialect of American English with about 30% accuracy in a six-alternative forced-choice task. While this performance is poor, it is statistically above chance. Like the normal-hearing listeners, "Mr. S."'s performance was also statistically above chance and his scores were within one standard deviation of the mean performance of 30 normal-hearing controls. The present results suggest that "Mr. S." was able to perceive and encode non-linguistic talker-specific information from the speech signal that he received through his implant and use that information in an explicit test of dialect categorization.

Keywords

Cochlear implants; Indexical properties; Dialect categorization; Speech perception

1. Introduction

Recent findings suggest that normal-hearing children and adults, as well as hearing-impaired children and adults, perceive and encode talker-specific information in the speech signal. For example, normal-hearing 4- and 5-year-old children and normal-hearing adults can easily recognize familiar voices, even under degraded listening conditions [1,2]. Normal-hearing adults and children as young as 10 years old are also highly reliable at discriminating two unfamiliar talkers in a same-different task [3]. However, Cleary et al. [4] found that talker discrimination is more difficult for pediatric cochlear implant users than normal-hearing children.

Identifying a talker's gender is one of the easier tasks related to talker-specific information in the speech signal, Normal-hearing adults are very good at gender identification, even when listening to degraded speech signals [5]. In addition, accurate discrimination of male and female talkers has been found for both adult [6] and pediatric cochlear implant users [7]. Categorization of talkers by regional dialect, however, is a more difficult task even for

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normal-hearing adults. Clopper et al. [8,9] reported that normal-hearing adults categorized unfamiliar talkers by regional dialect of American English with 30% accuracy in a six-alternative forced-choice task. While this performance was poor, it was statistically above chance.

2. Methods

2.1 Stimulus materials

Six male and six female talkers from each of six dialect regions in the United States were selected from the TIMIT Acoustic-Phonetic Continuous Speech Corpus [10], for a total of 72 different talkers. The six dialect regions were New England, North, “North Midland, South Midland, South, and West. All of the talkers were between the ages of 20 and 29 years old at the time of recording and were all white.

The stimulus materials included three sentences from each of the 72 talkers. Two of the sentences, “She had your dark suit in greasy wash water all year” and “Don’t ask me to carry an oily rag like that” were read by each of the 72 talkers. In addition, a third novel sentence was selected for each talker. None of these novel sentences was repeated in the course of the experiment.

2.2 Listeners

A group of 30 normal-hearing adult listeners were recruited from the Indiana University community. The listeners in the normal-hearing control group were all between the ages of 18 and 25 years old at the time of testing. They were monolingual native speakers of English with no reported history of hearing or speech disorders.

One adult cochlear implant user, “Mr. S.”, was also recruited for participation in this study. “Mr. S.” is a post-lingually deafened 40-year-old white male. His hearing loss was due to cryoglobial anemia and autoimmune syndrome. He received his cochlear implant 8 years prior to his participation in this task. Like the normal-hearing controls, “Mr. S.” is a monolingual native speaker of English.

2.3 Procedure

The experiment consisted of three blocks of trials. On each trial, the listeners were presented with a single sentence and asked to select which of the six regions of the United States they thought the talker was from. The six response alternatives are shown in Fig. 1. In the first block of trials, the listeners heard each talker in random order reading Sentence 1. The second block was identical to the first, except that the talkers each read Sentence 2. The novel sentences were presented in the third block of trials. The listeners did not receive any feedback about the accuracy of their responses.

The normal-hearing listeners were presented with stimuli over headphones while seated in front of desktop personal computers and made their responses using a mouse. “Mr. S.” was seated in front of a laptop computer running the same protocol, but the stimulus materials were presented via a loudspeaker.

3. Results and discussion

A summary of the results is shown in Fig. 2. Overall, “Mr. S.” performed more poorly than the normal-hearing adults, but his categorization performance was still statistically above chance. His performance was also within one standard deviation of the normal-hearing participants’ mean performance, across the three experimental blocks and the six talker

dialect regions. These results suggest that some indexical information is available to cochlear implant users, but this information may be degraded relative to what normal-hearing listeners typically perceive and encode.

4. Theoretical and clinical implications

The integral nature of linguistic and talker-specific information in spoken language perception and processing is not limited to normal-hearing populations, but extends to cochlear implant users as well. The categorization performance by "Mr. S.", however, suggests that the ability to resolve talker-specific information may be impaired for cochlear implant users relative to their normal-hearing peers. It is well-documented in the sociolinguistic literature that normal-hearing listeners use talker-specific information to make judgments about the social background of their interlocutors [11]. Further research is needed to understand the extent to which this information is available and can be processed by hearing-impaired populations.

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References

1. Bartholomeus B. Voice identification by nursery school children. Can J Psychol. 1973; 27:464–472. [PubMed: 4766153]
2. Sheffert SM, et al. Learning to recognize talkers from natural, sinewave, and reversed speech samples. J Exp Psychol Hum Percept Perform. 2002; 28:1447–1469. [PubMed: 12542137]
3. Mann VA, Diamond R, Carey S. Development of voice recognition: Parallels with face recognition. J Exp Child Psychol. 1979; 27:153–165. [PubMed: 458368]
4. Cleary M, Pisoni DB, Kirk KI. Influence of voice similarity on talker discrimination in normal-bearing children and hearing-impaired children with cochlear implants. J Speech Lang Hear Res. (in press).
5. Lass NJ, et al. Speaker sex identification from voiced, whispered, and filtered isolated vowels. J Acoust Soc Am. 1976; 59:675–678. [PubMed: 1254794]
6. McDonald, CJ., et al. Talker discrimination and spoken word recognition by adults with cochlear implants. 26th mid-winter meeting of the Association for Research in Otolaryngology; Daytona Beach, Florida. 2003.
7. Osberger MJ, et al. Independent evaluation of the speech perception abilities of children with the Nucleus 22-channel cochlear implant system. Ear Hear. 1991; 12(Suppl):66S–80S. [PubMed: 1955092]
8. Clopper CG, Conrey BL, Pisoni DB. Effects of talker gender on dialect categorization. J Lang Social Psychol. (in press).
9. Clopper CG, Pisoni DB. Some acoustic cues for the perceptual categorization of American English regional dialects. J Phon. 2004; 32:111–140.
10. Fisher, WM.; Doddington, GR.; Goudie-Marshall, KM. The DARPA speech recognition research database: specifications and status. Proceedings of the DARPA Speech Recognition Workshop; 1986. p. 93-99.
11. Ryan, EB.; Giles, H. Attitudes Towards Language Variation: Social and Applied Contexts. Edward Arnold; London: 1984.

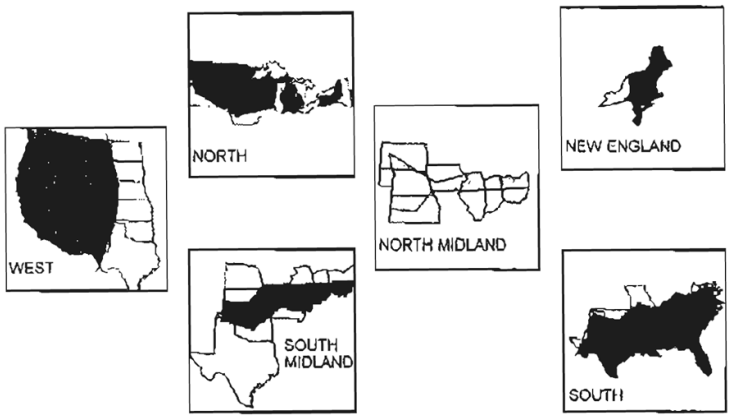

Fig. 1.
The six response alternatives in the perceptual categorization task.

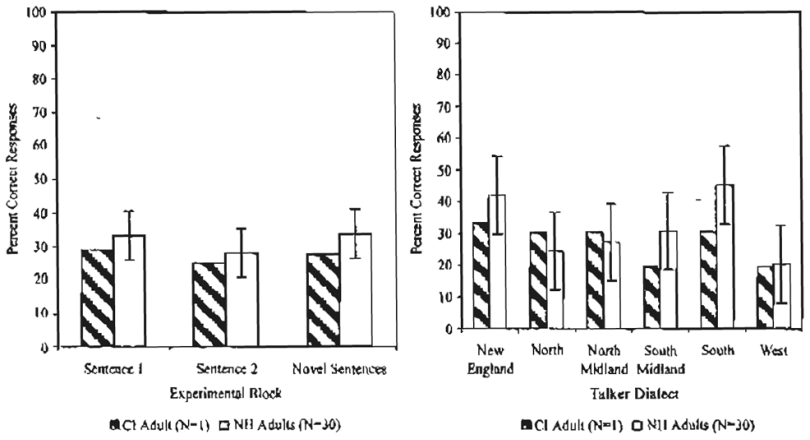

Fig. 2.

Percent correct dialect categorization performance by experimental block (left) and by talker dialect region (right). Error bars are one standard deviation.