Speech exposure familiarizes listeners with talkers’ vocal identity

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Introduction

• Talker identification experiments typically explicitly train listeners to identify voices.1-4 Ecologically, however, listeners learn to identify talkers without explicit practice.
• Exposure sans practice has been shown to be effective for perceptual learning5-6 but it is unknown whether the same applies for higher-order learning, like voice identification.7

Research Questions:

• Can listeners gain familiarity with voices even when they are not explicitly identifying them?
• When exposed to the same speech, do listeners still learn vocal information if they are differentially directing their attention between talkers’ vocal identity and verbal content?

Methods

Participants: Native speakers of American English (N = 96; 74 female, 22 male; ages 18-31; mean = 20.5 years) who reported no history of speech, hearing, or language disorder

Stimuli: Recordings of ten digits (0-9) presented in five-digit strings by 10 female and 10 male American adult speakers, identical across all exposure task conditions and test.

Procedure: Each participant was randomly assigned to one of three task conditions for the exposure phase (200 trials of five-digit sequences) with feedback. All participants were then tested for talker identification ability (50 trials of five digits with feedback).

• Talker Matching Task: Identify voices in an active training paradigm (matching voice heard with avatar)
• Talker 1-Back Task: Indicate whether the talker on each trial was the same as the talker from the previous trial
• Verbal 1-Back Task: Indicate whether the middle digit on each trial was the same as the middle digit from the previous trial

Task Design:

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<tr>
<th>Trial</th>
<th>Digit</th>
<th>Response</th>
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<tr>
<td>1</td>
<td>8, 3, 1, 4, 7</td>
<td>Talker Matching</td>
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<td>Talker 1-Back</td>
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<td>Verbal 1-Back</td>
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<td>3, 7, 4, 8, 1</td>
<td>Talker Matching</td>
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<td>Verbal 1-Back</td>
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<tr>
<td>3</td>
<td>1, 7, 4, 3, 8</td>
<td>Talker Matching</td>
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<td>Verbal 1-Back</td>
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Fig. 1: Mean task performance accuracy (d’ prime score) for all exposure task conditions, divided into blocks of 40 trials (200 total). Main effects of task (x²(2) = 124.70, p < 0.0001) and block (x²(1) = 99.72, p < 0.0001). The main effect of exposure condition was not significant (x²(1) = 0.07, p = 0.79). Significant task x block interaction (x²(2) = 155.49, p < 0.0001) as well.

Fig. 3: Mean task performance accuracy (50 response questions) for all exposure task conditions, divided into blocks of 10 trials. Type-III ANOVA on glmME for binomial data found significant main effects of exposure condition (x²(1) = 26.62, p < 0.0001) and block (x²(1) = 594.76, p < 0.0001) and significant task x exposure condition interaction (x²(2) = 8.64, p = 0.009).

Fig. 4: Mean task accuracy across the exposure task conditions (boxplots). For the talker matching task, there was a significant effect of exposure condition (x²(1) = 29.30, p < 0.0001). For the talker 1-back task, exposure condition did not account for a significant amount of the variance (x²(1) = 2.88, p = 0.09). This factor was also significant in the verbal 1-back task (x²(1) = 4.06, p < 0.05).

Fig. 4: Relationship between exposure task performance (d’ prime score) and test accuracy (percentage correct). The only significant correlations between exposure and test performance were for the Talker Matching task, for which the Pearson’s correlation coefficients were r = 0.61 (p = 0.001) for the exposed voices and r = 0.49 (p = 0.004) for the novel. Pairwise correlations for both the Talker 1-Back (‘exposed’ r = -0.04 (p = 0.81), ‘novel’ r = 0.15 (p = 0.41)) and Verbal 1-Back (‘exposed’ r = 0.31 (p = 0.09), ‘novel’ r = 0.16 (p = 0.37) were not significant.

Discussion

• Prior exposure to voices enhances accuracy in talker identification.
• Listeners were significantly more accurate at identifying talkers if they had been previously exposed to those talkers vs novel talkers.
• Those who were assigned the Talker Matching task during the exposure phase were the most accurate among the three tasks.
• Since the group that practiced identifying talkers during the exposure phase was the most accurate, affirming that explicit talker ID practice was the most effective task.
• The Verbal 1-Back group also performed significantly better at the talker identification test when given exposed voices rather than novel talkers, even though listeners were attending to the speech content.
• Interestingly, the Talker 1-Back group did not show any significant improvement at talker identification when given exposed voices.
• These results suggest that it is possible for listeners to unknowingly learn talkers’ vocal identity during speech perception while focusing on a separate task and without explicit practice.

References


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