The Rate of Hearing Screen Failure Among Students with Reading Impairments

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ABSTRACT

To develop effective interventions for students with reading impairments, there is a vital need to more fully explain the underlying factors that contribute to poor reading outcomes. The purpose of this study was to explore one potential factor: minimal hearing loss. Students in grades 2 to 12 completed assessment of reading and writing skills, as well as a hearing screening. No participants had a previous diagnosis of hearing loss or other condition that would affect hearing or literacy skills (e.g., Down syndrome, autism). Children with reading impairments were more likely to fail a hearing screening than children with typical reading skills. Additionally, given that auditory input from the right ear is processed in the left hemisphere, this pattern of right ear minimal hearing loss has potential to explain why some children with reading impairments are non-responders to traditional reading interventions that focus on auditory-based skills such as phonological awareness.

INTRODUCTION

Reading impairment results in long-term negative outcomes in academic, occupational, and social settings (Kutner et al., 2007). By 9th grade, over half of children with minimal hearing loss have repeated a grade (Bess et al., 1998). Overwhelmingly, non-responders to reading instruction exhibit deficits in phonological awareness (Al Otaiba & Fuchs, 2002), which has been linked to speech perception (Nittrouer, 1996) and underlying decoding development (Adams, 1990). Students with decoding-based reading impairment struggle in some areas related to hearing; individuals with dyslexia struggle with speech-in-noise perception and this difficulty is related to their decoding deficits (Ziegler, Pech-Georgel, George, & Lorenzi, 2009).

Thus, to develop effective interventions for these students, there is a vital need to more fully explain the underlying factors that contribute to poor reading outcomes. The proposed project explores one potential factor: minimal hearing loss (Werfel & Hendricks, 2016).

METHOD

Participants

Participants are 43 school-age 2nd to 12th grade students. Children in the normal reading group (n=19) scored above the 25th percentile on all measures of reading skills. Students in the reading impairment group (n=24) scored below the 25th percentile on at least one measure of reading. The groups did not differ on maternal education, nonverbal intelligence, ethnicity, or distribution of grade. Group differences were observed on distribution of race, as well as spoken language and earbud use. Students with reading impairment were more likely to be races other than white, had lower spoken language scores, and reported more daily minutes of earbud use. Additionally, the groups did not differ on reported presence of ear infections as a young child. Students were recruited from schools and tutoring programs throughout the states of South Carolina, North Carolina, and Ohio.

Table 1. Participant Demographic Information

<table>
<thead>
<tr>
<th>Group</th>
<th>n (boys)</th>
<th>Percent Minority</th>
<th>Maternal Education in Years (SD)</th>
<th>TOWRE Standard Score (SD)</th>
<th>CELF-5 Core Language Score (SD)</th>
<th>Daily Minutes of Earbud Use (SD)</th>
<th>Median Grade Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children with Normal Reading</td>
<td>10 (8)</td>
<td>15.79</td>
<td>17.79 (3.38)</td>
<td>104.27 (8.48)</td>
<td>108.74 (14.31)</td>
<td>20.74 (2.62)</td>
<td>5</td>
</tr>
<tr>
<td>Children with Reading Impairment</td>
<td>24 (14)</td>
<td>19.17</td>
<td>18.39 (2.02)</td>
<td>103.39 (7.06)</td>
<td>97.25 (16.87)</td>
<td>53.45 (31.06)</td>
<td>6</td>
</tr>
</tbody>
</table>

Procedure

Testing was completed in one to two sessions at the USC Speech & Hearing Research Center. All participants completed a hearing screening at 500, 1000, 2000, 4000, 6000, and 8000 Hz at 15 dB HL (the threshold for normal hearing in children) using over-the-ear headphones in a sound booth. Additionally, a battery of literacy assessments was administered.

Simple View Reading Groups

After completion of the research session, students were further classified according to Simple View of Reading (Gough & Tunmer, 1986) subtypes. Students in the normal reading group were classified as normal reading. Students who scored below the 25th percentile on any measure of word-level reading and above the 25th percentile on listening comprehension were classified as dyslexia. Students who scored above the 25th percentile on all measures of word-level reading and below the 25th percentile on either measure of reading comprehension were classified as poor comprehenders. Finally, students who scored below the 25th percentile on any measure of word-level reading and below the 25th percentile on listening comprehension were classified as mixed deficits.

RESULTS

Is hearing screening failure associated with deficits in decoding and/or comprehension skills?

Yes and no. Pearson Chi-square analyses revealed that the distribution of decoding deficits differed according to hearing screening group membership, such that children who failed the hearing screening were more likely to exhibit decoding deficits than children who passed the hearing screening $X^2 (1, N = 43) = 4.25, p = 0.039$. There was no difference, however, between groups on distribution of comprehension deficits, $X^2 (1, N = 43) = 2.46, p = 0.117$.

Does the distribution of simple view subtypes differ across hearing screening groups?

Yes. A Pearson Chi-square analysis revealed that the distribution of simple view subtypes differed across the hearing screening groups, $X^2 (1, N = 43) = 9.05, p = 0.29$. Specifically, children who passed the hearing screening were more likely to be normal readers, and children who failed the hearing screening were more likely to exhibit mixed deficits.

DISCUSSION

Students with reading impairment were much more likely to fail a hearing screening than students with normal reading. Additionally, decoding deficits were associated with failed hearing screenings, and the distribution of simple view of reading subtypes differed across groups. These findings indicate the need for more research that explores the relation of minimal hearing loss and reading acquisition.

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