This study explored relations of print exposure, academic achievement, and reading habits among 100 deaf and 100 hearing college students. As in earlier studies, recognition tests for book titles and magazine titles were used as measures of print exposure, college entrance test scores were used as measures of academic achievement, and students provided self-reports of reading habits. Deaf students recognized fewer magazine titles and fewer book titles appropriate for reading levels from kindergarten through Grade 12 while reporting more weekly hours of reading. As in previous studies with hearing college students, the title recognition test proved a better predictor of deaf and hearing students’ English achievement than how many hours they reported reading. The finding that the recognition tests were relatively more potent predictors of achievement for deaf students than hearing students may reflect the fact that deaf students often obtain less information through incidental learning and classroom presentations.

This article examines relations among the reading attainment, reading habits, and the amount and kinds of reading materials to which deaf college students have been exposed. In essence, the study sought to replicate the finding obtained with both hearing children (e.g., Stanovich, 1986) and hearing college students (e.g., Acheson, Wells, & MacDonald, 2008; Stanovich & Cunningham, 1992) that exposure to print is a significant predictor of reading ability and achievement. This issue is of particular importance because reading presents significant difficulties for most deaf students, but there is little evidence concerning who will become better or poorer readers.

From the early school years through university, deaf students typically lag behind hearing peers in reading achievement regardless of degree of hearing loss and whether or not they utilize cochlear implants (Archbold et al., 2008; Geers, Tobey, Moog, & Brenner, 2008; Moeller, Tomblin, Yoshinaga-Itano, Connor, & Jerger, 2007; Traxler, 2000). Examining a national normative sample of deaf and hard-of-hearing students taking the Stanford Achievement Test—9th Edition, Traxler (2000) found that only about 50% of 18-year-olds were reading above the fourth-grade level, a situation that has changed little over the past several decades (Luckner & Handley, 2008; Qi & Mitchell, 2012). Even the relatively selective population of deaf students attending university generally exhibits considerable difficulty in reading. Studies of deaf students at two universities by Albertini and Mayer (2011) and Parault and Williams (2010), for example, both found their samples to be reading below the sixth-grade level.

Reading challenges among deaf students traditionally have been ascribed to either the lack of phonological processing and phonemic awareness created by significant hearing loss, poor first language fluency (regardless of modality), or limited exposure to reading during childhood (Conrad, 1979; Mayer & Leigh, 2010; Nicholas & Geers, 2006). Recent studies, however, have demonstrated that deaf students from 12 years of age onward, on average, understand as
much or more from what they read as from signed or spoken communication (Borgna, Convertino, Marschark, Morrison, & Rizzolo, 2011; Marschark et al., 2006; Marschark et al., 2009; Stinson, Elliot, Kelly, & Liu, 2009). This finding indicates that deaf students’ language comprehension difficulties are not limited to print. Of particular concern in this context are findings indicating that deaf college students tend to be less accurate than their hearing peers in their comprehension monitoring (Banner & Wang, 2011; Borgna et al., 2011; Strassman, 1992), a situation with implications for academic achievement beyond reading per se.

The relation between reading and achievement includes both the direct link of content-related reading being necessary for most school subjects and an indirect link, as reading provides the individual with foundational knowledge and skills that support problem solving, logical reasoning, and decontextualized thinking (Anderson, Wilson, & Fielding, 1988; Olson, 1986; Stanovich, West, Cunningham, Cipielewski, & Siddiqui, 1996). Perhaps not coincidentally, these are all areas in which deaf students frequently lag behind hearing peers. Those relations also are bidirectional, as students who struggle with reading tend to read less, thus contributing to their lesser knowledge of both specific content and background knowledge. This situation, in turn, makes reading more difficult and less appealing (Marschark, Lang, & Albertini, 2002, chap. 8; Stanovich, 1986; Wilbur, 1977). Accordingly, Trezek, Wang, and Paul (2010) reported that better deaf readers find reading more satisfying, and Parault and Williams (2010) found that deaf university students with greater intrinsic motivation for reading read more.

Examining Reading Habits and Exposure to Print

Stanovich and Cunningham (1992) examined relations among reading habits, exposure to print, and outcomes associated with the acquisition of literacy among 300 hearing university students. That study included a battery of reading and cognitive tasks as well as a Magazine Recognition Test (MRT) and Author Recognition Test (ART; Stanovich & West, 1989). The latter two tests involved having participants indicate which of a series of titles or names they recognized within a larger list that included both real targets and invented foils. Such tests generally are taken as proxy measures of exposure to print, and the ART and MRT were both good predictors of performance in all domains. Consistent with Stanovich et al. (1996) and Hayes and Ahrens (1988), Stanovich and Cunningham concluded that print is a far richer source of information than is spoken language, a situation that would seem to emphasize the potential benefits of reading for deaf students.

Acheson et al. (2008) also examined links among reading habits, print exposure, and reading ability among hearing college students. They employed a self-report measure of reading habits and updated versions of the ART and MRT as a means of estimating print exposure. Reading ability was estimated via a sentence comprehension test and scores on the English and Reading Comprehension subtests of the American College Test (ACT; see Stiggins, Schmeiser, & Ferguson, 1978). The amount of time students reported reading textbooks was inversely related to both ART and MRT scores, suggesting that college students who spent more time studying had read fewer books and magazines. Time spent reading fiction and nonfiction, in contrast, was positively related to both MRT and ART scores.

The Present Study

Although deaf students’ reading difficulties are well documented, there does not appear to be information available concerning how much or what kinds of reading they do. This study was conducted with deaf and hearing students attending the same university, thus providing a comparison of the reading habits of the two groups and possible insights into relations of print exposure and achievement. Overall, it was expected that the deaf students would be found to read less than their hearing peers and therefore be less familiar with the titles of popular books and magazines. Measures of reading frequency and print exposure, however, were expected to be related to reading achievement at least as strongly for deaf students as they are for hearing students.
Another question addressed by this study was whether deaf and hearing students’ reading habits diverge over time. Toward that end, the materials included book titles that would have been read by students of different ages. This manipulation was motivated by the fact that the vocabulary, structure, and content of books generally is more difficult in books intended for older readers (Wauters, Tellings, van Bon, & Mak, 2008), and there is also an increasing gap in the reading abilities of deaf and hearing children as they get older (Traxler, 2000). Such differences may help to account for results like those of Geers et al. (2008) who found that deaf children with cochlear implants who were reading at grade level when they were 8- to 9-years old had fallen approximately 2 years behind by the time they were 15- to 17-years old. If deaf students tend to read less as a function of text difficulty, they would be expected to recognize more titles intended for younger children relative to hearing peers.

Methods

Participants

The study involved 100 deaf students and 100 hearing students enrolled at the Rochester Institute of Technology (RIT). RIT includes the National Technical Institute for the Deaf (NTID) as one of its eight colleges, but deaf participants came from all RIT colleges. All students were recruited via flyers and personal contacts and were paid for their participation.

As described by Bochner and Walter (2005), studies of deaf university students typically define reading and academic achievement operationally in terms of subtests on college entrance examinations—the ACT and/or the SAT. All students in this study had satisfied university entrance requirements, and ACT English, Reading, Math, and Composite scores as well as SAT Verbal, Math, and Composite scores were available from institutional records. ACT scores were available for 80 deaf students and 31 hearing students (111 total). SAT scores were available for 20 deaf students and 87 hearing students (107 total), with 18% of the students having scores on both tests.

Deaf students’ pure tone average (PTA) hearing thresholds in their better ear (i.e., the average hearing threshold across all sound frequencies) were obtained from institutional records even though that variable generally does not predict either reading ability or academic achievement (Allen, 1986; Convertino, Marschark, Sapere, Sarchet, & Zupan, 2009; Goldberg & Richburg, 2004; Powers, 2003; Tymms, Brien, Merrell, Collins, & Jones, 2003). PTAs ranged from 48 to 120 with a mean of 100.42 and a standard deviation of 16.91. Twenty-seven of the deaf students reported using cochlear implants. This is approximately the proportion of deaf students with implants in the larger RIT student population, although it is significantly larger than the almost 14% of deaf schoolchildren in the United States who have implants according to the Gallaudet Research Institute (2008). It is unclear whether students with cochlear implants are overrepresented in the RIT student population for academic or other reasons. Deaf students who gain entry to RIT or another university undoubtedly represent a select population, but the Gallaudet Annual Survey includes only about 60–65% of deaf children in the country, and it is widely assumed that the children most likely overlooked are singletons functioning in mainstream classrooms (many of whom likely have cochlear implants).

Materials and Procedure

Exposure to print was operationalized using two title recognition tests. Following studies of Cunningham and Stanovich (1990) and Cipielewski and Stanovich (1992), a Title Recognition Test (TRT) was constructed including a list of 160 book titles (see Appendix A). Book titles rather than book authors were utilized here on the recommendations of NTID English professors who indicated that because of the lesser breadth in their reading, deaf students are less likely to encounter specific authors repeatedly. There do not appear to have been previous studies comparing title and author recognition for deaf or hearing students, but utilizing an ART was thought likely to significantly underestimate deaf students’ reading histories. Included in the TRT were 80 real book titles and 80 invented foils. In order to examine possible differences in students’ familiarity with books they would have encountered at different ages, the list of real book titles was created with the assistance of local
librarians and spanned elementary through 12th-grade books. Within the list of real titles, 20 had been chosen by the librarians as likely to have been read between kindergarten and 3rd grade, 20 between 4th and 6th grade, 20 between 7th and 8th grade, and 20 between 9th and 12th grade. Foils were created so as to similarly parallel grade levels, 20 in each. A MRT was constructed using the 65 magazine titles from the Acheson et al. (2008, following Stanovich & Cunningham, 1992) study and 65 invented foils (see Appendix A). Students were asked simply to check all the titles they recognized, whether or not they had read them. The Reading Time Estimates section of the Acheson et al. Reading Habits Self-Reports was used to query students concerning their reading habits (see Appendix B). That self-report instrument asks students how many hours in a typical week they spend reading textbooks, other academic materials, magazines, newspapers, e-mail, Internet media (not including e-mail), fiction books, non-fiction books, and “other/special interest” materials (filled in by the participant). In addition to the reading time reported for each category, a total reported reading time was computed for each participant. Similar self-reports of reading activity have been used with both hearing (Schutte & Malouff, 2004) and deaf (Parault & Williams, 2010) university students.

Results and Discussion

Because of the imbalance in deaf and hearing students with ACT versus SAT scores and the lack of strict equivalence in converting scores from one test to the other, analyses reported below involving achievement scores utilized ACT scores for the deaf students and SAT scores for the hearing students. Although the two tests are assumed to be roughly equivalent for the purposes of college entrance, a second set of analyses was conducted in which common scores were created for the two samples. An “English Achievement” score was created by separately standardizing ACT English scores and SAT Verbal scores and then combining the two sets of z-scores. A “Composite Achievement” score similarly was obtained by separately standardizing the ACT and SAT Composite scores and combining them (ACT scores were used for students who had both ACT and SAT scores). Analyses yielded essentially the same results as the separate test scores, but because ACT and SAT scores were never used for between-group comparisons, the latter were assumed to be more valid and are reported here. Unless indicated otherwise, all significant effects reported below reached an alpha level of at least .05.

Acheson et al. (2008) had reported a sufficient level of reliability (Cronbach’s α = .723) for the part of their Reading Habits Self-Reports addressing how students thought they compared to peers in the time spent reading, enjoyment of reading, reading speed, complexity of reading material, and comprehension of reading material (five items). Reliabilities of reported reading times and their MRT and ART scores (two items) in this study yielded roughly comparable levels of internal consistency in the deaf and hearing samples, Cronbach’s α = .764 and .697, respectively (.748 overall). Self-reported reading times for textbooks, other academic materials, magazines, newspapers, e-mail, Internet content, fiction, and nonfiction (eight items) yielded similarly high levels of reliability: Cronbach’s α = .784 and .781 for deaf and hearing samples, respectively (.788 overall).

Overall, deaf students reported that they spent more time reading than did the hearing students, t(198) = 3.60, ranging from 6 to 56 hr per week, with a median of 24 hr (SD = 11.14). The hearing students reported reading from 1 to 43 hr per week with a median of 17.5 hr (SD = 10.03). Significant differences in reported reading times for different kinds of material, all in favor of the deaf students, were obtained for reading of magazines, newspapers, e-mail, fiction, and nonfiction (see Table 1). Of course, there is no way to verify the veracity of student reports, a common difficulty in studies asking individuals to report their reading habits. However, responses to book title foils and magazine title foils generally are considered to be “self-aggrandizement indices,” and no significant differences between the two groups were obtained in that regard (see Table 2). Further, it seems likely that deaf students make greater use of newspapers, e-mail, and magazines than their hearing peers at least in part because the latter are more able to obtain some of the same information through radio, television, and interpersonal communication.
As can be seen in Table 2, hearing students recognized more book titles and more magazine titles than their deaf peers, $t(198) = 6.84$ and 3.09, respectively. This finding suggests that deaf students may spend more time reading than hearing students because they require more time to read what they do, rather than because they read a greater volume of material (see below). Subtracting erroneous identifications of book and magazine foils from correct identifications of real titles yielded TRT and MRT scores. Consistent with the above findings, hearing students had significantly higher TRT and MRT scores than deaf students, $t(198) = 7.11$ and 4.71, respectively. TRT and MRT scores were significantly related to each other among both deaf and hearing students, $r(98) = .61$ and .57, respectively. Deaf students with cochlear implants had higher MRT scores than students without implants, $t(98) = 2.25$, and also had reported reading more “other academic” material, $t(98) = 2.16$, but there were no other differences between the groups on any of the reading or academic measures.

### Table 2 Book and magazine titles identified, foils (erroneously) identified, and (corrected) TRT and MRT scores

<table>
<thead>
<tr>
<th>Measure</th>
<th>Deaf</th>
<th>Hearing</th>
<th>$M$</th>
<th>$SD$</th>
<th>$M$</th>
<th>$SD$</th>
<th>$t$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Book titles</td>
<td>23.84</td>
<td>15.85</td>
<td>39.91</td>
<td>17.32</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Book foils</td>
<td>2.26</td>
<td>3.44</td>
<td>2.02</td>
<td>4.17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magazine titles</td>
<td>11.67</td>
<td>8.34</td>
<td>15.28</td>
<td>8.19</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magazine foils</td>
<td>4.87</td>
<td>4.60</td>
<td>3.94</td>
<td>3.61</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRT score</td>
<td>21.58</td>
<td>15.13</td>
<td>37.89</td>
<td>17.23</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MRT score</td>
<td>6.80</td>
<td>6.41</td>
<td>11.34</td>
<td>7.19</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note. TRT, Title Recognition Test; MRT, Magazine Recognition Test.*

The effects of book title age-level appropriateness were examined through a 2 (hearing status) by 4 (age level) analysis of variance in which the second factor was within subjects and the TRT score was the dependent variable. Significant main effects of hearing status, $F(1,198) = 40.98$, MSE = 83.54, and age level, $F(3,198) = 10.77$, were obtained. The hearing status by age level interaction was not significant, $F(3,198) < 1.00$, as hearing students had higher TRT scores than DHH students at all levels (Grades K–3 > 7–8 > 9–12 > 4–6). On the basis of results reported by Stanovich and Cunningham (1992), one could argue that at least one cause of DHH students’ lags in reading and achievement is the simple fact that they read less. When reading is difficult, getting a child to read can be a challenge in itself, although the present results suggest that deaf students read for leisure (i.e., books of the sort on the TRT) less than hearing peers at all ages. Several programs have been developed to increase DHH and hearing children’s motivation for reading, but beyond preliminary qualitative results, none have been shown actually to increase the quantity or quality of DHH students’ reading (Spencer & Marschark, 2010, chap. 6).

The extent to which the various achievement scores could be predicted by the TRT and MRT and reported number of hours reading was evaluated using stepwise multiple regression. Analyses of the deaf students’ data also included hearing thresholds (PTAs). As can be seen from Table 3, the TRT was the best predictor of all four of the deaf students’ ACT scores, explaining between 38% and 49% of the variance in Reading Comprehension, English, and Composite scores and 15% of Math scores. The TRT was the best predictor of hearing students’ SAT Verbal scores, accounting for 32% of the variance. Hearing students’ time spent reading fiction was a significant second predictor (Acheson et al., 2008) and was also the only predictor of their SAT Composite score. For both deaf and hearing students, their reported times reading various materials tended to be either negative predictors of their achievement scores or accounted for a very small proportion for the variance.

Acheson et al. (2008) found that their ART measure was inversely related to reported time reading textbooks, and both ART and MRT measures were...
positively related to reported time reading fiction and nonfiction. The latter would appear to lend some support to the validity of the ART and MRT as indicators of reading exposure. As suggested earlier, however, deaf students may spend more time reading not because they read a greater volume, but because it takes them more time to read. Stepwise multiple regressions were utilized to examine the possibility that the relation between self-report measures, PTAs (for deaf students), and the TRT and MRT as indicators of print exposure might be different for deaf and hearing students. Self-reported reading times for textbooks, other academic materials, magazines, newspapers, e-mail, Internet content, fiction, and nonfiction served as predictor variables, and TRT and MRT scores served as criterion variables in separate analyses. As can be seen in the middle section of Table 3, those analyses yielded similar results for deaf and hearing students. For both groups, TRT scores were best predicted by MRT scores, and MRT scores were best predicted by TRT scores. Note that PTA was never a significant predictor for the deaf students.

The suggestion that deaf students may read fewer books than hearing students because it takes them longer appears to contrast with the finding that the difference between deaf and hearing students in

| Table 3 | Stepwise multiple regressions predicting achievement scores, TRT, and MRT (additional predictors: types of reading, hours of reading, and deaf students’ hearing thresholds) |
|---|---|---|---|---|---|
| ACT Reading | TRT | .49 | .55 | NA | NA | NA |
| | Magazines | .53 | -.23 | | | |
| | MRT | .55 | .21 | | | |
| ACT English SAT Verbal | TRT | .38 | .62 | TRT | .32 | .50 |
| | Magazines | .53 | .23 | Fiction | .37 | .24 |
| ACT/SAT Math | TRT | .15 | .43 | Newspapers | .06 | -.27 |
| | Nonfiction | .20 | -.23 | Internet | .11 | .22 |
| ACT/SAT Composite | TRT | .48 | .68 | Fiction | .09 | .30 |
| | Magazines | .53 | -.22 | | | |

Without Achievement Predictors

<table>
<thead>
<tr>
<th>TRT</th>
<th>MRT</th>
<th>.38</th>
<th>.61</th>
<th>MRT</th>
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<tbody>
<tr>
<td></td>
<td>Total 'Other' Reading</td>
<td>.37</td>
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<td>Newspapers</td>
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<td>-.26</td>
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<tr>
<td></td>
<td>Magazines</td>
<td>.41</td>
<td>-.26</td>
<td>Fiction</td>
<td>.46</td>
<td>.23</td>
</tr>
<tr>
<td>MRT</td>
<td>TRT</td>
<td>.38</td>
<td>.59</td>
<td>TRT</td>
<td>.33</td>
<td>.57</td>
</tr>
<tr>
<td></td>
<td>Academic</td>
<td>.44</td>
<td>.26</td>
<td></td>
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</tbody>
</table>

With Achievement Predictors

<table>
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<tr>
<th>TRT</th>
<th>ACT Reading</th>
<th>.49</th>
<th>.32</th>
<th>MRT</th>
<th>.33</th>
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<tbody>
<tr>
<td></td>
<td>MRT</td>
<td>.57</td>
<td>.35</td>
<td>SAT Verbal</td>
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<td>Newspapers</td>
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<td>ACT Math</td>
<td>.64</td>
<td>-.27</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MRT</td>
<td>TRT</td>
<td>.38</td>
<td>TRT</td>
<td>.33</td>
<td>.57</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Academic</td>
<td>.44</td>
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<td>ACT Reading</td>
<td>.48</td>
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</tr>
<tr>
<td></td>
<td>ACT English</td>
<td>.57</td>
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</table>
the amount of time spent reading textbooks was quite small, although the time spent reading other academic materials was somewhat larger (see Table 1). It is unclear, however, whether the time spent by the two groups reading textbooks indicates that they read the same amount. Given deaf students’ difficulties in reading, the deaf students may have depended less on textbooks than their hearing peers, believing that they would learn more in class, where instruction is provided in sign language sometimes accompanied by spoken language. Prior research is consistent with that suggestion, as deaf students frequently report full understanding of sign language in the classroom, when related test scores are quite low (e.g., Marschark, Sapere, Convertino, Seewagen, & Maltzen, 2004). In fact, several studies now have demonstrated that deaf students aged 12 years and older learn no more from signed or spoken instruction than they do from reading the same content (Marschark et al., 2006, 2009; Stinson et al., 2009). They also tend to overestimate learning from both modalities significantly more than hearing peers.

A related issue that can be at least tentatively addressed in this article involves relations between student achievement scores and TRT and MRT scores. In studies involving hearing children, Stanovich and his colleagues have demonstrated that the causal connection in the positive relation between how much individuals read and their reading abilities is that reading more leads to better reading (e.g., Stanovich, 1986; Stanovich & Cunningham, 1992). That issue apparently has not yet been evaluated with regard to deaf children, but this study allowed preliminary examination of the issue with deaf college students. Multiple regression analyses using MRT and TRT scores as criterion variables were repeated, but ACT (deaf students) and SAT scores (hearing students) were added to the other predictor variables. In addition to the TRT being a robust predictor of reading-related achievement scores for deaf students (as above), achievement scores (but not PTAs) were also robust predictors of TRT and MRT scores. As in previous studies, the MRT and TRT were the primary predictors of each other for the hearing students. Although the hearing students’ SAT Verbal scores were a second significant predictor of their TRT scores, the strong predictive relation observed between achievement scores and recognition tests among the deaf students was not observed among the hearing students, consistent with the findings of Stanovich and Cunningham (1992). The relevant achievement data were not collected at the same time as the print exposure data, but these results suggest the possibility that the causal relation between amount of reading and reading achievement among deaf students has a bidirectional component not present among hearing students.

A variety of studies have failed to observe relations between thresholds and either reading or achievement among older students (Allen, 1986; Calderon, 2000; Convertino et al., 2009; Powers, 2003; Tymms et al., 2003). The failure of PTAs to predict scores in this article thus is consistent with the majority of relevant literature.

In summary, the above results involving a title recognition task rather than an author recognition task replicated findings of Stanovich and Cunningham (1992) and Acheson et al. (2008) indicating print exposure to be a good predictor of hearing college students’ reading achievement, as indicated by the observed relation between their SAT Verbal scores and TRT scores. The TRT was expected to be an even more potent predictor for deaf college students, and the strong relationships observed between it and ACT Reading Achievement and English scores suggest that it was. Consistent with the earlier studies involving hearing students, the TRT and MRT were better predictors of English achievement scores for both deaf and hearing students than were self-report measures, which may be prone to self-aggrandizement or metacognitive inaccuracy. Deaf students obtained TRT and MRT scores approximately 50% of those obtained by their hearing peers, but their greater predictive value would appear to emphasize the importance of reading for deaf students’ academic success.

Conclusions and Implications

Reading has long been a major challenge for deaf students and a concern of their parents and teachers (Luckner & Handley, 2008; Qi & Mitchell, 2012). This article examined relations among print exposure, reading attainment, and achievement using books and MRTs, a self-report of reading habits, and students’ college entrance examination scores.
Consistent with findings of Stanovich and Cunningham (1992) and Acheson et al. (2008), recognition tests associated with print material were found to be better predictors of academic achievement than is the total amount of time students report spending in academically related and leisure reading. The TRT and MRT in this study also were more potent predictors of achievement for deaf students than for hearing students. This finding emphasizes that various measures of achievement may not be fully equivalent for deaf and hearing students. More generally, the results reflect the fact that deaf students obtain less information than hearing students from incidental learning and through-the-air (signed or spoken) communication. Such findings point to the need for parents and teachers to take deaf students’ strengths and needs into consideration in structuring the input of information relevant to school achievement as well as knowledge of the world.

The suggestion that deaf students may get more information from reading than from interpersonal communication, relative to hearing students, is consistent with recent findings indicating that deaf students in high school and college learn as much from reading as they do from sign language (or spoken language) in the classroom (Marschark et al., 2009; Stinson et al., 2009). They also tend to overestimate how much they are learning significantly more than hearing peers (Borgna et al., 2011; Marschark et al., 2004). Taken together, such results indicate that deaf students’ academic challenges are not limited to print literacy, but likely entail issues of language comprehension and cognition that need to be addressed by teachers if we are to optimize academic outcomes.

The finding that the TRT was the primary predictor of reading-related (English) achievement for hearing students, but that SAT English scores were a secondary predictor of the TRT is inconsistent with Stanovich and Cunningham’s (1992) finding of a unidirectional relationship between print exposure and achievement. This may be a consequence of differences between an ART and a title recognition test or variability in the population of college students in universities focusing on liberal arts versus technical education. TRT and achievement scores in this study, however, were clearly bidirectionally significant predictors for the deaf college students. This relationship clearly warrants further investigation with deaf adults as well as deaf children.

Finally, the finding that deaf students reported reading more fiction and nonfiction than their hearing peers but identified only about half as many book and magazine titles suggests the need to examine reading times (are these findings the result of deaf students’ reading more slowly?) as well as reading comprehension (do they understand as much?) in those populations. Although it may be that the deaf students were more likely than the hearing students to inflate their reported reading times, they did not incorrectly identify TRT and MRT foils more frequently. These findings therefore may be a consequence of deaf students depending more on text for information that hearing students obtain through hearing (e.g., radio, television). Alternatively, those results could indicate that the deaf students’ reports of a greater number of hours reading reflect slower reading rather than more reading. This result would be consistent with the fact that fiction and nonfiction reading times were not associated with their TRT scores. The extent to which slower reading might be associated with greater or lesser comprehension, however, remains to be determined for both deaf college students and deaf children. Studying university students has the advantage of reducing the acknowledged variability among deaf students’ reading and academic attainments, but the results may not generalize to children and the broader range of reading habits and reading abilities in the deaf population at large.

Notes

1. Approximately 10% of RIT’s 15,000 students are deaf or hard of hearing. Half of them are enrolled in NTID’s associate degree programs specifically designed for and limited to deaf students. The other half is enrolled in regular baccalaureate programs in the other colleges of the university.

2. Some of the magazine foils by Acheson et al. were found to have become real magazine titles.

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Conflicts of Interest

No conflicts of interest were reported.

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References


Appendix A

Real Book Titles (ordered by grade level)

Kindergarten through third-grade
1. Aesop’s Fables
2. Madeline
3. Stone Soup
4. Goodnight Moon
5. The Story of Babar
6. The Very Hungry Caterpillar
7. Adventures of Pinocchio
8. Corduroy
9. The Three Little Pigs
10. Harold and the Purple Crayon
11. Winnie-the-Pooh
12. Amelia Bedelia
13. The Little Engine That Could
14. The Tale of Peter Rabbit
15. Curious George
16. Where the Wild Things Are
17. The Cat in the Hat
18. Green Eggs and Ham
19. Alexander and the Terrible, Horrible, No Good, Very Bad Day
20. Charlotte’s Web

Fourth grade through sixth grade
21. The Secret Garden
22. Tales of the Fourth Grade Nothing
23. The Black Stallion
24. Harriet the Spy
25. The Wind in the Willows
26. The Phantom Tollbooth
27. How to Eat Fried Worms
28. Pippi Longstocking
29. Doctor Doolittle
30. Sarah Plain and Tall
31. Superfudge
32. The Borrowers
33. A Light in the Attic
34. Black Beauty
35. The Rescuers
36. Heidi
37. From the Mixed-Up Files of Mrs. Basil E. Frankweiler
38. Swiss Family Robinson
39. Ramona the Pest
40. Where the Sidewalk Ends
41. Little Women
42. Fahrenheit 451
43. The Last of the Mohicans
44. Robinson Crusoe
45. Ivanhoe
46. The Count of Monte Cristo
47. Johnny Tremain
48. The Outsiders
49. The Hunchback of Notre Dame
50. The Legend of Sleepy Hollow
51. A Wrinkle in Time
52. Call of the Wild
53. My Friend Flicka
54. The Yearling
55. Where the Red Fern Grows
56. A Tree Grows in Brooklyn
57. Treasure Island
58. The Hobbit
59. 20,000 Leagues Under the Sea
60. War of the Worlds
61. I Know Why the Caged Bird Sings
62. Go Tell It on the Mountain
63. Wuthering Heights
64. Don Quixote
65. The Red Badge of Courage
66. Crime and Punishment
67. The Scarlet Letter
68. The Odyssey
69. Their Eyes Were Watching God
70. Brave New World
71. The Catcher in the Rye
72. The Jungle
73. Of Mice and Men
74. Anna Karenina
75. Death of a Salesman
76. Our Town
77. A Tale of Two Cities
78. The Old Man and the Sea
79. The Pearl
80. A Farewell to Arms

Book Title Foils (ordered by grade level)

Kindergarten through third-grade
1. At the Top of the Muffin
2. The World Is Round, Except On the Sides
3. Chocolate Burgers and Dandelion Soup
4. Mystery at Pine Valley Camp
5. The Grape Flavored House
6. Grandma and the Licorice Stick
7. Cheese and Moon Pies
8. Bunnies on Your Birthday
9. The New Girl in Class
10. Timmy's Train Ride
11. My Lucky Keychain
12. Dragons in My Desk
13. Wilma Walrus Goes to the Dentist
14. My Daddy the Superhero
15. A Balloon Walrus Goes to the Moon
16. What Time Is Tomorrow?
17. What Color Is Your Apple?
18. The Garbage Truck Disaster
19. Froggie Domingo Leaps to London
20. Popsicle Pie

Fourth grade through sixth grade
22. And You Thought Kittens Couldn’t Fly
23. Nobody Ever Guessed It
24. Zelda’s Imagination
25. Snakes, Fish, and Other Furry Creatures
26. The Pirate and the Big Green Sea
27. Hot Top

Ninth grade through 12th grade
29. Chocolate Burgers and Dandelion Soup
30. Mystery at Pine Valley Camp
31. The Grape Flavored House
32. Grandma and the Licorice Stick
33. Cheese and Moon Pies
34. Bunnies on Your Birthday
35. The New Girl in Class
36. Timmy's Train Ride
37. My Lucky Keychain
38. Dragons in My Desk
39. Wilma Walrus Goes to the Dentist
40. My Daddy the Superhero
41. A Balloon Walrus Goes to the Moon
42. What Time Is Tomorrow?
43. What Color Is Your Apple?
44. The Garbage Truck Disaster
45. Froggie Domingo Leaps to London
46. Popsicle Pie
28. The Knight in the Basement
29. The Rollaway
30. Mandy's Garden on the Rooftop
31. Mummies in Museums
32. The Spiral Staircase to Jupiter
33. Sadie Goes to Hollywood
34. The Magic of Cat Whiskers
35. Buck the Bully's New Braces
36. Give it to Ringo
37. He's Your Little Brother!
38. Entering My TV Time Machine
39. Searching the Wilds
40. Harvey Plaid Pants
Seventh grade and eighth grade
41. Golden Blue Jeans
42. Once Upon a President
43. Vatania's Silver Spoon
44. Call Me Topsy-Turvy
45. The Perils of Evenrude
46. Dracula's Last Dram
47. Find Your Way to Luxembourg
48. How Many Windows Are in the White House?
49. Simon's Sinister Plan
50. Why Knees are Needed
51. Is There Chrome in Chromosomes
52. Don't Blow Up the Chemistry Lab
53. Photosynthesis Shop
54. Bones in the Garage
55. Maurice the Magician
56. The Telephone Tango
57. The Ghosts of Rio Vista
58. Murder at Wellington Court
59. Blackout in the Maze
60. The Story of Light Bulb Jackson
Ninth grade through 12th grade
61. Shades of Madness
62. Time of the Breezes
63. Operation Sierra One
64. Abandonment of Nelson
65. The Glimmering Phoenix
66. Manhattan Dynasties
67. The Peacock Conspiracy
68. Anywhere
69. Restless Game
70. Weekend Voodoo
71. Rendezvous with Rembrandt
72. Blue Bells and Nightingales
73. Inspiration Sings
74. White Blossoms in Denver
75. Trapped in Cyberspace
76. Summoned by Danger
77. Until You’ve Walked in My Sandals
78. Tending to My Soul
79. In Envy of Silver
80. Jupiter's Lost Moon

Real Magazine Titles
1. Atlantic Monthly
2. Backpacker
3. Biography
4. Black Enterprise
5. Boating World
6. Bon Appetit
7. Business Week
8. Car & Driver
9. Cat Fancy
10. Cigar Aficionado
11. Consumer's Digest
12. Country Living
13. Details
14. Discover
15. Ebony
16. Family Circle
17. Field & Stream
18. Flex
19. Food & Wine
20. Fortune
21. Game Pro
22. Golf World
23. Good Housekeeping
24. Gourmet
25. Guitar Playing
27. Hot Rod
28. Hunting
29. InStyle
30. Jet
31. Ladies Home Journal
32. Maxim
33. Men's Health
34. Modern Bride
35. Money
36. Motor Trend
37. Mountain Bike
38. Organic Gardening
39. Outdoor Life
40. PC World
41. Popular Mechanics
42. Popular Science
43. Premiere
44. Psychology Today
45. Redbook
46. Rosie
47. Science News
48. Self
49. Ski Magazine
50. Smithsonian
51. Spin
52. Stuff
53. Technology
54. The Progressive
55. The Source
56. U.S. News & World Report
57. Ultimate Audio
58. Vegetarian Times
59. Vibe
60. Wildlife Conservation
61. Wired
62. Women’s Day
63. Working Mother
64. Yoga Journal

Magazine Title Foils

1. Adventures in Wine
2. Amateur Cook
3. American Getaways
4. Ancient Structures
5. Better Yourself
6. Bull market
7. Cars for Less
8. Cash Flow
9. Chocolate Cravings
10. Circuit Surge
11. Clothes Hound
12. Computers Unwrapped
13. Counterfeit Antiques
14. Decorating Styles
15. Dow Jones Weekly Report
16. Electrical & Mechanical News
17. Elliot
18. Entertainment Review
19. Exercise
20. Fashion Island
21. Felines
22. Fit at 50 Plus
23. For the Health of It
24. Forrest Trails
25. Galactic Digest
26. Golden Cruises
27. Hair Sculpting
28. Health and Life
29. High Sky
30. Historic Buildings
31. Ideas Illustrated
32. Interlude
33. Intrigue
34. Invitation
35. Lawn Tips
36. Men’s Journal
37. Millionaire Meals
38. MTV
39. Music Media
40. Night Lights
41. Organic Philosophy
42. Organization Now
43. Outdoor Luxury
44. Outdoor Outlet
45. PC International
46. Plush
47. Recycling Habits
48. Resort to Spas
49. Rolling Hills
50. Scrapbooking Digest
51. Signs Unlimited
52. Sports Nation
53. Stock and Bond Digest
54. Suburban Living
55. Ten
56. Tent Travels
57. The Zen in You
58. Tools and Repair
59. Trends America
60. Trendy Times
### Appendix B

#### Self-Report Reading Time Estimates

How many hours do you spend in a *typical week* reading each type of material below:

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<th>Material</th>
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<td>Academic materials other than textbooks</td>
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<td>Magazines</td>
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<td>Newspapers</td>
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<td>Internet media (all subjects not including e-mail)</td>
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<td>Fiction books</td>
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<td>Other categories (please list)</td>
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*Note.* Adapted from Acheson et al. (2008).