Research in Developmental Disabilities 77 (2018) 49–59

Contents lists available at ScienceDirect

Research in Developmental Disabilities

journal homepage: www.elsevier.com/locate/redevdis

Predicting reading ability in teenagers who are deaf or hard of hearing: A longitudinal analysis of language and reading

Sarah Worsfold[a,*], Merle Mahon[b], Hannah Pimperton[a], Jim Stevenson[c], Colin Kennedy[a,d]

[a] Faculty of Medicine, University of Southampton, Southampton, SO16 6YD, UK
[b] Language and Cognition Research Department, UCL, London, WC1X 8EE, UK
[c] Psychology, Faculty of Social and Human Sciences, University of Southampton, Southampton, SO17 1BJ, UK
[d] University Hospital Southampton NHS Foundation Trust, UK

ARTICLE INFO

Number of reviews completed is 2

Keywords:
Permanent childhood hearing loss
Reading accuracy
Reading comprehension
Expressive language
Language comprehension
Longitudinal design

ABSTRACT

Background: Deaf and hard of hearing (D/HH) children and young people are known to show group-level deficits in spoken language and reading abilities relative to their hearing peers. However, there is little evidence on the longitudinal predictive relationships between language and reading in this population.

Aims: To determine the extent to which differences in spoken language ability in childhood predict reading ability in D/HH adolescents.

Methods: and procedures: Participants were drawn from a population-based cohort study and comprised 53 D/HH teenagers, who used spoken language, and a comparison group of 38 normally hearing teenagers. All had completed standardised measures of spoken language (expression and comprehension) and reading (accuracy and comprehension) at 6–10 and 13–19 years of age.

Outcomes: and results: Forced entry stepwise regression showed that, after taking reading ability at age 8 years into account, language scores at age 8 years did not add significantly to the prediction of Reading Accuracy z-scores at age 17 years (change in $R^2 = 0.01$, $p = .459$) but did make a significant contribution to the prediction of Reading Comprehension z-scores at age 17 years (change in $R^2 = 0.17$, $p < .001$).

Conclusions: and implications: In D/HH individuals who are spoken language users, expressive and receptive language skills in middle childhood predict reading comprehension ability in adolescence. Continued intervention to support language development beyond primary school has the potential to benefit reading comprehension and hence educational access for D/HH adolescents.

What this paper adds?

The difficulties D/HH children have in acquiring reading skills have been repeatedly demonstrated but longitudinal studies of D/HH children identifying aspects of underlying language skills that contribute to variation in reading skills are rare. The present study examines the stability of reading skills from middle childhood to adolescence in D/HH individuals and shows moderate stability in

* Corresponding author at: Auditory Implant Service, Building 19, Highfield, University of Southampton, Southampton, SO17 1BY, UK.
E-mail addresses: smw3@soton.ac.uk (S. Worsfold), merle.mahon@ucl.ac.uk (M. Mahon), h.pimperton@ucl.ac.uk (H. Pimperton), jsteven@soton.ac.uk (J. Stevenson), crk1@soton.ac.uk (C. Kennedy).

https://doi.org/10.1016/j.ridd.2018.04.007
Received 5 April 2017; Received in revised form 9 February 2018; Accepted 4 April 2018

Reading Comprehension and a high level of stability in Reading Accuracy scores. It also shows that variation in the language ability of D/HH children in middle childhood is predictive of their Reading Comprehension in late adolescence. This predictive relationship is over and above the continuity in Reading Comprehension between childhood and late adolescence. The same was not found for Reading Accuracy; language ability in middle childhood was not a significant predictor of adolescent word reading skills. Within the D/HH group, differences in the relationship between severity of hearing loss and reading ability in late adolescence were accounted for by differences in language ability. The results of this study contribute to the case for continued targeted intervention on language skills for D/HH individuals beyond primary school. Maximising their language ability, and consequently their ability to use reading to access learning, is likely to enhance their educational attainment and subsequent life chances

1. Introduction

Despite recent technological improvements, such as digital hearing aids and cochlear implants, and earlier diagnosis and management of babies born deaf or hard of hearing (D/HH), reading ability in D/HH children and young people continues to lag behind that of their hearing peers (Wauters, van Bon, & Tellings, 2006; Moeller, Tomblin, Yoshinaga-Itano, Connor, & Jerger, 2007; Harris & Terlektsi, 2011; Qi & Mitchell, 2011; Pimperton et al., 2016; Harris, Terlektsi, & Kyle, 2017a). Moreover, with increasing age a widening gap in reading achievement between D/HH and hearing children has been observed (Blair, Peterson, & Viehwg, 1985; Marschark & Harris, 1996; Kyle & Harris, 2010, 2011). As children get older, reading takes on an increasingly important role in enabling them to access the curriculum; they move from 'learning to read' to 'reading to learn'. Thus the reading deficits shown by the D/HH population are likely to have an increasingly significant impact on their educational attainment and subsequent employment opportunities. The continuing importance of reading ability and educational attainment for the later occupational status of D/HH individuals in adulthood has been shown by Walter and Dirmyer (2013).

Despite group-level deficits in their reading ability, D/HH children and young people show substantial individual variation in reading skills, with some reading at an age-appropriate level (Kyle & Harris, 2006, 2010Kyle and Harris, 2010; Harris and Terlektsi, 2011; Pimperton et al., 2016). The question of what drives this variation is an important one because identifying these drivers may raise potential avenues for intervention to support reading development in this group.

In hearing children, the causal contribution of underlying language abilities to reading development has been repeatedly demonstrated through good quality longitudinal and intervention studies (see Hulme & Snowling, 2014, for review). Phonological language skills (e.g. phonological awareness, letter-sound knowledge) appear to be most important for reading accuracy (i.e. decoding written words into their phonological form) (Muter, Hulme, Snowling, & Stevenson, 2004; National Institute for Literacy, 2008; Bowyer-Crane et al., 2008; Caravolas et al., 2012) whereas non-phonological broader oral language skills (e.g. vocabulary, grammatical knowledge, morphological skills) appear to be most important for reading comprehension (i.e. understanding the meaning of what is read) (Nation, Cocksey, Taylor, & Bishop, 2010; Clarke, Snowling, Truelove, & Hulme, 2010; Fricke, Bowyer-Crane, Haley, Hulme, & Snowling, 2013).

The phonological and non-phonological language skills identified as playing a causal role in reading development in hearing children are all skills which D/HH children find difficult to acquire and in which they show deficits relative to the skills of hearing peers (Moeller et al., 2007; Musselman, 2000; Wake, Hughes, Poulakis, Collins, & Rickards, 2004). Taken together this suggests that variation in reading skills of D/HH children may be driven by variation in these underlying language skills. Consistent with this, factors related to audiological experience, such as severity of hearing loss, age at identification and age at cochlear implantation, that influence language development in D/HH children, have also been found to relate to their reading development (Moeller et al., 2007; Archbold et al., 2008; McCann et al., 2009).

The findings outlined above imply a similar role for language skills in causally driving the development of reading skills in D/HH children, as in hearing children. However, there is a dearth of good quality longitudinal and intervention studies to test whether, and if so which, language skills play a causal role in the reading development of D/HH children.

The most extensive set of studies of the role of language in reading for D/HH individuals is on phonological coding and awareness (PCA). Mayberry, del Giudice, and Lieberman (2011) identified 25 studies that had examined PCA abilities and their relationship with reading abilities in deaf children and adults. The assessment of reading proficiency was based on some studies that measured reading comprehension and others reading accuracy. They estimated that 11% of the variance in reading proficiency was explained by PCA, similar to the 12% of variance that was thus explained in a meta-analysis of studies with hearing participants (Bus and van IJzendoorn, 1999). Around half of studies included in the Mayberry et al. (2011) meta-analysis showed evidence of an effect of PCA on reading proficiency in the deaf participants, while the other half did not. It is likely that differences between studies in terms of the format of the PCA tasks used (e.g. auditory input-oral response vs. visual input-nonverbal response), aspects of reading assessed (accuracy vs. comprehension), and populations included (e.g. children vs. adults, oral language vs. sign language users) will have contributed to the lack of consistency in results.

Vocabulary and grammatical knowledge are key broader language skills that have been causally associated with reading comprehension development in hearing readers and have also been shown to relate to reading skills in deaf children (Geers, 2003; Barajas, Gonzalez-Cuenca, & Carrero, 2016). In line with this, the Mayberry et al. (2011) meta-analysis also reported that a broader measure of general language ability (signed or spoken) explained 35% of the variance in reading proficiency in those studies that included such a language measure, and was the factor with the strongest relationship to reading. They concluded that "deaf readers, like hearing readers, are more likely to become successful readers when they bring a strong language foundation to the reading process" (Mayberry et al., 2011, p.181).

In commenting on the Mayberry et al. (2011) meta-analysis, Kyle, Campbell, and MacSweeney (2016) point out that the majority