



Learning to read new words in individuals with Down syndrome: Testing the role of phonological knowledge



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ABSTRACT

This study examined the effect of word level phonological knowledge on learning to read new words in Down syndrome compared to typical development. Children were taught to read 12 nonwords, 6 of which were pre-trained on their phonology. The 16 individuals with Down syndrome aged 8–17 years were compared first to a group of 30 typically developing children aged 5–7 years matched for word reading and then to a subgroup of these children matched for decoding. There was a marginally significant effect for individuals with Down syndrome to benefit more from phonological pre-training than typically developing children matched for word reading but when compared to the decoding-matched subgroup, the two groups benefitted equally. We explain these findings in terms of partial decoding attempts being resolved by word level phonological knowledge and conclude that being familiar with the spoken form of a new word may help children when they attempt to read it. This may be particularly important for children with Down syndrome and other groups of children with weak decoding skills.

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1. Introduction

Although there is variability between individuals, reading accuracy has been identified as a relative strength in Down syndrome in comparison to general ability and reading comprehension (e.g. Boudreau, 2002; Buckley, 1985; Cardoso-Martins & Frith, 2001; Hulme et al., 2012; Laws & Gunn, 2002; Nash & Heath, 2011). Typically individuals with Down syndrome show better reading of words than nonwords (Roch & Jarrold, 2008). Further, they tend to have poor phonological awareness (Lemons & Fuchs, 2010; Næss, Melby-Lervåg, Hulme, & Lyster, 2012), a skill that is important for decoding in typical development (e.g. Byrne & Fielding-Barnsley, 1989; Hulme, Goetz, Gooch, Adams, & Snowling, 2007; Wagner et al., 1997). This relationship is also present in Down syndrome (Fowler, Doherty, & Boynton, 1995; Roch & Jarrold, 2008); indeed a recent meta-analysis found that the deficit in nonword reading in individuals with Down syndrome is moderated by their performance on phoneme deletion tasks (Næss et al., 2012).

The relative difficulties in nonword reading and phonological awareness among individuals with Down syndrome suggests that they may be recruiting compensatory strategies to support the development of word reading, such as visual skills or vocabulary knowledge (Boudreau, 2002; Buckley, 1985; Kay-Raining Bird, Cleave, & McConnell, 2000). A recent

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longitudinal study suggested that vocabulary is a stronger predictor of reading development in Down syndrome than in typical development (Hulme et al., 2012). Related to this, Nation and Cocksey (2009) have suggested that phonological (sound-based) aspects of vocabulary knowledge may be particularly important for learning to read when decoding is compromised. The aim of the current study was to investigate the contribution of word level phonological knowledge to reading and orthographic learning in individuals with Down syndrome.

In order to study the mechanisms behind reading development in Down syndrome, it is useful to consider models of reading in typical development. The triangle model of reading (Plaut, McClelland, Seidenberg, & Patterson, 1996) proposes two ways in which the phonology of words can be activated from their orthography: directly or indirectly via semantics. Semantic information (meaning-based knowledge) is argued to be most important when the direct phonological pathway is impaired or compromised such as when reading irregular words (McKay, Davis, Savage, & Castles, 2008; Taylor, Plunkett, & Nation, 2011) or in disorders such as Down syndrome or dyslexia.

Semantic knowledge is not well-specified in the triangle model and was conceptualised as additional input to the phonological representation (Plaut et al., 1996). In studies with children, semantics is typically assessed by vocabulary tasks. However, these tasks often require both phonological and semantic knowledge about a word (Johnson, Paivio, & Clark, 1996; Levelt, Roelofs, & Meyer, 1999). Nation and Cocksey (2009) devised separate measures of phonological knowledge and semantic knowledge and found that at the item-level, phonological, but not semantic, knowledge uniquely predicted variations in children's reading of irregular words. They suggested that irregular words may result in partial decoding attempts, and possession of a whole-word phonological representation allows children to resolve these attempts and produce the correct response. Such a process may well be important for learning to read in individuals who have decoding difficulties, such as individuals with Down syndrome.

One method to determine how existing phonological knowledge affects reading is to conduct training studies with novel words. This controls what phonological information about a word children have been exposed to. In such studies, children are taught to read unfamiliar words or nonwords with or without pre-training. Pre-training can be used to train phonological knowledge of words or nonwords and may involve individuals hearing and saying the items (McKague, Pratt, & Johnston, 2001) or discriminating between the target items and phonologically similar distracters (Duff & Hulme, 2012). It has been found that typically developing children are more accurate when attempting to read words that have received such phonological pre-training (i.e. those they have phonological knowledge about), than those words which have not (Duff & Hulme, 2012; McKague et al., 2001). This supports the idea that knowing the phonological form of a word is causally related to children's ability to learn to read it.

Training studies can also explore how children establish orthographic (written) representations of new words. According to Share's self-teaching hypothesis (Jorm & Share, 1983; Share, 1995) when a child encounters an unknown word, they independently convert the letters into sounds, a process termed phonological recoding. Multiple successful encounters with a word result in the formation of an orthographic representation. Orthographic knowledge can be tested using orthographic choice tasks that assess whether children can discriminate the correct written form of the word from a nonword with the same pronunciation but a different spelling. If familiarising the child with the phonological form of a word supports decoding, this should also promote the creation of an accurate orthographic representation.

The aim of the present study was to examine the effect of phonological knowledge on written nonword learning in individuals with Down syndrome. A group of typically developing children was matched to the individuals with Down syndrome on word reading. A subgroup of the typically developing children was also individually matched to the individuals with Down syndrome on decoding. This two-stage matching procedure was used to investigate whether individuals with Down syndrome learnt to read new words at a rate commensurate with their reading or decoding level. It was predicted that individuals with Down syndrome would show written nonword learning in line with their decoding skill but below the level expected from their word reading ability.

Phonological pre-training was designed to familiarise individuals with the phonological form of the nonwords prior to encountering them in print. It was expected that this would benefit the typically developing children (Duff & Hulme, 2012; McKague et al., 2001). The individuals with Down syndrome would likely have poorer decoding skills than typically developing children at the same level of reading and so make more partial decoding attempts that could be resolved through phonological knowledge. Therefore it was also predicted that individuals with Down syndrome would benefit more from phonological pre-training than the typically developing children matched for word reading but that when the groups were matched for decoding, they would benefit equally from phonological pre-training.

2. Method

2.1. Participants

Sixteen children and adolescents with Down syndrome (mean age of 13;08 (SD = 2;11; range 8–17 years); five males) were recruited through families who were also taking part in a longitudinal study and all individuals completed the study. All individuals also participated in a spoken word learning study approximately 12 months previously (Mengoni, Nash & Hulme, 2013), which trained different nonwords using different methods and none of the background data were re-used in the present study. All individuals had Trisomy 21 according to parental report and were known from previous testing to have a reading age of at least five years. Parental consent was obtained for the individuals to participate in the study.

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