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Contributions of phonological awareness, phonological short-term memory, and rapid automated naming, toward decoding ability in students with mild intellectual disability

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ABSTRACT

Reading decoding ability is a fundamental skill to acquire word-specific orthographic information necessary for skilled reading. Decoding ability and its underlying phonological processing skills have been heavily investigated typically among developing students. However, the issue has rarely been noticed among students with intellectual disability who commonly suffer from reading decoding problems. This study is aimed at determining the contributions of phonological awareness, phonological short-term memory, and rapid automated naming, as three well known phonological processing skills, to decoding ability among 60 participants with mild intellectual disability of unspecified origin ranging from 15 to 23 years old. The results of the correlation analysis revealed that all three aspects of phonological processing are significantly correlated with decoding ability. Furthermore, a series of hierarchical regression analysis indicated that after controlling the effect of IQ, phonological awareness, and rapid automated naming are two distinct sources of decoding ability, but phonological short-term memory significantly contributes to decoding ability under the realm of phonological awareness.

1. Introduction

Decoding ability refers to the conversion of printed letters into equivalent speech sounds. It is a fundamental skill to acquire word-specific orthographic information necessary for skilled reading (Kirby, Desrochers, Roth, & Lai, 2008). Word decoding requires attending to the graphemes details of a word, identifying phonemes represented in the word, blending a string of the phonemes, and finally reading the word. Typical beginner readers usually move through the stages successfully when they step forward in their academic skills (Barker, 2010). However, compared to their non disabled peers, students with intellectual disability may have considerable difficulties in passing decoding steps effectively and their decoding abilities often lag behind their chronological and mental age (Cawley & Parmar, 1995; Conners, Atwell, Rosenquist, & Sligh, 2001; Gronna, Jenkins, & Chin-Chance, 1998). Decoding deficiencies in students with intellectual disability may impede their word-specific orthographic information and consequently interfere with their reading accuracy. Hence, understanding phonological processing aspects underlying decoding abilities in these students may have profound implications for their remedial intervention programs.

Phonological awareness, phonological short-term memory, and rapid automated naming are three well known aspects of phonological processing closely related to decoding ability (Wagner & Torgesen, 1987; Wagner et al., 1997). Phonological awareness refers to the ability to manipulate individual sounds or phoneme of a given language and make judgment about

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them (Schuele & Boudreau, 2008). Phonological short-term memory involves storing distinct phonological features for a short period of time. Finally, rapid automated naming refers to rapid efficient retrieval of a series of names of colors, objects, digits, and letters presented in random orders (Denckla & Rudel, 1974).

A large number of studies have consistently established that the three aspects of phonological processing strongly contribute to reading abilities typically in developing participants, although there are some controversies as to whether they have independent unique contributions or share some common variances (e.g., Elbro, 1996; Goswami & Bryant, 1990; Share, 1995; Wagner & Torgesen, 1987). However, a small number of researchers are concerned with the issue within participants with intellectual disability, especially those of unspecified origin (Conners, Atwell, Rosenquist, & Sligh, 2001; Wise, Sevcik, Romski, & Morris, 2010; Saunders & DeFulio, 2007). In some ways, this may be because it is assumed that low IQs in students with intellectual disability explains their poor reading performance and there is no need to look for any specific dysfunction. Nevertheless, as mentioned by Conners et al. (2001), intelligence is neither the only nor the most important predictor of reading performance. Controlling the effect of IQ, there are some unique variances in reading performance accounted for other cognitive functions.

The goal of the present study is to investigate the contributions of phonological awareness, phonological short-term memory, and rapid automatic naming to decoding ability in students with intellectual disability of unspecified origin after controlling the effect of IQ. In the following sections, an overview of the three phonological processing skills and their contributions to decoding ability are reviewed.

1.1. Phonological awareness and decoding ability

As mentioned earlier, phonological awareness refers to the ability of manipulating individual sounds or phoneme of a given language and making judgment about them (Schuele & Boudreau, 2008). Phonological awareness is an umbrella term used to describe a variety of tasks such as blending and segmenting phonemes or syllables in a word, rhyme detection tasks, initial and final phoneme or syllables detection tasks, and finally initial and final phoneme or syllables deletion tasks.

It has been argued that phonological awareness is the prerequisite to the ability to decode words (Wagner & Torgesen, 1987). The point of this argument is that awareness of phonemes is essential to segment letter strings into phoneme based units and subsequently blending the resulting phonemes into words which are fundamental to develop a decoding ability. Concerning typically developing participants, numerous correlation studies have confirmed that phonological awareness is directly linked to decoding ability (e.g., Hester & Hodson, 2004; Plaza & Cohen, 2003; Roman, Kirby, Parrila, Wade-Woolley, & Deacon, 2009; Strattman & Hodson, 2005; Tengestal & Tqnnessen, 2011). When measuring prior to or at the onset of reading instruction, empirical studies have demonstrated that phonological awareness successfully predicts decoding ability and reading performance in later years (e.g., Catts, Fey, Zhang, & Tomblin, 2001; de Jong & van der Leij, 1999, 2002; Georgiou, Parrila, & Papadopoulos, 2008; Hogan, Catts, & Little, 2005; Pokorni, Worthington, & Jamison, 2004; Torgesen et al., 1999; Wagner et al., 1997). Furthermore, training studies have shown that explicit instruction in phonological awareness leads to gain not only in decoding ability skill but also in general reading ability (e.g., Ball & Blachman, 1991; Durguno-lu & Ouml, 2002; Gillon & Dodd, 1995; Gillon, 2000; Pokorni et al., 2004; Torgesen, Wagner, Rashotte, Herron, & Lindamood, 2010; Torgesen et al., 1999)

Concerning subjects with intellectual disability, most studies addressed the question of whether phonological awareness skills are correlated with reading decoding ability, have involved participants with Down syndrome. Taken together, their findings approved the significant link between different measures of phonological awareness and reading decoding abilities (for a review see Lemons & Fuchs, 2010; Nass, Melby-Lervag, Hulme, & Lyster, 2012). Similar results were also reported by Wise et al. (2010) in a sample of 80 elementary school age students with mild intellectual disability of heterogeneous etiology (mostly Down syndrome, fragile × syndrome, and unspecified origin). The researchers found that, after controlling for chronological age and vocabulary knowledge, phonological awareness tasks accounted for a large and significant amount of unique variance of both word and non word decoding skills. Additional supports were provided by Saunders and DeFulio (2007) who found strong relationships between certain measures of phonological awareness (sound categorization tasks) and decoding abilities after controlling for IQ in thirty (21–58 years old) adults with mild intellectual disability of unspecified origin. Furthermore, in another study, Conners et al. (2001) compared 21 stronger decoders with 44 weaker decoders, all of whom had intellectual disability of heterogeneous etiology. The participants were between 8 and 12 years of age, with an IQ < 70. Their initial group comparisons revealed that the stronger decoders were significantly better than weaker decoders in phonological awareness tasks ($t = 2.49$, SE = 4.07).

1.2. Phonological short-term memory and decoding ability

Phonological short-term memory capacity, as measured by non word repetition tasks, has been consistently related to word and non word decoding ability (Gathercole & Baddeley, 1993; Gathercole, Willis, & Baddeley, 1991; Wagner et al., 1997). Simultaneously, the nature of this relationship remains debatable. Some researchers have found that phonological short-term memory does not uniquely contribute to decoding ability, when the effects of phonological awareness or other aspects of phonological processing are controlled (Muter & Snowling, 1998; Ramus et al., 2003; Wagner et al., 1997). The researchers suggested that verbal item information is stored in the short-term memory directly via temporary activation of the language network; in that case, processing and storage of verbal item information directly depends upon the availability