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Research in Developmental Disabilities



Reading disabilities in children: A selective meta-analysis of the cognitive literature[☆]



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ARTICLE INFO

Article history:

Received 10 April 2014

Received in revised form 29 December 2014

Accepted 16 January 2015

Available online 26 February 2015

Keywords:

Reading disabilities

Cognition

Meta-analysis

ABSTRACT

This article synthesizes literature that compares the academic, cognitive, and behavioral performance of children with and without reading disabilities (RD). Forty-eight studies met the criteria for the meta-analysis, yielding 735 effect sizes (ESs) with an overall weighted ES of 0.98. Small to high ESs in favor of children without RD emerged on measures of cognition (rapid naming [ES = 0.89], phonological awareness [ES = 1.00], verbal working memory [ES = 0.79], short-term memory [ES = 0.56], visual-spatial memory [ES = 0.48], and executive processing [ES = 0.67]), academic achievement (pseudoword reading [ES = 1.85], math [ES = 1.20], vocabulary [ES = 0.83], spelling [ES = 1.25], and writing [ES = 1.20]), and behavior skills (ES = 0.80). Hierarchical linear modeling indicated that specific cognitive process measures (verbal working memory, visual-spatial memory, executive processing, and short-term memory) and intelligence measures (general and verbal intelligence) significantly moderated overall group effect size differences. Overall, the results supported the assumption that cognitive deficits in children with RD are persistent.

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1. Introduction

A popular assumption is that children with reading disabilities (RD) have specific localized low-order processing deficits. A component consistently implicated in reading disabilities is phonological awareness. Phonological awareness is “the ability to attend explicitly to the phonological structure of spoken words” (Scarborough, 1998, p. 95). Abundant evidence shows that children with RD have problems in processing phonological information (e.g., Gottardo, Collins, Baciú, & Gebotys, 2008; Melby-Lervåg, Lyster, & Hulme, 2012; Nelson, Lindstrom, & Lindstrom, 2012; Scarborough, 2009; Stanovich & Siegel, 1994; Vellutino, Fletcher, Snowling, & Scanlon, 2004; Wagner & Torgesen, 1987; Waterman & Lewandowski, 1993). Recently, some studies have suggested other processes may be involved in reading acquisition that are as important as phonological awareness (e.g., Swanson, Harris, & Graham, 2003; Swanson & Jerman, 2007). Although several studies show that reading deficiencies are related to phonological awareness (e.g., Badian, 2001, 2005; Bus & van Ijzendoorn, 1999; Catts, Gillispie, Leonard, Kail, & Miller, 2002; Morris et al., 1998; Stanovich, 1988), additional studies suggest other processes such as those related to rapid naming (e.g., Bonifacci & Snowling, 2008; Compton, 2003; Cronin, 2013; Kirby, Parrila, & Pfeiffer, 2003; Schatschneider, Fletcher, Francis, Carlson, & Foorman, 2004), orthography (e.g., Cunningham & Stanovich, 1990; McBride-Chang, Manis, Seidenberg,

[☆] This research was supported by an Institute of Education Science (IES), Cognition and Student Learning, grant numbers R324B080002 and R324A090002 awarded to H. Lee Swanson.

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Custodio, & Doi, 1993; Shany & Share, 2011; Spencer & Hanley, 2004; Zaretsky, Kraljevic, Core, & Lencek, 2009), semantics (e.g., Crisp & Lambon Ralph, 2006; Nation & Snowling, 1998), and memory span (e.g., Das & Mishra, 1991; Nevo & Breznitz, 2013; Parrila, Kirby, & McQuarrie, 2004) contribute statistically significant amounts of variance to reading.

The current literature weighs heavily on the side of phonological deficits as the major sources of reading difficulties. Nevertheless, an understanding of the interplay between multiple processes is necessary before one has an adequate account on the major information processing variables that contribute to RD. More important, little is known about potential moderator variables (e.g., age of the sample, severity of reading problems) that influence the magnitude of the effect sizes between children with and without RD on cognitive measures.

In the present study, we sought to investigate the evidence on cognitive differences between children with and without RD. Thus, our interest in reading ability was narrowly confined to word reading and those variables (e.g., phonological awareness, rapid naming speed) that have been identified in the literature as critically related to reading disabilities (see Siegel, 2003, for a comprehensive review). We are also interested in investigating potential cognitive processes (e.g., spelling, orthography, vocabulary, memory) that may also play an important role in predicting reading disabilities. The study used meta-analytic procedures to aggregate the research literature. The three primary purposes of this synthesis were to (a) conduct a meta-analysis of differences between children with and without RD, (b) identify some of the variables that moderate effect sizes between children with and without RD (e.g., age groups, socioeconomic status [SES], and types of criterion reading measures used to classify skilled and readers at-risk), and (c) to see if interactions between variables moderated the effect sizes between the two groups of children.

Two main research questions directed this synthesis:

1. Which performance domains (i.e., intellectual, academic, cognitive) make the largest contribution to the differences between children with RD and their average-achieving counterparts? In other words, which array of measures show the largest magnitude of effect sizes that explain the similarities and differences between the two groups?
2. What performance similarities or differences among children with and without RD are a function of variations in age, intelligence quotient (IQ), ethnicity, and gender? For example, we determine if some of the same deficits (as reflected in the magnitude of effect size) that emerge in studies that include older participants with RD in secondary school also occur when the sample is early elementary school age.

To answer these questions, the present synthesis uses hierarchical linear modeling (HLM) procedure to identify key constructs (e.g., IQ, reading, math, memory, and phonological processing) that contribute unique (independent) variance to defining differences and similarities between children with and without RD.

2. Method

2.1. Identification of studies (literature search)

2.1.1. Data gathering

Several approaches were used to locate the relevant studies published in peer-reviewed journals. First, a computer search located studies comparing children with reading disabilities and without reading disabilities on psychological, occupational, and vocational variables using the Web of Knowledge, PsycINFO, and ERIC databases. The computer search used the following terms: “cognitive processes, cognition, memory, speed, phonological” coupled with “learning disabilities, dyslexia, reading disorders, orthographic, and specific reading disabilities.” Entry of these terms yielded 11,432 references. Additional terms were entered into the search such as “IQ” and “assessment,” but these results were found to produce results that overlapped with the earlier terms. A refinement of the search focused only on empirical studies and journal articles published in English. The sample search obtained articles using the above descriptors that ranged in publication dates from 1957 (the earliest year of the earliest article found using the descriptors) and March 2013. Second, published articles by primary researchers (i.e., Badian, Berninger, Bowers, Bull, Chiappe, Das, De Jong, Fletcher, Johnson, Naglieri, Pennington, Siegel, Stanovich, Swanson, Vellutino, Willcutt, and Wolf) were also analyzed for possible inclusion. Finally, a manual search of journals where the majority of reading disability articles is published was conducted (e.g., *Journal of Educational Psychology*, *Journal of Learning Disabilities*, and *Learning Disability Quarterly*). From this pool of literature, articles were eliminated that focused on children with below average intelligence (mild mental retardation range, <85) and/or were not comparative or data-based studies.

Focusing on comparative studies (children with RD vs. children without RD) that were published in English journals narrowed the search down to 588 studies. The 588 potential studies were further evaluated to determine their relevance to the current review. To be included in the meta-analysis, each study had to satisfy the following criteria:

1. Children with RD (a combination of various labels were used in articles, e.g., reading disabilities, dyslexia, students with learning disabilities in reading, Individualized Educational Plan's [IEP's] which indicated a focus on reading difficulties, etc.) were compared to chronologically age matched children without RD group (i.e., no indication of a learning or behavior deficit) on at least one cognitive measure (e.g., phonological awareness, naming speed, memory, executive processing, etc.).

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