

Are morphological awareness interventions effective in improving reading and/or spelling outcomes in children with dyslexia?

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This critical review examines the current evidence on whether morphological awareness (MA) interventions are effective in improving the reading and/or spelling outcomes in children with dyslexia. A literature search yielded five relevant articles of variable research design. The articles' study design, methods of sampling, data collection, analyses and interpretation, and overall rigour were evaluated. Overall, the evidence gathered from this review are mixed, resulting in suggestive evidence that MA training improves the reading and spelling outcomes of children with dyslexia.

Introduction

Dyslexia is a relatively common learning disability affecting 13 to 14% of school-aged children in North America (International Dyslexia Association, 2002). This learning disability is characterized by: "difficulties with accurate and/or fluent word recognition and by poor spelling and decoding abilities." In addition to phonological and phonics deficits, studies have concluded that children with dyslexia often have trouble deriving and inflecting words and lack awareness of morphological boundaries in both oral and written language (Carlisle, 1995).

MA, defined as an individual's "understanding of how words can be broken down into smaller units of meaning such as roots, prefixes, and suffixes," is important for a child's reading and spelling development (Tighe & Binder, 2015; Arnbak & Elbro, 2000). Previous research focused extensively on the impact of phonics and phonological awareness interventions on reading and spelling outcomes. However, these interventions may not be enough to provide lasting improvements (Bowers & Bowers, 2017). Of children who exclusively receive intensive phonics/phonological awareness-based interventions, 10 to 15% continue to experience reading difficulties (Bowers & Bowers, 2017). This may be because a one-to-one phoneme-to-grapheme relationship does not always exist in English (or Danish) orthography (Tighe & Binder, 2015; Borleffs et al., 2017). Orthography, the conventional spelling system of a language, is largely based on morphology which makes reading and writing more meaningful and predictable (Bowers & Bowers, 2017). As such, Arnbak & Elbro (2000) have concluded that MA of spoken and written language may be as important in reading and spelling development as phonemic and phonological awareness. As a result of these findings, there has been a recent incentive to explicitly teach children about morphology with the

hopes of improving word recognition, comprehension, vocabulary, and reading motivation (Bowers et. al, 2010).

Given the evidence of the impact that MA has on reading and spelling development, there has been an emergence in the literature on whether explicit MA interventions improve the reading and spelling abilities of children with dyslexia. If explicit teaching of MA improves the reading and spelling outcomes for these children, it could be a useful tool for speech-language pathologists (S-LP) and educators.

Objectives

The objective of this review was to investigate the literature to determine if MA interventions are effective in improving reading and/or spelling outcomes in children with dyslexia.

Methods

Search Strategy

Online databases including Google Scholar, NCBI, and Taylor & Francis were searched using the following key terms: [(morphological awareness training)] AND (children with dyslexia) AND (morphological awareness instruction) AND (reading and spelling skills). Reference lists of previously searched articles were also used to obtain other relevant studies.

Selection Criteria

In order to be included in the review, studies must have conducted an MA intervention on school-aged children with dyslexia. Papers had to be available in English.

Data Collection

Results of the literature search yielded five articles fitting the selection criteria described above. The papers included in the review cover an array of designs

including one randomized control trial, one systematic review, one meta-analysis, one experimental control group design, and one cross-sectional ability level-design study.

Results

Experimental Control Group Design

An experimental control group study design is considered Level III evidence (Oxford Centre for Evidence-based Medicine, 2009). The outcomes from the control and experimental group are compared after an experiment. The independent variable is changed in the experimental group which is the only difference between the groups. The independent variable is held constant in the control group.

Arnbak and Elbro (2000) completed an experimental control group study design to determine whether it was possible to improve children with dyslexia's awareness of morphemes through oral training in Danish. Additionally, the authors also examined if improved awareness of MA improved the reading and spelling ability in children with dyslexia. A total of 60 students from grades four and five with dyslexia were included in the study. A total of 33 students were assigned to the intervention group and 27 students were assigned to a control group. The experimental group received oral MA training by their ordinary remedial teachers for 15 minutes, three times a week for a total of 12 weeks. The remedial teaching of controls consisted of training in phonological awareness, grapheme-phoneme recording, spelling to dictation, and oral and silent reading tasks. Outcome measures were evaluated using an extensive battery of 17 different standardized tests.

Appropriate statistical analyses revealed improvements in the experimental group's MA and spelling abilities when compared to the controls. No significant improvements were identified for word decoding of simple and complex words. Strengths of this study include well defined descriptions of the methodology and procedures behind intervention and well-defined analytical measures. Adequate description and statistical measures of results and confounding variables were provided.

However, the study included poorly defined participant selection criteria related to the severity of dyslexia diagnosis. In addition, the teachers were trained in how to administer the intervention but did not have a deep understanding of morphology. This could have impacted the quality of administration, reducing the validity of results. Additionally, the authors noted that larger group size had the potential to correlate negatively with students' ability to inflect new words

and make substantial gains in reading and spelling outcomes. This may be due to higher distractibility and a reduced degree of intervention intensity. They also recognized that their decision to use oral training may impact students' concentration on the material being presented, which may have been mitigated by a mixed modality approach. These limitations in methodology could have impacted the spelling and reading outcomes of students included in the study.

Overall, this study provides suggestive evidence that oral MA training provides improvement in some aspects of MA (not morphological subtraction) and spelling abilities of children with dyslexia. However, the evidence provided by this paper does not suggest that oral MA training improves reading abilities of students with dyslexia.

Randomized Control Trial Design

Randomized controlled trials (RCT) are considered to be Level I evidence for research design (Oxford Centre for Evidence-based Medicine, 2009). Participants in RCTs are randomly assigned to an experimental group or a control group. The difference between control and experimental groups in an RCT is the outcome variable being studied.

Berninger et al. (2008) used an RCT design to determine if providing either orthographic or morphological spelling treatment improved the spelling abilities of students with dyslexia and if these improvements transferred to reading. The authors also explored whether explicit language treatment or nonverbal problem-solving treatment improved the spelling and reading of pseudowords. The participants consisted of 22 children with dyslexia in grades four to six and 17 children with dyslexia in grades seven to nine. Both groups participated in the author-developed Mark Twain's Writers' Workshop. All students received all components of the composition instruction but were randomly assigned to either the orthographic ($n=11$, grades four to six; $n=9$, grades seven to nine) or the morphological ($n=11$, grades four to six; $n=8$, grades seven to nine) spelling treatment. The children participated in two-hour sessions for 14 consecutive weekdays. Treatment rotated between spelling instruction and composition instruction. Outcome measures for reading and spelling included the Wide Range Achievement Test-3 (WRAT-3) spelling subtest, Wechsler Individual Achievement Test-II (WIAT-II), the Woodcock-Johnson III, Phonemic Decoding Efficiency: Form A of the Test of Word Reading Efficiency (TOWRE), and PAL Expressive Coding.

Appropriate statistical analyses revealed that children who received morphological spelling treatment

improved more in the spelling of dictated pseudowords than the group that received orthographic treatment. However, the younger orthographic treatment group demonstrated greater improvements in real word spelling compared to the morphological treatment group. The older morphological and orthographic participant groups did equally as well in real word spelling. Both orthographic and morphological treatments were associated with improved reading. The authors provided well described participants and included detailed selection criteria. Objectives, methods and statistical analyses are considered to be valid and details are included. Appendices included sample composition lessons which improves the replicability of the study. An absent application to current practice is an obvious limitation. Additionally, long-term effects were not addressed in this study.

This study provides compelling evidence that both orthographic and morphological training are beneficial in improving the reading and spelling abilities of children with dyslexia.

Systematic Review

A systematic review is considered Level I evidence (Oxford Centre for Evidence-based Medicine, 2009). The purpose of a systematic review is to collect and analyze all evidence that answers a specific question. The question must be clearly defined and have inclusion and exclusion criteria. A broad, thorough search of the literature is performed and a critical analysis of the search results.

Carlisle's (2010) systematic review aimed to integrate findings from studies that explored whether MA instruction contributed to improvement in literacy skills for school-aged children. Sixteen studies met the inclusion criteria, including three studies on MA training for students with dyslexia. Other studies explored whether MA instruction was related to improvements in components of literacy development including phonology, orthography, and word meaning. Two databases were explored (PsychINFO and ERIC) using the terms "morph*" and "awareness" "instruction" "program" and "analysis". Searches also included the terms "reading", "spelling", and "vocabulary".

The systematic review determined that MA interventions (in a variety of forms) provided benefit to children's reading and spelling abilities. The author's inclusion criteria were well described and valid. However, objectives, methodology, and statistical analysis were vastly different between papers, and therefore needed to be further subdivided based on similarities. This limits the applicability of findings. Of

the papers included, three studies regarding the effects of MA instruction on improving the reading and spelling skills of children with dyslexia were found. Carlisle found that these papers determined that word reading and spelling improved with MA training. However, due to the limited inclusion of papers regarding morphological training on the reading and spelling abilities of students with dyslexia, generalizability of results are limited. This systematic review provides suggestive evidence that MA training provides improvement to the reading and spelling abilities of children with dyslexia.

Meta-Analysis

Meta-analysis is considered to be Level I evidence (Oxford Centre for Evidence-based Medicine, 2009). Meta-analysis is a research process used to systematically gather and merge findings of single, independent studies, using statistical methods to calculate an overall effect.

Goodwin and Ahn's (2008) meta-analysis was completed to determine the effect of morphological interventions on literacy outcomes for students with literacy difficulties. The analysis included 17 independent studies, which all contained control and treatment groups. All studies included participants that were considered to have a language delay, reading disability/dyslexia, speech and language delay, poor reading ability, struggling readers, poor/struggling spellers, and English Language Learners. The authors searched four databases (ERIC, Education Full Text, PsychINFO, and Dissertation Abstracts Online Database) for studies on school-aged children that included a control group that was compared to a morphological intervention group. Of the 17 studies included, six used the term reading disabled/dyslexic.

The meta-analysis determined that, across 17 studies, MA interventions were successful, with the degree of success depending on the literacy outcome of interest (i.e. reading, spelling, and vocabulary). Further, the authors determined that MA interventions improved the literacy outcomes of children with reading disabilities/dyslexia. Inclusion criteria was well defined and adhered to, which included design, participant, and morphological instruction procedures. The variance-weighted analysis was deemed valid and all calculations and data points were included. However, terminology was not well defined. It was not clear what diagnostic criteria constituted "reading disability" or "dyslexia" and if they were equated. Additionally, because morphological interventions differed significantly across studies, authors were not able to determine which interventions yield the largest benefit to reading and spelling outcomes.

This meta-analysis provides suggestive evidence that MA intervention programs improve the reading and spelling ability of children with reading disability/dyslexia.

Cross-Sectional Study

Cross-sectional studies are considered Level III evidence (Oxford Centre for Evidence-based Medicine, 2009). Cross-sectional studies are performed to examine the presence or absence of an outcome and an exposure at a specific point in time.

Tsesmeli and Seymour (2009) conducted a cross-sectional ability level design study to determine the effectiveness of explicit morphological instruction on spelling in students with dyslexia. Three groups of participants were included in this study: a dyslexic group ($n=9$), a chronological age control group ($n=14$), and a spelling/reading age control group ($n=23$). Each student in the dyslexic group received 32 individual MA intervention sessions (40 minutes each) administered by one teacher. The MA intervention aimed to teach participants the internal structure of words to demystify English orthography. The authors developed a word list that was used for the pre-test, training programme, and post-test for each separate study. A delayed post-test was given to the dyslexic group approximately two months after the completion of the study.

Through appropriate statistical analysis, researchers determined that their intervention improved the accuracy of spelling, especially for words with complex derivational morphology for children in the dyslexic group. Based on the fact that the chronological age control group did not show significant improvement in spelling ability, researchers are confident the gains made in the dyslexic group are due to intervention effects. Pre-testing, post-testing, and delayed post-testing procedures and the intervention are well described, increasing replicability. However, the pre-test and post-test measures were not standardized, reducing the reliability of their results. Additionally, the authors included longer-term effects and generalizability of the intervention which have not been included in other studies. However, the intervention was provided to each student by a single teacher which could promote a “teacher effect” (a measurable difference that a particular teacher has on the outcome measure of interest above and beyond the intervention itself), impacting the validity of results. Additionally, the number of participants in the experimental group was not proportionate to the number of participants in the control groups. Tighter control of extraneous variables could have been improved by having a single, untrained control group. Further, the experimental group

only had nine male participants, limiting the generalizability of findings.

Tsesmeli and Seymour’s study provides suggestive evidence that morphological awareness training can improve the spelling abilities of adolescents with dyslexia.

Discussion

Overall, the findings from these studies indicate that MA intervention has the ability to improve some components of reading and spelling abilities for children with dyslexia.

Due to the variety of outcome measures across the studies included, it is difficult to determine if MA interventions unilaterally improve reading and spelling outcomes in children with dyslexia. For example, Berninger et. al (2008) sought to determine if orthographic or morphological spelling treatment improved spelling and reading of pseudowords. Comparatively, Carlisle’s systematic review had the goal of determining improvements to literacy skills at large and determined that results differed vastly based on the outcome measure of interest.

In addition, the wide variety in the methodology of the different MA interventions make it difficult to compare interventions. Arnbak and Elbro (2000) explored whether oral training in MA improved spelling and reading outcomes while Berninger et al. (2008) and Tsesmeli and Seymour (2009) used a mix-methods implementation of MA interventions. This confliction in methodology raises the question as to which intervention procedure renders greater improvements to outcome measures of interest. Additionally, these differences make it challenging to determine what specific variables are contributing to improvements in the reading and spelling ability of children with dyslexia.

This review revealed gaps in the literature related to this topic and provides suggestions for future research. Future studies should focus on comparing different MA interventions to provide determinations on efficacy based on intervention methodology. Additionally, it would be beneficial to explore interventions that provide a combination of treatments in phonological awareness, orthographic awareness, and MA to determine if greater improvements to reading and spelling abilities are achievable using all three. A greater use of RCTs in this area could provide more compelling evidence of improvements on reading and spelling outcomes of children with dyslexia. There is also an opportunity for future research to focus on long-

term effects and generalizability of MA interventions for this population.

Clinical Implications

Overall, the current literature included in this review provides suggestive evidence that MA training improves the reading and spelling outcomes of school-aged children with dyslexia. However, due to the highly variable intervention methodology and outcome measures, S-LPs and educators should carefully examine each intervention and select the most appropriate methodology and outcome measure to fit the individual needs of their students.

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