

Critical Review: What Child-Factors Predict Reading Outcomes in Early School-Aged Children with a History of Speech Sound Disorder?

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Current research has produced mixed results regarding the existence of an association between Speech Sound Disorder and literacy performance. This critical review therefore evaluated the available literature in order to determine whether the presence of a variety of child factors could play a mediating role on the literacy outcomes of school-age children diagnosed with Speech Sound Disorder. A literature search using computerized databases was completed, resulting in seven articles which satisfied inclusion criteria. These articles were evaluated based on the level of evidence provided as determined through considerations of study methodological validity, reliability, and relevance of findings. Overall, the results of this review provide somewhat suggestive evidence to support an association between literacy outcomes and a variety of child factors, including comorbid Language Impairment, genetic risk of Dyslexia, speech error patterns and types, production accuracy of polysyllabic words, receptive vocabulary, speech perception, and phonological processing skills. As a result of limitations on the quality of evidence found, further research is required to draw meaningful conclusions regarding the role of child factors on literacy outcomes in school-age children diagnosed with Speech Sound Disorder.

Introduction

Speech Sound Disorder (SSD) is defined in the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; *DSM-5*; American Psychiatric Association) as “persistent difficulty with the production of speech sounds that interferes with the intelligibility of one’s speech or prevents verbal communication”. The prevalence of SSD is difficult to establish due to the variability of sample age groups and the inconsistent use of disorder classifications, however, it is estimated that between 2.3% and 24.6% of school-aged children fit the criteria for SSD (American Speech-Language-Hearing Association; ASHA).

Although research has established a significant association between speech and language difficulties in early childhood and later reading difficulties, inconsistent findings have been reported when the link between SSD and literacy has been investigated specifically (Smith, Pennington, Boada, & Shriberg, 2005). For example, research completed by Raitano and colleagues in 2004 found that 5- and 6-year-old children diagnosed with SSD *without* comorbid language difficulties performed worse on pre-literacy measures of phonological awareness than typically developing controls (Raitano, Pennington, Tunick, Boada, & Shriberg, 2004). In contrast, a 2004 literature review completed by Schuele found that there were limited risks to literacy development among school-aged children diagnosed with speech and articulation impairments (Schuele, 2004). These mixed results

suggest that there may be additional contributing factors that mediate literacy outcomes in children with a history of SSD.

It is of relevance to speech-language pathologists to establish which factors play a role in literacy development in children diagnosed with SSD, as this will support early identification of children who are at an increased risk for poor literacy outcomes, and may thus contribute to more effective monitoring and intervention practices (ASHA, 2008).

Objectives

The aim of the present study was to critically review the available literature examining the influence of a variety of child factors – such as comorbidities or abilities in additional speech and/or language areas – on the literacy outcomes of school-age children diagnosed with SSD.

Methods

Search Strategy:

Online databases including PsychInfo, Google Scholar, PubMed, and Western Libraries Database were searched using the following terms: [(“Speech Sound Disorder”) OR (“Articulation Disorder”) OR (“Speech Disorder”) AND (“literacy”) OR (“reading”) AND (“school”) OR (“children”)]. Additional relevant sources were identified using the reference lists of previously searched articles.

Selection Criteria:

Studies included in the current review were required to describe the association between within-child factors and literacy or preliteracy ability in children with a diagnosis of SSD (or an equivalent diagnosis using different terminology: Articulation Disorder, Speech Disorder) as the main focus of their examination. Inclusion criteria also required that all study participants were of early school age, between 4- and 9-years-old, at the time of literacy-based assessment. Studies were excluded if they focused primarily or exclusively on the influence of parental and/or environmental factors on literacy outcomes in children diagnosed with SSD.

Data Collection:

The literature search produced seven articles which met the previously described selection criteria. These articles included five Level 2b research evidence studies, including two between-groups studies and three longitudinal mixed studies. One single-group study and one longitudinal study, both considered to be Level 3 research evidence, were also included.

Results

Sices, Taylor, Freebairn, Hansen, and Lewis (2007) conducted a between-groups, correlational study in order to assess the preliteracy skills of children diagnosed with moderate to severe SSD, with or without comorbid Language Impairment (LI). Participants were between the ages of 3- and 6-years-old and included 66 children with comorbid diagnoses of both SSD and LI, and 59 children with a diagnosis of SSD only. Groups were well-matched for gender distribution, socioeconomic status (SES), race, and age. Preliteracy skills, including phonological awareness, print awareness, alphabet knowledge, and print knowledge, were assessed using standardized measures.

Appropriate, detailed statistical analyses revealed that children with comorbid diagnoses of SSD and LI performed significantly worse on preliteracy measures than participants with an isolated diagnosis of SSD. SSD severity and lower SES were both associated with lower reading scores; however, these associations were no longer significant when language status (i.e. the presence of LI) was accounted for. It was also determined that measures of phonological awareness were not significant predictors of reading scores when other relevant predictors were accounted for, such as SES and comorbid LI. The study authors provided detailed information about study methodology and, as such, this study has high replicability. The validity of this study is supported by the use of detailed, quantifiable disorder and severity criteria, as well as comprehensive participant exclusion criteria and

sociodemographic matching. Adequate reliability was also reported. However, it is of note that this study is limited by the absence of a typically developing (TD) control group and the short-term nature of the investigation, meaning that practical implication for later literacy and academic success could not be examined.

These findings provide somewhat suggestive evidence that the additional diagnosis of comorbid LI predicts lower literacy performance in early school-age children diagnosed with SSD and may play a mediating role over other child factors such as SES, SSD severity, and phonological awareness.

Hayiou-Thomas, Carroll, Leavett, Hulme, and Snowling (2017) completed a longitudinal, mixed research study in order to examine the development of literacy skills in a sample of children diagnosed with SSD. Participants were 68 3-year-old children diagnosed with SSD and 68 TD children matched on chronological age. The SSD group was further split into three subgroups, including isolated SSD, SSD with comorbid LI, and SSD with genetic risk of Dyslexia. Participants' literacy skills were assessed at age 5½ using both standardized and study-designed measures for phoneme awareness, word-level reading, and spelling. Participants were then assessed again at age 8 using standardized measures for word-level reading, reading comprehension, and spelling.

Appropriate, detailed statistical analyses revealed that lower scores on measures of emergent literacy skills at age 5½ were significantly associated with persistence of SSD and the production of a higher percentage of "atypical" (rather than typical developmental) speech errors. The presence of comorbid LI and genetic risk of Dyslexia were both found to be associated with lower literacy scores at both age 5½ and 8, particularly when these factors were present together. It was found that a diagnosis of SSD during initial testing at age 3 did not have a significant predictive value on later literacy scores, indicating that the presence of additional risk factors plays a mediating role on reading outcomes in children with SSD. The authors provided detailed descriptions of study procedures. As a result, this study has high replicability. This study also utilized detailed, quantifiable definitions and criteria for relevant factors, promoting strong validity and reliability. This study was, however, limited by a small number of participants within each subgroup, resulting in a lower statistical power. Additionally, the TD control group was notably higher in some sociodemographic factors including SES and measures of IQ, which may have played a mediating role on results.

These findings provide somewhat suggestive evidence that persistence of SSD and the presence of a higher number of atypical speech errors play a role in later reading difficulties in school-age children diagnosed with SSD, however, this may hold true only during the early years of literacy development. Additionally, this study provides suggestive evidence of an ongoing association between poorer reading outcomes and comorbid LI and/or genetic risk of Dyslexia.

Rvachew and Grawburg (2006) completed a single-group research study in order to examine whether any correlations existed between standardized assessment scores of speech perception, articulation, and receptive vocabulary, and the outcome measures of phonological awareness and emergent literacy skills in a sample of 95 4- and 5-year-old children diagnosed with SSD.

Linear Structural Equation Modeling revealed that the greatest predictor of phonological awareness and emergent literacy performance in this sample was speech perception, followed closely by receptive vocabulary scores. Articulation scores, on the other hand, were not found to be significantly associated with performance on these outcome measures. This study provided detailed descriptions of methodology, including participant criteria and testing procedures. As a result, this study is highly replicable. Appropriate reliability was also reported. This study is limited by the short-term nature of the investigation, and by the absence of a TD comparison group, meaning that it was not possible to determine whether the examined factors played a unique role in the literacy outcomes of children when a diagnosis of SSD is present.

This study provides somewhat suggestive evidence that speech perception and receptive vocabulary abilities play a role in literacy outcomes in school-aged children diagnosed with SSD.

Preston, Hull, and Edwards (2013) completed a longitudinal, correlational study in order to determine the predictive value of speech error patterns (based on error type and frequency) on later phonological awareness and literacy development. Participants included 25 children diagnosed with SSD who were tested at two time points: 4½-years-old and 8-years-old. Phonological awareness skills as well as literacy skills including spelling, true word reading, and nonword reading, were assessed using standardized measures.

Appropriate, detailed statistical analyses revealed that children whose speech included a greater number of distortion errors, in which a given speech sound is produced in an altered form (rather than substitutions, in which one sound is replaced with another, or cluster

reductions, in which one of the sounds in a consonant blend is eliminated), and/or which had 10% or more errors defined as “atypical” at preschool age (4½) had significantly lower scores on measures of phonological awareness and literacy at school-age (8). The authors of this study provided detailed descriptions of methodology and used well-defined, quantifiable criteria for the relevant factors examined. As a result, this study is highly replicable. Appropriate reliability was also reported. It is of note that this study is limited by the absence of a matched, TD control group. The attrition rate was also high at 42%, with the sample dropping from 43 at initial testing to only 25 at follow-up, which resulted in low statistical power.

These findings provide somewhat suggestive evidence that speech error patterns at preschool age – particularly, a greater number of distortions and/or atypical errors – influence later literacy outcomes in children with a history of SSD during the early school years.

Peterson, Pennington, and Shriberg (2009) completed a longitudinal, mixed research study in order to examine literacy development in a sample of children diagnosed with SSD. Participants were 86 children diagnosed with SSD and 37 TD children. Groups were well-matched on age, gender distribution, race, non-verbal intelligence, and socioeconomic status. The SSD group was further split into four subgroups based on two dimensions: overall language functioning (i.e. presence vs. absence of LI) and persistence of SSD (i.e. resolved vs. persistent). Participants were assessed at two testing time points, age 5- to 6-years-old and age 7- to 9-years-old, using standardized measures. Preliteracy measures of phonological awareness were examined at initial testing while literacy skills including single word reading, spelling, and reading comprehension were examined at follow-up.

Appropriate, detailed statistical analysis revealed that there was a significant association between overall language functioning at initial testing, and literacy scores at follow-up – demonstrating that children with both SSD and LI were significantly more likely to experience reading difficulties at age 7- to 9-years-old. No significant association between SSD persistence and literacy outcomes was identified, however, SSD persistence was found to significantly predict scores on measures of phonological awareness during initial testing. This study reported clear and detailed methodology, as well as well-defined participant inclusion criteria. This study also utilized detailed, quantifiable definitions and criteria for relevant factors, promoting strong validity. Overall, this makes the present study highly replicable and supports the validity

of its measures. This study is limited by the use of a relatively homogenous sample in terms of sociodemographics, meaning that generalizability of results may be low. The authors did not report on reliability scores.

This study provides suggestive evidence that the presence of comorbid language difficulties predicts literacy difficulties in school-age children with a history of SSD. Additionally, this study provides somewhat suggestive evidence that there is an association between SSD persistence and phonological awareness abilities during the early school years, however, a similar association between SSD persistence and later literacy outcomes was not found.

Masso, Baker, McLeod, and Wang (2017) completed a between-groups, correlational design in order to determine whether a significant association existed between polysyllabic word production accuracy and known predictors of literacy development, including phonological processing, receptive vocabulary, and print knowledge. Participants included 93 children with a diagnosis of SSD between the ages of 4- and 5-years-old who were divided into two groups based on overall production accuracy for polysyllabic words (low vs. moderate). Polysyllabic word production and preliteracy skills were both examined using standardized assessment measures.

Appropriate, detailed statistical analysis revealed that there was a significant difference between children with low polysyllabic word production accuracy and moderate polysyllabic word production accuracy on three of the four phonological awareness measures examined, with the low accuracy cluster performing significantly worse. A similarly significant difference was identified for measures of receptive vocabulary; however, no significant difference was found on measures of print knowledge. The present study provided detailed descriptions of procedures and participant criteria. As a result, this study is highly replicable. Appropriate reliability was also reported. This study is limited by the absence of a TD comparison group, and the short-term nature of the investigation.

These findings provide somewhat suggestive evidence that school-age children diagnosed with SSD with lower performance accuracy for the production of polysyllabic words are at an increased risk of experiencing difficulties during preliteracy development.

Rvachew (2007) completed a longitudinal, mixed research study in order to examine the association between phonological processing skills and reading outcomes in children diagnosed with SSD. Participants

included 33 children diagnosed with SSD and 35 TD children. The SSD group was further split into two subgroups: poor phonological processing skills and good phonological processing skills. Participants were initially assessed between ages 4- and 5-years old, and follow-up was completed when participants were between 6- and 7-years-old. Phonological processing and reading were examined using standardized measures.

Appropriate, detailed statistical analysis revealed that children in the poor phonological processing subgroup had significantly lower scores on non-word decoding compared to those in the good phonological processing subgroup. No significant difference was found on a measure of sight word reading. The authors provided detailed descriptions of study procedures and, as a result, this study has high replicability. This study also utilized detailed, quantifiable definitions and criteria for relevant factors, promoting strong validity. Adequate reliability was also reported. Although the authors did provide a detailed account of participant exclusion criteria, neither sample sociodemographics nor group-matching were reported on.

These findings provide suggestive evidence that children diagnosed with SSD with weaker phonological processing skills are at an increased risk of later reading difficulties – specifically when it comes to decoding.

Discussion

Taken together, the results of the current literature review provide somewhat suggestive evidence that, in school-age children with a diagnosis of SSD, there are a variety of child factors that could play a possible, mediating role on literacy outcomes, including: comorbid LI, genetic risk of Dyslexia, speech error patterns and types, production accuracy of polysyllabic words, receptive vocabulary, speech perception, and phonological processing skills.

Greatest evidence was available in support of the influence of a comorbid diagnosis of LI in children diagnosed with SSD, with three articles finding a significant correlation between the presence of an LI diagnosis and lower reading scores on a variety of standardized measures. Despite consistent findings across these three articles, the quality of evidence provided is limited. Despite utilizing a control group of TD children, Hayiou-Thomas et al.'s 2017 study lacked sufficient group-matching, which resulted in inconsistent sociodemographic factors across study groups. As a result, it is not possible to conclude that scores on outcome measures were the direct result of SSD with or without LI, as there were additional,

unexamined child factors that differed within the sample which may have played a role in literacy performance. In addition, Sices et al.'s (2007) failure to use a TD control group, and Peterson et al.'s (2009) use of an extremely narrow, homogenous sociodemographic sample, further calls into question the overall validity and generalizability of the studies' results. It is also of note that, given the established link between literacy and language development, in combination with the quality of evidence provided, it is not possible at this time to draw meaningful conclusions regarding whether there is a unique, additive contribution to literacy performance when both LI and SSD are present, above and beyond the independent contribution of LI in isolation. Therefore, future research is needed to establish with greater certainty whether the presence of comorbid SSD and LI is meaningful from a literacy development perspective.

Both Hayiou-Thomas et al. (2017) and Preston et al. (2013) found that there was a significant association between speech error patterns and literacy performance on a variety of standardized measures. In particular, lower reading scores were associated with speech patterns that were characterized by a higher number of atypical rather than developmental speech errors. Although this association was supported by both studies, this evidence is greatly limited by the failure to utilize a TD control group in either study. As a result, it is not possible to determine whether speech patterns play a unique role in literacy outcomes in children with a diagnosis of SSD that is not equivalently present in peers who do not meet this clinical diagnosis. It is also of note that an extremely high attrition rate in Preston et al.'s 2013 longitudinal study resulted in low statistical power. Further, as a result of this low follow-up rate, it remains questionable whether this impact continues to be meaningful throughout the early school years. As previously mentioned, insufficient sociodemographic group-matching within Hayiou-Thomas et al.'s (2017) is an additional limitation on the quality of evidence provided.

Several additional associations were identified within the current review, however, each of these findings is limited by support from only a single study. Hayiou-Thomas et al. (2007) determined that the presence of a genetic risk for Dyslexia was associated with significantly lower literacy scores in children with a diagnosis of SSD. This study's previously described limitations remain relevant when establishing the quality of evidence supplied here. Masso et al. (2017) found that there was a significant association between polysyllabic word production accuracy and literacy scores in children with a diagnosis of SSD. The absence of a TD control group and failure to report on

participant sociodemographics were among the limitations of this study which greatly reduce the validity and generalizability of this evidence. Rvachew's 2007 study determined that children with a diagnosis of SSD with weaker phonological processing skills had significantly lower scores on some standardized literacy measures. Despite the inclusion of a TD control group, this study did not provide a detailed report of participant sociodemographics or group-matching, which calls into question the generalizability and validity of the proposed correlation. Rvachew and Grawburg (2006) found that both speech perception, and receptive vocabulary scores were significantly associated with scores on standardized measures of emergent literacy. As noted as a limitation with many of the previously discussed studies, these authors did not include a TD control group in their research. Finally, Preston et al. (2013) found that the presence of a greater number of speech distortions, rather than substitutions or cluster reductions, was significantly associated with lower literacy scores. The limitations of this study have previously been described.

Conflicting evidence was found regarding the influence of SSD persistence on literacy success, with one study finding a significant association (Hayiou-Thomas et al., 2017), while a second did not (Peterson et al., 2009). As a result, the existence of an association of this nature is currently inconclusive. Findings from the current review did not suggest that literacy scores were significantly associated with SSD severity or standardized articulation scores in the presence of a diagnosis of SSD. However, given the previously described limitations on the available evidence, the influence of these factors on literacy outcomes cannot be determined with certainty at this time.

Despite the identification of some associations between a variety of child factors and literacy outcomes in school-age children with a diagnosis of SSD, the methodological limitations and questionable levels of evidence provided by the examined studies suggest that further research is required in order to draw meaningful conclusions. Future research should aim to continue the examination of associations between child factors and literacy outcomes in children diagnosed with SSD while making use of strong methodology, including TD control groups and appropriate sociodemographic group-matching.

Clinical Implications

The findings of the current review do not supply sufficiently compelling evidence to indicate that there is a need to change current Speech-Language Pathology management practices for emergent literacy and literacy

development in school-age children with a diagnosis of SSD. However, the findings of this review still have meaningful implications by informing the knowledge of practicing clinicians regarding the factors which could place this population at an increased risk of experiencing reading difficulties. It is therefore recommended that clinicians consider these potential risk factors with caution as they continue to carefully monitor the progress and needs of their clients in order to provide sufficient services to pediatric clients with SSD, regardless of the presence or absence of these factors.

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