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**The Long-Term Effects of Phonological Awareness Intervention for Two
Populations of At-Risk Children: A Review of the Literature**

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by

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Dedication

This report is dedicated to my family for their amazing love and support throughout my education. Without their encouragement, I would not have pushed myself as far as I have in my academic career. This report is also dedicated to my classmates and friends who motivated me and, most importantly, reminded me to laugh.

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Abstract

The Long-Term Effects of Phonological Awareness Intervention for Two Populations of At-Risk Children: A Review of the Literature

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The primary purpose of the present review was to determine why conflicting findings have been reported regarding the long-term effects of phonological awareness training for children from low socioeconomic status families (low-SES) and children with familial risk for reading impairment. Four aspects of intervention were analyzed for each of the studies: service delivery, content of intervention, length of sessions, and total number of sessions. The second purpose of the review was to determine which aspects of intervention had the largest effect on improving later reading skills as well as if general aspects were beneficial to both at-risk groups or if there were population-specific factors. A total of ten intervention studies, five involving children from low-SES and five involving children with familial risk for reading impairment, were reviewed. Of the ten interventions reviewed, only three interventions, two involving children from low-SES

and one involving children at familial risk for reading impairment, demonstrated successful long-term effects on reading. The remaining interventions demonstrated differences across the four aspects analyzed and conflicting long-term outcomes. As no population specific factors were observed across studies, the similarities found in the three successful interventions suggest that a general intervention program can be beneficial for both populations of at-risk children.

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INTRODUCTION

Children from low socioeconomic status families (low-SES) and children with familial risk for reading impairment are considered at greater risk than others for experiencing difficulty acquiring pre-literacy skills, such as phonological awareness. As a result, these children are also at risk for experiencing difficulty acquiring later literacy skills. While both populations are at-risk for the same difficulties, they are at-risk for different reasons. Children from low-SES are at-risk due to environmental reasons while children with familial risk are at-risk due to biological reasons.

Children from low-SES typically score well below average on standardized measures of expressive and receptive language abilities and demonstrate delayed preschool language skills (e.g. Henning, McIntosh, Arnott, & Dodd, 2010). One explanation proposed by Henning et al. (2010) for these lower scores is that these children generally receive less verbal stimulation. McIntosh, Crosbie, Holm, Dodd, and Thomas (2007) explain that these children come from backgrounds where there is likely less exposure to books and print. Additionally, children who come from low-SES backgrounds may come from stressful environments (American Psychological Association, 2011). All of these factors negatively impact children's pre-academic skills.

Children with at least one parent with reading impairment are also at-risk for reading difficulties. Hindson et al. (2005) reported studies indicating that an average of 34-38.5% of children who have a family member with a reading impairment will also have a reading impairment. As discussed by Roseberry-McKibbin (2007), many studies

have provided strong evidence that weaknesses in phonological processing, particularly in phonological awareness, are heritable and are a primary cause of reading disabilities. By kindergarten, children with familial risk for reading impairment already demonstrate delayed pre-literacy skills, indicating that early intervention may be needed in order to help them catch up with their peers (e.g. Elbro & Petersen, 2004; Hindson et al., 2005; Regtvoort & van der Leij, 2007).

Phonological awareness is the ability to hear and manipulate sounds and refers to the understanding that words are made up of smaller units of sound, such as phonemes, onset, rime, and syllables. Having phonological awareness allows an individual to use different skills such as phoneme identification, alliteration, rhyming, syllabification, and phonemic awareness. Phonemic awareness is a subset of phonological awareness and involves manipulation of sound at the smallest level (i.e. the phoneme). Having phonemic awareness allows an individual to blend individual phonemes to create new words and to do the reverse, segment words into individual phonemes (Justice & Kaderavek, 2004; Owens, 2008). Early intervention targeting phonological awareness has been found to be beneficial for helping typically developing children acquire later literacy skills. In a study by Treutlein, Zöllner, Roos, and Schöler (2008), preschoolers who received phonological awareness training demonstrated better performance on phonological awareness tasks in elementary school and outperformed untrained peers in reading and writing. Phonological awareness is an essential pre-reading skill and is a strong predictor of later reading success (Justice & Kaderavek, 2004; Owens, 2008).

Early phonological awareness intervention has been found to be beneficial for typically developing children. It is important to determine if it can also be beneficial for children at risk for reading impairment. Multiple studies have evaluated the short- and long-term effects of training phonological awareness in children from low-SES and children with familial risk for reading impairment (e.g. Blachman, Tangel, Ball, Black, & McGraw, 1999; Nancollis, Lawrie, & Dodd, 2005; Elbro & Petersen, 2004; Regtvoort & Leij, 2007). While these studies have reported positive short-term effects of phonological awareness training, there have been mixed long-term results. While both short- and long-term results measure the child's progress on trained measures, the long-term results evaluate the child's ability to maintain progress and to transfer the learned pre-literacy skills to later literacy skills. For this reason, it is important to find phonological awareness intervention programs that are successful in both the short- and the long-term. If pre-literacy skills are not transferred to later reading skills, then the children who are already behind will fall further behind. Once a child is able to read, the amount of time spent reading is a strong indicator of later reading achievement. If a child continues to struggle with reading, reading will not be enjoyable and the child will not spend as much time reading as his or her peers. The gap in reading ability increases and the Matthew effect, in which "the rich get richer," can be observed (Cook & Cook, 2009).

Aims of the Current Review

The primary purpose in reviewing and analyzing the long-term effects of phonological awareness training for children from low-SES and children with familial

risk for reading impairment is to determine why there are conflicting findings for each of the populations. Studies involving each of the at-risk populations will be evaluated separately. Studies involving children from low-SES will be evaluated first. Four different aspects of the intervention programs will be analyzed. These include: service delivery (e.g. home vs. classroom; parent vs. teacher), content of intervention (e.g. phonological awareness combined with other pre-literacy skills vs. phonological awareness only), length of sessions, and total number of sessions. The process will be repeated for the studies involving the children with familial risk for reading impairment.

After evaluating and summarizing the findings for each of the at-risk populations, the second purpose of the review is to compare the results found across populations in order to determine which features of the intervention programs can have the largest effect on improving later reading skills as well as if there are general aspects of the intervention programs that are beneficial to both at-risk groups or if there are factors that are population-specific. For example, children from low-SES may benefit more from intervention programs that incorporate oral language skill training. Comparing the findings for each of the populations will help to determine if there is a general intervention program that can be beneficial for all children at-risk for reading difficulties or if at-risk populations need specialized intervention programs.

Hypothesis

It is predicted that conflicting findings across the two populations are due to differences in at least one of the four different aspects of each of the intervention

programs (i.e. service delivery, content of intervention, length of sessions, total number of sessions). Regarding service delivery, smaller group size during intervention is hypothesized to promote larger long-term gains; however, whole-class delivery in a language-rich environment may be just as effective (Gillon, 2002). Based on Justice & Kardavek's (2004) assertion that collaborative interventions are the gold standard for emergent literacy intervention, intervention programs that allow the teachers, SLPs, and parents to collaborate are also expected to promote long-term benefits. Regarding content of intervention, programs that incorporate letter-sound training are predicted to show stronger long-term success. This is based on findings that programs combining letter-sound training with phonological awareness are more effective than purely phonological training (e.g. Bus & van IJzendoorn, 1999). In addition, it is expected that for children from low-SES, incorporating oral language skills training will also contribute to more significant long-term effects as these children generally receive less verbal stimulation and may benefit from additional support (Henning et al., 2010). Finally, it is hypothesized that for both groups of children, the more time intensive the intervention, the larger in magnitude the long-term gains in literacy will be. This is based on Gillon's (2002) review of phonological awareness intervention studies, in which less intensive intervention programs were found to be less likely to produce significant long-term gains.

METHODS

Selection Criteria

The following criteria were used in selecting the studies for review:

1. Participants must have been either from low-SES or had familial risk for reading impairment. Participants were considered low-SES if they attended a school in a low-income, disadvantaged area. Participants were considered to have familial risk for reading impairment if at least one parent had a reading impairment.
2. The studies needed to be longitudinal.
3. Intervention must have been delivered prior to formal reading instruction (i.e. in preschool or kindergarten).
4. Interventions had to include a phonological awareness component.
5. The four different aspects of intervention under review (i.e. service delivery, content of intervention, length of sessions, and total number of sessions) had to be described.

Literature Search Procedures

The following databases and search engines were used to search for appropriate studies: Educational Resource Information Center (ERIC) and Psychological Abstracts (PsychINFO). Search terms related to the population, intervention type, and duration of the study were used. Terms included:

1. Population: low-SES; low-income; dyslexia; familial-risk dyslexia; preschool; kindergarten; at-risk; reading impairment
2. Intervention type: phonological awareness; phonemic awareness; early intervention; pre-literacy skills
3. Study duration: long-term; longitudinal

Using various combinations of the stated terms, the literature search yielded a total of 584 hits. Using the stated selection criteria, 12 total studies were included in the current review. Within these 12 studies, a total of 10 intervention programs were evaluated. Five of the intervention programs involved children from low-SES and the other five involved children with familial risk for reading impairment. The remaining two studies included in the current review were follow-up studies to one of the intervention studies involving children from low-SES (i.e. McIntosh, Crosbie, Holm, Dodd, & Thomas, 2007).

EVALUATING THE EVIDENCE: CHILDREN FROM LOW-SES

Studies involving at-risk low-SES children will be evaluated first. Four different aspects (i.e. service delivery, content of intervention, length of sessions, and total number of sessions) will be analyzed. The process will then be repeated for the studies involving the children with familial risk for reading impairment.

Description of Interventions Involving Children from low-SES

Five intervention studies involving children from low-SES were assessed. An additional two studies (Henning et al., 2010; O'Connor, Arnott, McIntosh, & Dodd, 2009) were follow-ups to the 2007 study from McIntosh, Crosbie, Holm, Dodd, and Thomas. The two follow-up studies are included in the section discussing the long-term results of the five interventions assessed. Four aspects of each of the interventions used were compared across studies. The four aspects included service delivery, content of intervention, length of sessions, and total number of sessions. Table 1 provides a summary of these aspects for each of the studies.

Across the five intervention studies, 924 children initially participated. By the final follow-up one to two years later, 597 (65%) of the total children remained. This included 312 trained at-risk children and 285 untrained controls. Results reported are based on the final 597 children. The high level of attrition may be due to the tendency of families from low-SES to move more frequently (e.g. Blachman et al., 1999). At the start of intervention, participants ranged in age from an average of 4.65 to 5.63 years and had not yet received formal reading instruction. Two of the studies involved preschoolers

(Henning et al., 2010; Nancollis, Lawrie, & Dodd, 2005) and three of the studies involved kindergarteners (Whiteley, Smith, & Connors, 2007; Saint-Laurent & Giasson, 2001; Blachman et al., 1999).

SERVICE DELIVERY

All five interventions took place in the classroom. However, two of these interventions (Blachman et al., 1999; Whiteley et al., 2007) used small groups (4-6 children), rather than whole-class delivery. Administrators varied across the intervention programs. Three of the studies (Blachman et al., 1999; McIntosh et al., 2007; Saint-Laurent & Giasson, 2001) had classroom teachers administer the intervention. Blachman et al. (1999) also used TAs as administrators. Nancollis et al. (2005) used the study's primary author (an SLP) as the administrator and Whiteley et al. (2007) used trained research workers to implement the intervention program.

CONTENT OF INTERVENTION

While each of the researchers used phonological awareness training as the primary component in their interventions, Nancollis et al. (2005) were the only researchers to focus solely on phonological awareness training. In addition, they and McIntosh et al. (2007) were the only researchers to not target phonemic awareness during the training. Both studies involved preschoolers, and phonemic awareness is not considered developmentally appropriate at this age. Across the remaining interventions, a variety of additional pre-literacy skills were trained. Both Blachman et al. (1999) and Whiteley et al. (2007) incorporated letter-sound training into their interventions. While

Blachman et al. (1999) continued intervention in first and second grade, the focus switched from training pre-literacy skills to training reading skills through the use of a 5-step reading program that emphasized letter-sound training and phonemic awareness skills. Blachman et al. (1999) were the only researchers to include a reading program designed to reinforce the skills learned in Kindergarten into their intervention plan. McIntosh et al. (2007) included oral language skills in their program. Henning et al. (2010), the authors of one of the two follow-up studies to McIntosh et al.'s 2007 study, defined the oral language skills used as vocabulary, story retell, story recall, and categorization. Saint-Laurent and Giasson (2001) integrated various early literacy skills into their intervention program, including print awareness and writing. A subgroup of this study received additional sessions targeting phonological awareness and interactive reading. Saint-Laurent and Giasson (2001) also incorporated a take-home component into their program. Parents involved in this study were invited to four workshops at the beginning of the Kindergarten year in which the classroom teacher and a member of the research team provided ideas and useful materials to help promote literacy at home. All five of the intervention programs presented the phonological awareness training through game-like activities (Blachman et al., 1999; Nancollis et al., 2005; Whiteley et al., 2007) or through literacy contexts, such as books, word play, or nursery rhymes (McIntosh et al., 2007; Saint-Laurent & Giasson, 2001).

LENGTH OF SESSIONS

Session length varied across the interventions reviewed. Session times were as much as 150 minutes per week (30 minutes per day) and as little as 45 minutes per week. The session times for the Blachman et al. (1999) and Whiteley et al. (2007) interventions amounted to the most intervention time per week. Both Kindergarten intervention programs were administered 15-20 minutes per day. Blachman et al.'s (1999) first and second grade reading programs were administered 30 minutes daily, for the full first grade year, and for the full second grade year for the students still requiring extra reading intervention. Nancollis et al. (2005) administered their intervention once a week, in a 45-minute session, which is equivalent to 9-minutes per day. Two studies (McIntosh et al., 2007; Saint-Laurent & Giasson, 2001) did not include adequate detail of session length. McIntosh et al. (2007) incorporated the training into the classroom schedule daily, but did not approximate the total training time per day. While Saint-Laurent and Giasson (2001) also integrated the training into the classroom schedule, they did not indicate any sort of frequency. However, they did explain that the subgroup that received additional phonological awareness training as well as interactive reading, received the training twice a week for 25-30 minute sessions.

TOTAL NUMBER OF SESSIONS

The total intervention time varied across interventions, and ranged from as much as 25 total hours to as little as 6.75 total hours. Whiteley et al.'s (2007) intervention was the most time-intensive. The program lasted for 15 weeks total, resulting in 25 total

intervention hours. Children who did not show positive change by the end of the 15-week program received a second, 15-week, intervention. Blachman et al.'s (1999) total Kindergarten intervention time lasted for 11 weeks, or, 10.25-13.7 total hours. Subsequent reading programs lasted at least one full school year, and even two for certain students. The subgroup in the 2001 Saint-Laurent and Giasson study that received the extra phonological awareness training had a comparable total early intervention time. The students received 45 total sessions, equaling 11 hours of phonological awareness training and 11 hours of interactive reading. However, the students that did not have the additional training only received 20 phonological awareness sessions over the course of a full school year. While teachers were encouraged to incorporate more phonological awareness instruction during class time, the authors did not indicate how frequently this was done. The remaining two interventions had less extensive total intervention times. Nancollis et al. (2005) implemented their program for 9 weeks, equaling 6.75 total hours. McIntosh et al. (2007) employed their program for 10 total weeks. While their intervention was implemented daily, the authors did not state total training time per day. However, as the programs designed by Nancollis et al. (2005) and Blachman et al. (1999) were also 10 weeks in duration, McIntosh et al.'s (2007) total intervention time was likely between 6.75 and 13.7 total hours.

Levels of Evidence for Interventions Reviewed for Children from low-SES

The levels of evidence from the Oxford Centre for Evidence-Based Medicine (2001), as described by Gillam and Gillam (2006), were used to determine the level of

evidence for each intervention. There are five possible levels of evidence, with Level 1 representing the highest and Level 5 the lowest. Level 1 includes randomized control trials (RCTs) or systematic reviews (SRs) of RCTs; Level 2 includes nonrandomized studies, multiple-baseline designs, and SRs; Level 3 includes studies of multiple cases who received the same treatment; Level 4 includes single case studies; and, Level 5 includes reports based on expert opinion. Two of the studies (McIntosh et al., 2007; Saint-Laurent & Giasson, 2001) represent Level 1 evidence; the remaining three studies represent Level 2 evidence.

To further guide the critical analysis of each study, the critical appraisal questions outlined by Gillam and Gillam (2006) were used. The more appraisal points (i.e. “yes” answers to critical appraisal questions) that can be applied to a study improves the quality, reliability and generalizability of the study’s findings. While answers to the critical appraisal questions do not alter the assigned level of evidence, appraisal points can distinguish between well-designed Level 1 studies and poorly conducted Level 1 studies. Consistent with Level 1 and Level 2 evidence, all studies included a control group for comparison. A control group is important in order to determine the amount of change made that can be attributed to treatment. Whiteley et al. (2007) were the only researchers to use a not-at risk control group; the rest of the interventions involved at-risk control groups. For each intervention, treatment and control groups were similar in all important ways and adequate participant information (e.g. age, gender, SES) was provided. In addition, the assessments used (formal and informal) were reported to be valid and reliable. These aspects are consistent with Level 1 and Level 2 evidence and

improve the quality and generalizability of each study's findings. However, none of the researchers indicated if individuals conducting assessments were blinded to which group the participants were assigned. The use of blinding is expected of a study with Level 1 or Level 2 evidence and increases the quality and reliability of a study's findings. In addition, statistical, but not practical, significance was reported for each intervention. While these studies can still be graded as Level 1 or Level 2 studies, a clinician should be more cautious in interpreting the reported findings as these threats can limit the validity of the studies. Refer to Table 2 for a summary of the evidence and appraisal points awarded for each of the interventions.

Results of Interventions Reviewed for Children from low-SES

Overall, results of the studies indicate that interventions were successful short-term; however, long-term outcomes demonstrated mixed findings. Table 3 provides a summary of the short- and long-term effects of each of the interventions reviewed for children from low-SES. Short-term effects are those that measure the immediate gains made on trained phonological awareness skills after the intervention phase. Long-term effects are those that measure maintenance of trained phonological awareness skills as well as the transfer of these skills to literacy. Long-term effects were measured at least one year after the end of intervention.

SHORT-TERM EFFECTS OF INTERVENTION

Each of the intervention programs demonstrated positive short-term effects on measures of phonological awareness. Three of the five studies (Blachman et al., 1999; Nancollis et al., 2005; McIntosh et al., 2007) reported that participants made significant or highly significant gains on measures of phonological awareness compared to at-risk controls. Only one intervention (Saint-Laurent & Giasson, 2001) reported that participants made only moderately significant gains when compared to at-risk controls. The subjects in this study, aside from the subgroup that received additional sessions targeting phonological awareness, received the least amount of intervention time.

As the trained participants involved in these interventions were compared to at-risk controls, it would be expected that the trained at-risk children would outperform the untrained at-risk children post-intervention. Whiteley et al. (2007), however, were the only researchers to compare trained at-risk subjects to untrained not-at-risk subjects. While 62% of the at-risk children in this study made positive short-term gains, 38% did not. When the at-risk children who made positive short-term gains and the at-risk children who did not were compared to the untrained not-at-risk controls, significant differences were found across the three groups. Specifically, even though the majority of the trained at-risk children made significant gains, they did not reach the same levels of performance as their untrained not-at-risk peers.

LONG-TERM EFFECTS OF INTERVENTION

Maintenance of phonological awareness skills was determined by phonological awareness measures. Transfer of phonological skills to later reading skills was determined by reading measures. All five studies demonstrated maintenance of trained phonological awareness skills at least one year after the end of intervention. However, only two of the five studies (Blachman et al., 1999; Whiteley et al., 2007) demonstrated transfer of trained phonological awareness skills to later reading skills. In the remaining three intervention programs (Saint-Laurent & Giasson, 2001; Nancollis et al., 2005, McIntosh et al., 2007), the trained at-risk children demonstrated long-term positive effects only for the specific skills targeted (e.g. phonological awareness, letter-sound correspondence). The trained at-risk children did not transfer the trained skills to later literacy skills in first or second grade, which is a skill that typically developing children are able to do.

Of the two intervention programs that demonstrated positive effects of early intervention on later reading skills, Blachman et al. (1999) were the only researchers to explicitly teach reading immediately following phonological awareness training. The reading program reinforced the skills learned in Kindergarten and demonstrated exactly how pre-literacy skills transfer to literacy skills. While both programs demonstrated positive effects, only Blachman et al.'s (1999) program improved the performance of all of the trained at-risk children, rather than just a subgroup. For the Whiteley et al. (2007) program, final assessment of at-risk children's progress at the end of first grade indicated that only 44 of the 67 at-risk children (66%) were no longer considered at-risk. While

these 44 children had caught up with not-at-risk controls on measures of decoding, demonstrating a transfer of effects to reading, the remaining 23 at-risk children remained significantly behind. In addition, 13 of these 23 children had shown short-term progress and had been determined to not need the second 15-week intervention. As these children remained at-risk by the end of the study, this indicates that skills learned in the short-term may not be maintained long-term for at-risk children.

Summary of Findings for Interventions Reviewed for Children from low-SES

Results of the studies indicate that while early intervention programs targeting phonological awareness skills are successful in the short-term and that trained at-risk children are able to maintain these skills long-term, it is difficult for these children to transfer these skills to reading. Only two of the five interventions (Blachman et al., 1999; Whiteley et al., 2007) demonstrated transfer of pre-literacy skills to later literacy skills. When comparing the four aspects of each of the interventions used across studies (i.e. service delivery, content of intervention, length of sessions, and total number of sessions), the most successful interventions were those employed by Blachman et al. (1999) and Whiteley et al. (2007); they also had the most similarities. Both groups of researchers implemented their programs in small groups in Kindergarten. While the other researchers used whole-class implementation, which may be more realistic, the present findings suggest that small groups may be more effective. Depending on the content of intervention, the choice to begin intervention in Kindergarten may be more developmentally appropriate. A program that focuses on phonemic awareness (an

element of phonological awareness) and letter-sound training would not be developmentally appropriate for preschoolers (Nancollis et al., 2005). Blachman et al. (1999) and Whiteley et al. (2007) were the only researchers to include letter-sound training, which, when combined with phonological awareness training, is a strong predictor of later reading success (Regtvoort & van der Leij, 2007). While early intervention content was similar for Blachman et al. (1999) and Whiteley et al. (2007), Blachman et al. (1999) were the only researchers to follow-up early intervention with a reading intervention program that expanded on the learned pre-literacy skills. As Blachman et al. (1999) improved the performance of more at-risk children than did Whiteley et al. (2007), it may be beneficial to add an explicit reading intervention program as a follow-up to early intervention programs targeting pre-literacy skills. Finally, when considering length of sessions and total number of sessions, Blachman et al. (1999) and Whiteley et al.'s (2007) programs were the most time-intensive. Both programs were administered daily for 15-20 minutes. This amounted to 10.25-13.7 total hours for the Blachman et al. (1999) study and 25 total hours for the Whiteley et al. (2007) study.

EVALUATING THE EVIDENCE: CHILDREN WITH FAMILIAL RISK FOR READING IMPAIRMENT

Description of Interventions Involving Children with Familial Risk for Reading Impairment

Five studies involving children with familial risk for reading impairment were assessed. One of these studies (van Otterloo, van der Leij, & Henrichs, 2008) was a pilot study for the 2009 van Otterloo and van der Leij study. The same four aspects (i.e. service delivery, content of intervention, length of sessions, total number of sessions) of each of the interventions were compared across studies. Table 4 provides a summary of these aspects for each of the studies.

Across the five intervention studies, 493 children initially participated. By the final follow-up, 396 (80%) of the total children remained. This included 173 trained at-risk children and 223 controls. Results reported are based on the final 396 children. Attrition may be due to families moving from the area or not being able to be contacted (Hindson et al., 2005). At the start of intervention, participants ranged in age from an average of 4.6 to 6.27 years and had not yet received formal reading instruction. One of the studies involved preschoolers (Hindson et al., 2005) and four of the studies involved kindergarteners (Elbro & Petersen, 2004; Regtvoort & van der Leij, 2007; van Otterloo, van der Leij, & Henrichs, 2008; van Otterloo and van der Leij, 2009). In all studies, at least one parent had a reading disability.

SERVICE DELIVERY

Service delivery differed across each of the interventions used in the studies with some delivered by parents and others by teachers. Three of the intervention programs (Regtvoort & van der Leij, 2007; van Otterloo et al., 2008; van Otterloo & van der Leij, 2009) were delivered by the parents. Parents received training and implemented the program in the home. Two of the interventions (Elbro & Petersen, 2004; Hindson et al., 2005) were carried out by the children's teachers and occurred in the classroom, although Hindson et al. (2005) occasionally delivered services in the home.

CONTENT OF INTERVENTION

Across the five studies, each of the interventions used a multi-component program consisting of phonemic awareness and letter-sound training. Two of the five studies included additional components. Hindson et al. (2005) incorporated shared book reading into their intervention program. Regtvoort and van der Leij (2007) decided to teach decoding, a reading skill, in conjunction with pre-literacy skills. This program was further differentiated from the other interventions, by the researchers' decision to use a computer-based intervention program due to its game-like presentation and the ease and consistency with which parents could administer the program. The other four intervention studies presented the intervention through game-like activities and through meaningful literacy contexts, such as rhymes, books, and songs.

LENGTH OF SESSIONS

Session length varied across the interventions reviewed. Session times were as much as 150 minutes per week (30 minutes per day) and as little as 10 minutes per week. Participants who were involved in the classroom-based interventions (Elbro & Petersen, 2004; Hindson et al., 2005) received services in 30-minute sessions. These services were provided daily in the Elbro and Petersen (2004) program and were provided 2-3 times per week in the Hindson et al. (2005) study. The subjects that received individual, home-based, intervention received 10 minutes of daily training (Regtvoort & van der Leij, 2007; van Otterloo et al., 2008; van Otterloo & van der Leij, 2009).

TOTAL NUMBER OF SESSIONS

The total intervention time varied across interventions, and ranged from as much as 42 total hours to as little as 5.5 total hours. The Elbro and Petersen (2004) intervention program was significantly more time-intensive than the other four interventions, with the total intervention time amounting to 42 hours. Total intervention time was less than 12 hours for the remaining four programs. The Hindson et al. (2005) study was the least intensive, with some participants receiving only 5.5 hours of total intervention time.

Levels of Evidence for Interventions Reviewed for Children with Familial Risk for Reading Impairment

To guide the critical analysis of each study, the same guidelines used for the studies involving children from low-SES were applied. Three of the studies (Elbro &

Petersen, 2004; van Otterloo et al., 2008; van Otterloo & van der Leij, 2009) were randomized control studies, which represent Level 1 evidence. The remaining two studies did not indicate whether participants were randomly assigned to groups. As a result, these studies were categorized as nonrandomized studies, which represents Level 2 evidence.

To further guide the critical analysis of each study, the same critical appraisal questions described for the studies involving children from low-SES were used. Four of the studies (Elbro & Petersen, 2004; Regtvoort & van der Leij, 2007; van Otterloo et al., 2008; van Otterloo & van der Leij, 2009) included an at-risk control group for comparison. Elbro and Petersen (2004) and Regtvoort and van der Leij (2007) also included a not-at-risk control group. Hindson et al. (2005) did not use a control group; rather, they used a not-at-risk treatment group for comparison. For each intervention, treatment and control groups were similar in all important ways and adequate participant information (e.g. age, gender, SES) was provided. This is consistent with Level 1 and Level 2 evidence and improves the quality and generalizability of each study's findings. None of the researchers indicated if individuals conducting assessments were blinded to which group the participants were assigned. Blinding improves the quality and reliability of a study's evidence and is expected for studies representing Level 1 and Level 2 evidence. The assessments used (formal and informal) were reported to be valid and reliable. Statistical significance was reported for each intervention. Practical significance was reported for all but one (Hindson et al., 2005) of the interventions. While these studies can still be graded as Level 1 or Level 2 studies, a clinician should be more

cautious in interpreting the reported findings. Refer to Table 5 for a summary of the evidence for each of the interventions.

Results of Interventions Reviewed for Children with Familial Risk for Reading Impairment

Similar to the findings for children from low-SES, results of the studies involving children with familial risk for reading impairment indicate that interventions were successful short-term; however, long-term outcomes demonstrated mixed findings. Table 6 provides a summary of the short- and long-term effects of each of the interventions reviewed for children with familial risk for reading impairment.

SHORT-TERM EFFECTS OF INTERVENTION

Four of the five intervention programs demonstrated at least moderately significant short-term effects on measures of phonological awareness. When compared to at-risk controls, Hindson et al. (2005) and van Otterloo et al. (2008) reported significant effects and Elbro and Petersen (2004) and Regtvoort and van der Leij (2007) reported moderately significant effects. When trained at-risk children were compared to untrained not-at-risk controls, Regtvoort and van der Leij (2007) found no significant differences between the groups, indicating that in the short-term, the at-risk children caught up with their age-matched peers. Van Otterloo and van der Leij (2009) were the only researchers to report no significant effects on measures of phonological awareness compared to at-risk controls. However, the researchers explained that gains in phonological awareness

may still be considered meaningful given the relatively small sample size of the study (i.e. 30 trained at-risk children and 27 controls) and given that the effects found were in the expected direction.

LONG-TERM EFFECTS OF INTERVENTION

Long-term effects were measured at least one year after the end of intervention and examined whether or not trained phonological awareness skills were maintained and transferred to later literacy. Maintenance of phonological awareness skills was determined by phonological awareness measures. Transfer of phonological skills to later reading skills was determined by reading measures. Only one of the five interventions (Elbro & Petersen, 2004) demonstrated positive effects of early intervention on later reading skills. In second and third grade, the trained at-risk children significantly outperformed the untrained at-risk children on measures of phonological awareness and decoding, and came close to achieving the same performance levels as the not-at-risk controls. By seventh grade, the trained at-risk children still demonstrated positive effects from early intervention and had significantly fewer poorer readers than the untrained at-risk group. Positive trends were found for reading comprehension and significant effects were found for reading fluency. Despite this success, the trained at-risk children fell significantly behind the not-at-risk controls. This indicates that with increased age, the positive effects of early intervention decreased. For the trained at-risk children in the remaining four interventions, improved pre-literacy skills did not transfer to later reading skills. In three of the studies (Regtvoort & van der Leij, 2007; van Otterloo et al., 2008;

van Otterloo & van der Leij, 2009), follow-up testing revealed no significant differences between trained and untrained at-risk children on measures of reading, indicating that early intervention had no effect on later literacy skills. While Hindson et al. (2005) reported that the intervention helped at-risk children to meet grade-level expectations, the trained not-at-risk children could transfer phonemic awareness skills to decoding tasks while the trained at-risk children could not.

Summary of Findings for Interventions Reviewed for Children with Familial Risk for Reading Impairment

While results of the studies indicated positive short-term results, trained at-risk children demonstrated difficulty transferring trained skills to literacy. In three of the studies, at-risk children achieved similar levels of performance on follow-up measures of reading, regardless of whether or not they had received early intervention services (Regtvoort & van der Leij, 2007; van Otterloo et al., 2008; van Otterloo & van der Leij, 2009). Only one of the five interventions (Elbro & Petersen, 2004) demonstrated transfer of pre-literacy skills to later literacy skills. When comparing the four aspects of each of the interventions used across studies (i.e. service delivery, content of intervention, length of sessions, and total number of sessions), Elbro and Petersen's (2004) intervention was significantly more time-intensive, with at least 30 more hours of intervention time. In addition, Elbro and Petersen (2004) were the only researchers to implement their intervention solely in the classroom, with no home component. While the content of intervention was similar to the other intervention programs (e.g. phonemic awareness

combined with letter-sound training), Elbro and Petersen used the classroom teachers to deliver the content while the other interventions incorporated the parents as teachers. However, while the trained at-risk children in Elbro and Petersen's (2004) study were able to transfer the trained skills to later literacy and were able to perform near age-expected levels in first and second grade, the positive effects of early intervention had decreased significantly by seventh grade.

OVERALL SUMMARY

Interventions Involving At-Risk Children Compared

Overall, the intervention programs reviewed for children from low-SES differed across the four aspects of intervention analyzed (i.e. service delivery, content of intervention, length of sessions, and total number of sessions). The intervention programs reviewed for children with familial risk for reading impairment differed across three aspects: service delivery, length of sessions, and total number of sessions. The differences found within groups were similar across groups. For example, regarding session length, interventions involving children from low-SES varied from as much as 150 minutes per week to as little as 45 minutes per week. A similar range was found for interventions involving children with familial risk for reading impairment (150 minutes to 10 minutes per week). The only aspect of intervention that differed across the two groups of at-risk children was content of intervention. While interventions for both groups of at-risk children targeted phonological awareness, there were differences between groups in which additional skills were targeted during intervention. For example, all of the interventions for children with familial risk for reading impairment included letter-sound training compared to only two of the interventions involving children from low-SES (Blachman et al., 1999; Whiteley et al., 2007). The remaining interventions involving children from low-SES targeted different skills, such as oral language skills or early reading and writing skills.

Despite the overall differences across the interventions administered, both populations of at-risk children demonstrated positive short-term gains for trained measures; however, both groups demonstrated difficulty transferring the trained pre-literacy skills to later reading skills. Of a total of ten interventions reviewed, only three interventions, two involving children from low-SES (Blachman et al., 1999; Whiteley et al., 2007) and one involving children with familial risk for reading impairment (Elbro & Petersen, 2004), demonstrated successful long-term effects on reading. Interestingly, these three successful interventions had the most similarities with regards to the four aspects of intervention analyzed (i.e. service delivery, content of intervention, length of sessions, and total number of sessions). The remaining interventions demonstrated differences across the four aspects analyzed, leading to conflicting long-term outcomes for at-risk children.

When comparing the two successful interventions involving children from low-SES (Blachman et al., 1999; Whiteley et al., 2007) with the one successful intervention involving children with familial risk for reading impairment (Elbro and Petersen, 2004), similarities were found across each aspect of intervention analyzed. Regarding service delivery, intervention delivered in the classroom by professionals was a commonality among the successful programs. While small-group delivery was beneficial for children from low-SES, the trained children with familial risk for reading impairment in Elbro and Petersen's (2004) study made positive long-term gains using whole-class delivery.

Each of the three successful programs also incorporated letter-sound training into the content of intervention. Blachman et al.'s (1999) decision to incorporate a reading

program after early intervention produced greater long-term effects than the Whiteley et al. (2007) program. The positive long-term effects of this program suggest that at-risk children may need a more explicit and intensive reading program than what is typically offered in the curriculum. However, Elbro and Petersen (2004) did not include a reading program, and their intervention resulted in positive long-term effects for trained at-risk children. The final aspects of intervention, total length and number of sessions, may explain this success. Total intervention time may also help explain the success of the subgroup in Whiteley et al.'s (2007) study that was no longer considered at-risk by the end of first grade. Both Elbro and Petersen (2004) and Whiteley et al. (2007) had the most time-intensive programs. Elbro and Petersen (2004) included 42 hours and Whiteley et al. (2007) included 25 total hours of intervention time, while Blachman et al. (1999) only included between 10.25 and 13.7 total hours of intervention time. At a two-year follow up, both Blachman et al. (1999) and Elbro and Petersen (2004) reported similar levels of statistical significance on measures of reading, indicating that total intervention time is equally as important to a program's long-term success as an added reading program.

DISCUSSION

Conclusions

One of the aims of the current review was to determine why conflicting findings have been found for populations of at-risk children regarding the long-term effects of early intervention on later reading skills. It was predicted that disparities were due to differences in at least one of the four aspects (i.e. service delivery, content of intervention, length of sessions, and total number of sessions) of each of the intervention programs. Findings from the current review confirm this hypothesis. Regarding the interventions involving children from low-SES, differences in each of the four aspects affected later reading skills for at-risk children. Regarding the interventions involving children with familial risk for reading impairment, differences in three of the four aspects (i.e. service delivery, length of sessions and total number of sessions) influenced children's later literacy skills.

The second purpose of the review was to compare the results found across populations in order to determine which features of the intervention programs had the largest effect on later reading skills as well as to determine if there were general aspects of the intervention programs that were beneficial to both at-risk groups or if factors were population-specific. It had been hypothesized that for both groups of children, programs that were more time-intensive and those that included letter-sound training would show greater long-term success. These predictions were confirmed by the current findings. However, hypotheses regarding service delivery were not confirmed by the current

review. It had been proposed that intervention programs that allowed the teachers, SLPs, and parents to collaborate and those that used a smaller group size during intervention would result in more significant long-term gains in literacy. Surprisingly, none of the three successful interventions (Blachman et al., 1999; Elbro & Petersen, 2004; Whiteley et al., 2007) incorporated the parents or a home program. However, as parental involvement and home language experiences can profoundly enhance a child's literacy experiences (Snow, Burns, & Griffin, 1998), an intervention program that incorporates the parents could still be beneficial. There was no advantage of small-group delivery compared to whole-class delivery, as significant gains were found in either condition. A possible explanation is that whole-class delivery allowed the learning environment and instructors to remain constant across time, which helped promote generalization of learned skills. Finally, it was expected that for children from low-SES, incorporating oral language skills training would contribute to more significant long-term effects. Only one of the interventions, Henning et al. (2010), included oral language skills in their intervention program. This added component did not appear to improve the long-term success of the at-risk children. The authors suggested that while intervention should target generic, cognitive abilities, they should be related to early literacy learning (e.g. rule derivation can be taught through letter-sound correspondence activities). As no other population specific components were observed across studies, the similarities found in the three successful interventions suggest that a general intervention program can be beneficial for both populations of at-risk children.

One aspect of intervention that was not considered in the initial hypothesis was whether or not the inclusion of additional support after early intervention would affect long-term literacy skills. Blachman et al. (1999) were the only researchers to follow-up early intervention with a reading intervention program that expanded on the learned pre-literacy skills. The positive long-term effects of this program suggest that at-risk children may need a more explicit and intensive reading program than what is typically offered in the curriculum. However, the other two successful interventions, Elbro and Petersen's (2004) study involving children with familial risk for reading impairment and Whiteley et al.'s (2007) study involving children from low-SES, did not include a reading program. The interventions in these studies were more time-intensive and also demonstrated long-term success. As significant findings were found in each condition (i.e. reading program versus increased intervention time) for each at-risk population, it is necessary to present possible explanations for each condition's success. An added reading program provides at-risk children with explicit teaching of how to transfer pre-literacy skills. While typically developing children are able to automatically transfer pre-literacy skills to later reading skills, the at-risk children in seven of the ten studies reviewed did not demonstrate this ability. On the other hand, increased intervention time allows at-risk children increased repetition of skills, enabling these children to have a stronger grasp of the skill learned before attempting to transfer the skills to reading. Whether an added reading program or increased intervention time is used, both conditions indicate that children at-risk of reading difficulties need more intensive services in order to gain long-term benefits.

Clinical Implications

Findings from the current review suggest that a general early intervention program comprised of key features from the four aspects analyzed (i.e. service delivery, content of intervention, length of sessions, and total number of sessions) should be used with children at-risk for reading impairment. Whole-class delivery, by the classroom teachers, is recommended. The content should include letter-sound training in addition to phonological awareness training. In general, more time-intensive programs promote more significant long-term gains. However, time-intensive programs may not be feasible in all classrooms and additional reading programs may be recommended after early intervention is complete. This should depend on the student's progress and the quality of the reading program offered in the general curriculum. Finally, while gains can be made in the short-term, progress monitoring is essential for at-risk children in order to ensure that gains are maintained and that transfer of pre-literacy skills to later reading skills occurs.

Suggestions for Future Research

It is recommended that in order to determine the most cost- and time-effective course of intervention, future research investigate the optimal amount of total intervention time. Results of Whiteley et al.'s (2007) study suggest that if no reading program is used after early intervention, at least 25 hours of total intervention time is needed in order to begin to produce long-term gains. Additionally, while early phonological awareness training combined with a reading intervention program in first

grade produced more positive effects for the trained at-risk children in Blachman et al.'s (1998) study, it is unclear whether at-risk children may benefit solely from a reading intervention program and no early phonological awareness training. While it would seem likely that children with trained pre-literacy skills would benefit more from a reading program expanding on those trained skills, future research should examine this question.

Table 1: Summary of Interventions Reviewed for Children from Low-SES

Study	Service delivery	Content of intervention	Session length	Total intervention time
Blachman et al. (1999)	Teachers and TAs; small-group intervention (4-5) in K classes	PA & LST	15-20 minute/day	41 lessons/11 weeks/10.25-13.7 hours
	1 st and 2 nd grade teachers; classroom	5-step reading program- phonemic awareness and letters emphasized	Daily 30-min lessons	Full year intervention
Saint-Laurent & Giasson (2001)	Teachers; classroom	PA & early reading/writing activities	Not specified; additional PA sessions: 25-30 min, 2x/week	20 lessons; additional PA sessions: 45 total/ 11 hours interactive reading & 11 hours PA
Nancollis et al. (2005)	SLP; preschool classroom	PA only	45 min, 1x/week	9 weeks/ 6.75 hours
McIntosh et al. (2007)	Preschool teacher; classroom	PA & oral language skills	Intervention incorporated into daily schedule	10 weeks
Whiteley et al. (2007)	Researchers; small-group intervention (6) in K classes	PA & LST	20 min/day	15 weeks/ 25 hours (2 nd 15-week intervention was used for children who had made no or minimal progress)

Note: PA phonological awareness, LST letter-sound training

Table 2: Evidence for Interventions Reviewed for Children from Low-SES

Study	Level of Evidence	Comparisons	Random Assignment	Participants	Group Similarity	Blinding	Measures	Statistical Significance	Practical Significance
Blachman et al. (1999)	2	At-risk control group	No	Yes	Yes	Unknown	Yes	Yes	Not given
Saint-Laurent & Giasson (2001)	1	At-risk control group	Yes	Yes	Yes	Unknown	Yes	Yes	Not given
Nancollis et al. (2005)	2	At-risk control group	No	Yes	Yes	Unknown	Yes	Yes	Not given
McIntosh et al. (2007)	1	At-risk control group	Yes	Yes	Yes	Unknown	Yes	Yes	Not given
Whiteley et al. (2007)	2	Not-at-risk control group	No	Yes	Yes	Unknown	Yes	Yes	Not given

Table 3: Results of Interventions Reviewed for Children from Low-SES

Study	Short-term effects	Long-term effects
Blachman et al. (1999)	PA: positive/ highly significant ($p < .0001$); Reading: positive/moderate significance ($p < .056$); compared to at-risk controls	1 year later: PA: positive/ highly significant ($p < .0001$); Reading: positive/ significant ($p < .01$) 2 years later: Reading: positive/ significant ($p < .0287$)
Saint-Laurent & Giasson (2001)	PA: positive/ significant (moderate) ($p < .05$) compared to at-risk controls	1 year later: No significant effects on reading measures; maintained significant effects for phonological awareness ($p < .01$)
Nancollis et al. (2005)	PA: positive/ significant ($p < .01$) compared to at-risk controls	2 years later: No significant effects on reading measures (e.g. non-word reading: $p = .216$); highly significant effects on trained measures ($p < .001$)
McIntosh et al. (2007) + follow-up studies	PA: positive/ highly significant ($p < .001$) compared to at-risk controls	2 years later: Henning et al. (2009) and O'Connor et al. (2009) found no significant effects on reading measures when compared to at-risk and not-at-risk same-age children ^a
Whiteley et al. (2007)	PA: 62% of at-risk children made positive gains and 38% did not ^b . These two groups were compared to not-at-risk controls; highly significant differences were found across the three groups ($p < .001$)	1 year later: 66% of the at-risk children were no longer considered at-risk (no significant differences on reading measures compared to not-at-risk controls); 30% of children did not respond to intervention ^c

Note: PA phonological awareness

^a O'Connor et al. (2009) found a subgroup of children (46%) achieved average range scores on PA and reading measures

^b The latter group of children received the 2nd 15-weeks of intervention

^c This percentage includes 13 children who made positive gains after the first intervention and therefore did not receive the 2nd 15-week intervention

Table 4: Summary of Interventions Reviewed for Children with Familial Risk for Reading Impairment

Study	Service delivery	Content of intervention	Session length	Total intervention time
Elbro & Petersen (2004)	Teachers/ K classroom	PA & LST	30 min/day	17 weeks/ 42 hours
Hindson et al. (2005)	Teachers/ individual intervention in preschool (sometimes home)	PA, LST & structured book reading	30 min, 2-3X/week	11-17 lessons/ 5.5-8.5 hours
Regtvoort & van der Leij (2007)	Trained parents/ home	PA, LST & decoding (computer program)	10 min/day	70 lessons/ 12 hours
van Otterloo et al. (2008)	Trained parents/ home	PA & LST	10 min/day	10 weeks/ 8-8.5 hours
van Otterloo and van der Leij (2009)	Trained parents/ home	PA & LST	10 min/day	14 weeks/ 12 hours

Note: PA phonemic awareness, LST letter-sound training

Table 5: Evidence for Interventions Reviewed for Children with Familial Risk for Reading Impairment

Study	EBP Level	Comparisons	Random Assignment	Participants	Initial Group Similarity	Blinding	Measures	Statistical Significance	Practical Significance
Elbro & Petersen (2004)	1	At-risk and not-at-risk control groups	Yes	Yes	Yes	Unknown	Yes	Yes	Yes
Hindson et al. (2005)	2	Not-at-risk treatment group	Not given	Yes	Yes	Unknown	Yes	Yes	Not given
Regtvoort & van der Leij (2007)	2	At-risk and not-at-risk control groups	Not given	Yes	Yes	Unknown	Yes	Yes	Yes
van Otterloo et al. (2008)	1	At-risk control group	Yes	Yes	Yes	Unknown	Yes	Yes	Yes
van Otterloo and van der Leij (2009)	1	At-risk control group	Yes	Yes	Yes	Unknown	Yes	Yes	Yes

Table 6: Results of Interventions Reviewed for Children with Familial Risk for Reading Impairment

Study	Short-term effects	Long-term effects
Elbro & Petersen (2004)	PA: positive/ significant (moderate) ($p < .05$) compared to at-risk controls	Grade 2: positive/significant ($p < .01$) effects on phonological awareness and oral word reading accuracy; Grade 3: positive/significant ($p < .01$) effects on phonological awareness and silent word reading; Grade 7: no significant effects of training on reading measures
Hindson et al. (2005)	PA: positive/ significant ($p < .01$) compared to at-risk controls; trained not-at-risk children significantly outperformed trained at-risk children on measures of phoneme identity, letter knowledge, and print concepts ($p < .01$)	1 year later: Trained not-at-risk children significantly outperformed at-risk children on nonword decoding ($p < .01$); at-risk children were thought to have at least reached grade-level expectations although this was not compared to a dedicated at-risk control group
Regtvoort & van der Leij (2007)	PA: positive/ significant (moderate) ($p < .05$) compared to at-risk controls; compared to untrained not-at-risk controls, no significant differences were found	Grades 1 and 2 measures of word reading: no significant differences between trained and untrained at-risk subjects. Not-at-risk subjects significantly outperformed trained at-risk subjects ($p < .01$)
van Otterloo et al. (2008)	PA: positive/ significant ($p < .01$) compared to at-risk controls	1 year later: No significant differences between trained and untrained at-risk subjects on measures of reading
van Otterloo and van der Leij (2009)	PA: positive/ not significant compared to at-risk controls	1 year later: No significant differences between trained and untrained at-risk subjects on measures of reading

Note: PA phonemic awareness

References

- American Psychological Association. (2011). *Fact sheet: Education and socioeconomic status*. Washington, DC: American Psychological Association.
- Blachman, B.A., Tangel, D.M., Ball, E.W., Black, R., & McGraw, C.K. (1999). Developing phonological awareness and word recognition skills: A two-year intervention with low-income, inner-city children. *Reading and Writing: An Interdisciplinary Journal*, *11*, 239-273.
- Bus, A.G., & van IJzendoorn, M.H. (1999). Phonological awareness and early reading: A meta-analysis of experimental training studies. *Journal of Educational Psychology*, *91*, 403-414.
- Cook, J.L., & Cook, G. (2009). *Child development: Principles and perspectives* (2nd ed.). Boston, MA: Allyn & Bacon.
- Elbro, C., & Petersen, D.K. (2004). Long-term effects of phoneme awareness and letter sound training: An intervention study with children at risk for dyslexia. *Journal of Educational Psychology*, *96*, 660-670.
- Gillam, S.L., & Gillam, R.B. (2006). Making evidence-based decisions about child language intervention in schools. *Language, Speech, and Hearing Services in Schools*, *37*, 304-315.
- Gillon, G. (2002). Phonological awareness intervention for children: From the research laboratory to the clinic. *The ASHA Leader*, *December 3 Issue*. Retrieved from <http://www.asha.org/Publications/leader/2002/021203/021203a.htm>

- Henning, C., McIntosh, B., Arnott, W., & Dodd, B. (2010). Long-term outcome of oral language and phonological awareness intervention with socially disadvantaged preschoolers: the impact on language and literacy. *Journal of Research in Reading, 33*, 231-246.
- Hindson, B., Byrne, B., Fielding-Barnsley, R., Newman, C., Hine, D.W., & Shankweiler, D. (2005). Assessment and early instruction of preschool children at risk for reading disability. *Journal of Educational Psychology, 4*, 687-704.
- Justice, L.M., & Kaderavek, J.N. (2004). Embedded-explicit emergent literacy intervention 1: Background and description of approach. *Language, Speech, and Hearing Services in Schools, 35*, 201-211.
- McIntosh, B., Crosbie, S., Holm, A., & Dodd, B. (2007). Enhancing the phonological awareness and language skills of socially disadvantaged preschoolers: An interdisciplinary programme. *Child Language Teaching and Therapy, 23*, 267-286.
- Nancollis, A., Lawrie, B.A., & Dodd, B. (2005). Phonological awareness intervention and the acquisition of literacy skills in children from deprived social backgrounds. *Language, Speech, and Hearing Services in Schools, 36*, 325-335.
- O'Connor, M., Arnott, W., McIntosh, B., & Dodd, B. (2009). Phonological awareness and language intervention in preschoolers from low socio-economic backgrounds: A longitudinal investigation. *British Journal of Developmental Psychology, 27*, 767-782.
- Owens, R.E. (2008). *Language development: An introduction* (7th ed). Boston, MA:

- Allyn & Bacon.
- Regtvoort, A.G.F.M., & van der Leij, A. (2007). Early intervention with children of dyslexic parents: Effects of computer-based reading instruction at home on literacy acquisition. *Learning and Individual Differences, 17*, 35-53.
- Roseberry-McKibbin, C. (2007). *Language disorders in children*. Boston, MA: Allyn & Bacon.
- Saint-Laurent, L. & Giasson, J. (2001). Effects of a multicomponent literacy program and of supplemental phonological sessions on at-risk kindergartners. *Educational Research and Evaluation, 7*, 1-33.
- Snow, C.E., Burns, M.S., & Griffin, P. (1998). *Preventing reading difficulties in young children*. Washington, DC: National Academy Press.
- Treutlein, A., Zöllner, I., Roos, J., & Schöler, H. (2008). Effects of phonological awareness training on reading achievement. *Written Language and Literacy, 11*, 147-166.
- van Otterloo, S.G., & van der Leij, A. (2009). Dutch home-based pre-reading intervention with children with familial risk of dyslexia. *Ann. of Dyslexia, 59*, 169-195.
- van Otterloo, S.G., van der Leij, A., & Henrichs, L.F. (2009). Early home-based intervention in the Netherlands for children with familial risk of dyslexia. *Dyslexia, 15*, 187-217.
- Whiteley, H.L., Smith, C.D., & Connors, L. (2007). Young children at risk of literacy

difficulties: Factors predicting recovery from risk following phonologically based intervention. *Journal of Research in Reading*, 30, 249-269.