Predictors of and Interventions Associated with Later Literacy Accomplishments

Carl J. Dunst
Carol M. Trivette
Deborah W. Hamby

A secondary analysis of the National Early Literacy Panel research synthesis was conducted to identify clusters of predictors and interventions associated with later literacy accomplishments. Findings showed that there are many precursors of later literacy competence, and that interventions focusing on affecting changes in specific literacy skills were more likely to be effective than nonfocused interventions. Implications for practice are described.

The twofold purpose of this practice-based research synthesis was to summarize research evidence on the predictors of early literacy accomplishments and describe the characteristics of interventions for promoting young children's acquisition of literacy skills. This was accomplished by a secondary analyses of the National Early Literacy Panel (NELP) findings reported to date (Fitts, 2005; National Early Literacy Panel, 2006; Schatsclneider & Westberg, 2006; Shanahan, 2005; Strickland & Shanahan, 2004). The NELP, in collaboration with the National Center for Family Literacy, involved an extensive review and synthesis of available research to answer four questions: (1) What are the skills and abilities of young children ages birth-to-5 years that predict later reading outcomes? (2) What programs and interventions contribute to or inhibit gains in children's skills and abilities that are linked to later reading outcomes? (3) What environments and settings contribute to or inhibit gains in children's skills and abilities that are linked to later reading outcomes? and (4) What child characteristics contribute to or inhibit gains in children's skills and abilities that are linked to later reading outcomes? Available data to answer the first two questions was the focus of this *CELLreview*.

The conduct of this practice-based research synthesis was guided by a characteristics/consequences framework that attempted to isolate the particular early literacy skills and the characteristics of interventions that were associated with later literacy accomplishments (Dunst, Trivette, & Cutspec, 2002). This was done by integrating findings from the NELP in a number of different ways with a focus on implications for developing practice guides that parents and practitioners could use to promote and enhance the early literacy learning and development of infants, toddlers, and preschoolers (Dunst, Trivette, Masiello, Roper, & Robyak, 2006). The implications should be considered tentative but suggestive, pending the release of the final report of the NELP.

Background

Preliteracy, emergent literacy, and early literacy development encompasses different domains of literacy experiences and accomplishments (Dunst et al., 2006). Both Adams (1990) and van Kleeck (1998) noted that literacy learning experiences and accomplishments fall broadly into two categories: print (orthographic) and speech (phonological) processing skills and subcategories or domains within categories. The print-related domains include, but are not limited to, alphabet knowledge, print awareness, written language, and text comprehension. The speech processing domains include, but are not limited to, listening comprehension, phonological awareness, and oral language.

The early literacy learning accomplishments within domains have been described as having many different

kinds of foundations and antecedents (see e.g., Neuman & Dickinson, 2002; Vernon-Feagans & Blair, 2006). The NELP examined more than 20 predictors of later literacy success to isolate which predictors were associated with which literacy accomplishments. The predictor variables that were examined included, but were not limited to, phonological awareness, concepts about print, oral language, reading comprehension, alphabet knowledge, decoding words, and visual processing skills. Table 1 includes definitions of the predictor variables we selected for our secondary analysis and Table 2 includes our categorization of the predictors according to subcategories. The focus of our secondary analysis was those predictor variables that could potentially be operationalized as practices for effecting changes in literacy skill acquisition. Many, but not all of the predictors, suggest the kinds of experiences and opportunities that one might use as interventions for effecting later literacy success. The implication for the predictor/outcome relationships found by the NELP for routine, day-to-day intervention was one focus of this research synthesis. The procedure we used was much like that used by Lonigan (2006) for identifying the predictors and associated experiences related to later reading and writing success.

Description of the Practices

In addition to the predictor analyses, the NELP also examined five kinds of interventions to facilitate children's acquisition of literacy-related skills: (1) helping children make sense of print and cracking the alphabetic code, (2) reading to and sharing books with children, (3) parent and home programs for improving young children's language learning, (4) preschool and kindergarten programs, and (5) language enhancement and enrichment programs. Category 1 print and alphabetic code interventions included practices designed to promote phonological awareness, letter knowledge, spelling, phonics, and print awareness (e.g., Ball & Blachman, 1991; Byrne & Fielding-Barnsley, 1991; Nelson, Nilsson, & Frascara, 1981; Roberts, 2003). Category 2 reading interventions included dialogic reading, interactive shared reading, and other kinds of shared reading practices (e.g., Justice & Ezell, 2002; Lonigan & Whitehurst, 1998; Wasik & Bond, 2001; Zevenbergen & Whitehurst, 2003). Category 3 parent and home-based interventions included practices to support early and emergent literacy learning (e.g., Baxendale & Hesketh, 2003; Donachy, 1976; Jordan, Snow, & Porche, 2000). Category 4 preschool and kindergarten interventions included such things as the increased learning opportunities afforded by different kinds of preschool education (e.g., Frazier & Morrison, 1998; Roberts et al., 1989; Rodríguez, Díaz, Duran, & Espinosa, 1995; Ulrey, Alexander, Bender, & Gillis, 1982). Category 5 enhancement and enrichment program interventions included the use of different kinds of instructional practices and language enhancing tech-

niques and procedures (e.g., Cole, Mills, Dale, & Jenkins, 1996; Girolametto, Pearce, & Weitzman, 1996; Peterson, Jesso, & McCabe, 1999; Register, 2001; Valdez-Menchaca & Whitehurst, 1988).

Search Strategy

Search Terms

The National Early Literacy Panel (2006) used nine descriptors to identify search terms for investigating the predictors of later literacy success. The descriptors were *language*, *cognition*, *motivation*, *schooling*, *home and family*, *word learning*, *fluency*, *reading comprehension*, and *miscellaneous*. These descriptors together with information in four key sources (Harris & Hodges, 1995; Kamil, Mosenthal, Pearson, & Barr, 2000; Neuman & Dickinson, 2002; Snow, Burns, & Griffin, 1998) were used to identify two additional descriptors (*literacy outcomes* and *age group*) and a total of 351 search terms.

The search for intervention studies was done using 13 search terms together with each of the four types of interventions. The search terms for identifying intervention studies were based on the results of the predictor analyses.

Sources

PsychINFO and ERIC were the two electronic databases searched for studies of both the predictors of later literacy success and interventions to promote acquisition of literacy-related skills. Terms within categories were first searched using the OR operator and then the category citations were searched with the *age* and *literacy outcomes* and the AND operator. The main searches were supplemented by examining published research reviews, studies nominated by the NELP members, and hand searches of seven journals also nominated by panel members (*British Journal of Educational Psychology*, *Child Development*, *Developmental Psychology*, *Early Childhood Research Quarterly*, *Journal of Educational Psychology*, *Journal of Learning Disabilities*, *Reading Research Quarterly*, and *Scientific Studies of Reading*).

Selection Criteria

Studies were included if they were published in English, published in a referred journal, reported empirical findings, and included children between the ages of 0 to 5 or 6 (kindergarten). Studies were included in the predictor analyses if the correlations between early and later literacy accomplishments were included (or could be calculated?). Studies were included in the intervention analyses if appropriate research designs were used and the findings were considered not confounded by other explanatory variables.

Search Results

Three hundred (300) studies out of an initial pool of more than 7,300 studies met the selection criteria and were

included in the predictor analyses. One hundred ninety-one (191) studies were included in the analyses of the intervention studies out of an initial pool of 280 articles.

Outcomes

The three outcomes in the predictor analyses were decoding, reading comprehension, and spelling. The average correlation between the predictors and these outcomes were used as the size of effect of the relationship between measures. The effect sizes in the NELP analyses were weighted since the sample sizes in the different studies were not the same (L. Westberg, personal communication, March 17, 2007).

The influences of the interventions were examined for 11 outcomes, including, but not limited to, oral language, phonological awareness, alphabet knowledge, reading, and spelling. Cohen's *d* average effect sizes for the differences between the intervention and comparison group or condition was used as the index for ascertaining the effectiveness of the interventions.

Secondary Coding

Predictor Analyses. The predictor variables included in our secondary analysis (Table 1) were first coded as a print-related skill, linguistic processing skill, or visual processing skill. We used the frameworks described in Adams (1990), Dunst et al. (2006), and van Kleeck (1998) to make the classifications of the predictor variables. All but two of the predictors (concepts [not otherwise specified] and readiness) were assigned to one of the three clusters of predictors. We then developed subcategories of predictors within the print-related and linguistic processing categories to isolate the best predictors of later literacy accomplishments (Table 2). Our main interest was the extent to which clusters and subcategories of predictors best explained the strength of the relationship with the three different outcomes.

The effect sizes and confidence intervals reported in the National Early Literacy Panel (2006) report were used to conduct the secondary analyses. Clusters of effect sizes of the individual predictor variables included in the NELP report were combined and used for our secondary analyses. The effect size for the print-related, linguistic processing, and visual processing predictors, subcategories of predictors, and intervention outcomes were combined by adjusting the sizes of effects and confidence intervals based on the number of studies included in the different NELP analyses. These were used as the best estimates of the relationship between the independent and dependent measures. An average correlation of .45 corresponds to a Cohen's *d* effect size of 1.0, indicating a relatively strong relationship between measures (Dunst, Hamby, & Trivette, 2004).

Intervention Analyses. Our secondary analysis of the NELP findings for the intervention studies focused on the outcomes that were the same or similar for the different kinds of practices. Oral language was the only outcome that was included in all five categories of studies. Phono-logical awareness and alphabet knowledge were examined as outcomes in three categories of studies, and decoding was an outcome in two categories of studies. The analyses were therefore limited to these outcomes for our secondary analysis. The measure of effect used by the NELP was Cohen's *d* effect size for the difference between the intervention and comparison or control conditions (L. Westberg, personal communication, April 12, 2007).

Synthesis Findings

Predictor Analyses

Our secondary analyses began by examining the overall relationship between our three categories of predictors followed by analyses of the predictors within categories. Figure 1 shows the results from the most general of all our secondary analyses. What is shown is the average adjusted effect sizes and 95% confidence intervals between the predictor categories and the three outcomes constituting the focus of the NELP. All three categories of predictors were related to the outcomes as evidenced by the average effect sizes and confidence intervals albeit at different degrees of strength. Both the linguistic processing and print-related predictors showed relatively strong relationships with all three outcomes, whereas the visual processing predictors showed a relatively strong relationship with only spelling. The print-related predictors were most strongly related to all three outcomes and especially so for spelling.

The relationships between the subcategories of predictors we constituted for our secondary analysis and the three
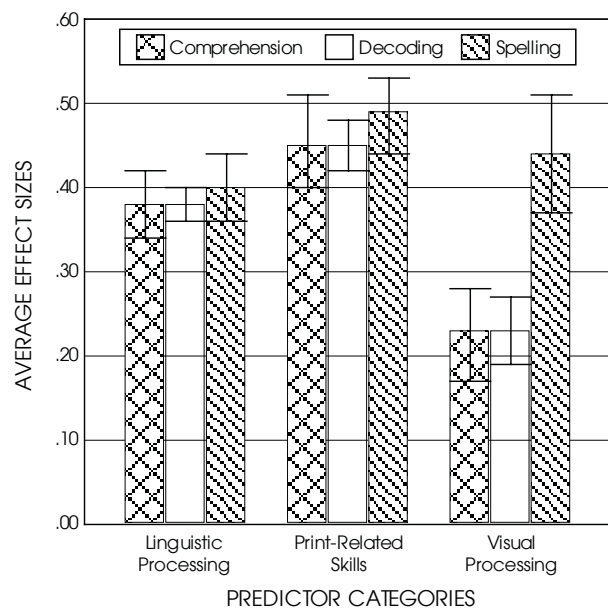

Figure 1. Average adjusted effect sizes (r) and 95% confidence intervals between three categories of predictors and comprehension, decoding, and spelling outcomes.

outcomes examined by the NELP are shown in Figure 2. Taken together, the majority of the predictor subcategories were moderately to strongly related to the three outcomes albeit differentially. Alphabet awareness and decoding best predicted the spelling and decoding outcomes, whereas print awareness, reading, and phonological processing best predicted the comprehension outcomes. The largest majority of the predictors (except for the relationship between visual processing and both comprehension and spelling) were related to the outcomes to a degree suggesting they all covary with comprehension, decoding, and spelling in a manner indicating that they in all likelihood contribute, at least to a certain degree, to later literacy accomplishments.

Table 3 shows the relationship between the individual predictors within subcategories and the three outcomes. Discerning the differential relationships between the predictor variables within categories and subcategories and the three outcomes is partly constrained by the fact that in 12 sets of analyses, no studies were included in the NELP syntheses that reported the correlations between a predictor variable and the outcomes. In those instances where data were available to assess the relationships between the predictor variables and outcomes, the findings showed *all* the predictors were related to the outcomes as evidenced by confidence intervals not including zero (Hedges, 1994).

Comprehension. Three of the print-related predictors were most strongly related to comprehension and had effect sizes between .48 and .54: concepts about print, alphabet knowledge, and print awareness. The phonemic understanding, decoding, and reading predictors were moderately related to comprehension with average effect sizes between .39 and .44.

Decoding. Predictors in three subcategories had the largest effect sizes with decoding, these were: decoding, alphabet awareness, and reading. All three decoding predictors, all four alphabet awareness predictors, and two of the four reading predictors had effect sizes between .48 and .72 with the decoding outcome. Both phonological awareness and rapid automatized naming (digits/letters) had effect sizes of .40 with decoding.

Spelling. Both decoding predictors and 3 of the 4 alphabet awareness predictors showed strong relationships with spelling. The effect sizes between these predictors and spelling ranged between .54 and .78. Additionally, visual perception processing skills, concepts about print, and phonological awareness had effect sizes between .40 and .44 with spelling.

Intervention Studies

Figure 3 shows the average effect sizes and 95% confidence intervals for the influence of the interventions on oral language outcomes (the only outcome measured in all five types of studies). All of the interventions except preschool and kindergarten programs had positive effects on
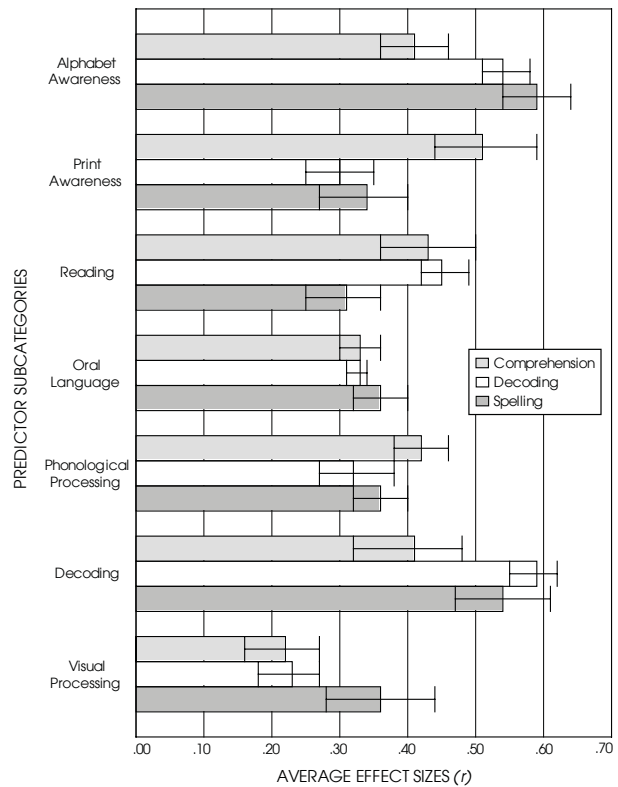

Figure 2. Average adjusted effect sizes and 95% confidence intervals for the relationships between the subcategories of predictors and comprehension, decoding, and spelling outcomes.

this outcome. Two of the interventions (reading and language enhancement) were the most strongly related to oral language outcomes. What is most apparent, however, are the very large confidence intervals for all of the interventions, indicating that some of the interventions within categories were more effective than others.

The comparisons for the outcomes included in at least 2 or 3 categories of interventions are shown in Table 4. Making sense of print interventions was by far the superior intervention for having broad-based positive outcomes. Notwithstanding this pattern of results, the large confidence intervals (except for phonological awareness) indicate that the interventions within categories were differentially effective in terms of having positive effects. The same is the case for the other interventions as well. The findings presented in Figure 3 and Table 4 suggest a need to further analyze the interventions within categories to isolate the conditions under which the same or similar types of practices had positive or negative effects.

The relative effectiveness of all five types of interventions was judged by combining selected outcome measures into two categories (language processing and print-related) and comparing the adjusted average effect sizes for the cat-

egories of practices in a manner similar to what we did in the predictor analyses. The language category included phonological awareness, oral language, and decoding. The print-related category included alphabet knowledge, concepts about print, rapid automatized naming, reading, spelling, and print awareness. Figure 4 shows the findings. Making sense of print, reading, and language enhancement

Figure 3. Influences of the five types of interventions on oral language outcomes.

Figure 4. Average adjusted effect sizes and 95% confidence intervals for the influence of the five categories of interventions on language and print-related outcomes.

NOTES: NA = Not assessed. A confidence interval including zero indicates that the average effect size is not significantly different than zero.

interventions were all associated with positive oral language outcomes. Making sense of print was the only intervention related to positive print-related outcomes. The large confidence intervals for all the interventions, however, suggest that the categories of practices may be too broad to capture differential effects of the interventions.

Conclusion

Findings from our secondary analysis of the National Early Panel indicate that certain early and emergent literacy skills were related to later literacy competence albeit differentially. The largest majority of predictors nonetheless showed a moderate to strong relationship to later comprehension, decoding, and spelling, suggesting that there are many precursors of the outcomes constituting the focus of the NELP.

Results also showed that the interventions examined by the NELP were also differentially related to the outcomes constituting the focus of analysis. Interventions that focused specifically on affecting changes in children's language acquisition were effective in terms of language outcomes, whereas interventions that focused on making sense of print and cracking the alphabetic code were the only practices related to print-related outcomes.

The most telling finding was the very large confidence intervals for the interventions constituting the focus of analysis. Such large confidence intervals indicate considerable variability in the effectiveness of the interventions within categories. Stated differently, the large confidence intervals indicate that some studies within categories were very effective while others were not very effective. Inasmuch as the NELP has not yet released a report on the particular studies that were included in each intervention category, the kind of practice characteristics analyses we typically do to unpack and disentangle what mattered most in terms of the differential findings could not be conducted (see especially Dunst, 2007). We, however, plan to conduct this kind of analysis at a later time.

Implications for Practice

Lonigan (2006) as part of his descriptions of the implications of the NELP findings and other research for practice stated that "The collective findings across [a] growing body of empirical evidence indicate that *oral language*, *phonological processing skills*, and *print knowledge* are strongly predictive of how well and how easily children will [subsequently] learn to read and write" (pp. 97-98, emphasis added). Preschool experiences in these areas would therefore seem indicated as a way of building the foundation for later literacy accomplishments.

Our secondary analysis of NELP findings builds upon and expands on these implications for practice. At the most general level results indicate that targeted practices are more likely to be effective compared to nontargeted prac-
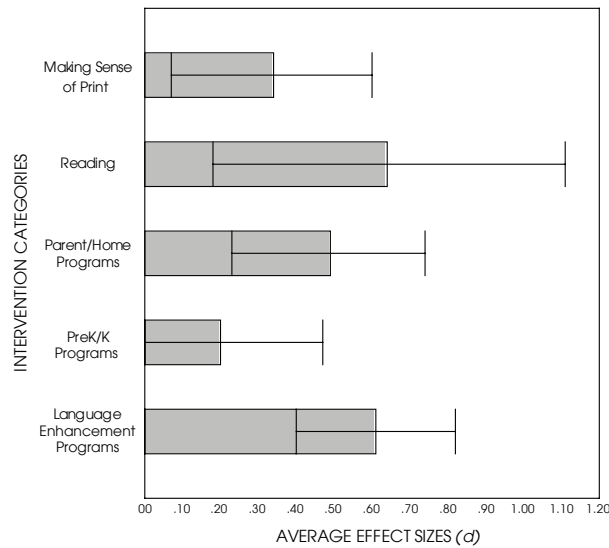
tices. For example, findings from the intervention study analyses showed that practices aimed at affecting changes in oral language outcomes tend to have effects in that area but not other literacy areas. In comparison, practices aimed at affecting changes in helping children crack the alphabet code tend to have the strongest effects in print-related areas. Findings indicate that there is a certain degree of specificity in terms of the practice characteristics/consequences relationship (see e.g., Aram, 2006).
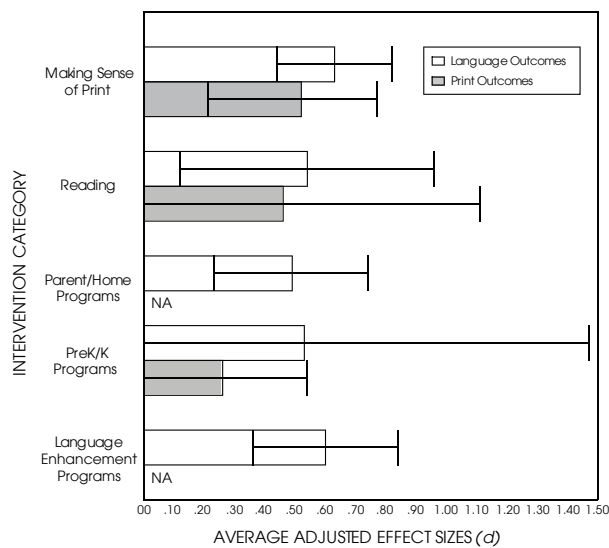
Findings from the predictor analyses suggest (but do not prove) that experiences in certain literacy areas are more likely to result in better outcomes than experiences in other areas. For example, the majority of print-related predictors were associated with positive outcomes in all three literacy domains (Table 3). To the extent that one is willing to assume that the predictor skills are proxy measures for the consequences of experiences in those same areas, then early experiences in print-related learning would seem a "good bet" in terms of having subsequent positive outcomes.

The most important implication for practice is perhaps based on a finding that is not so readily apparent. In a secondary analysis of the National Reading Panel (National Institute of Child Health and Human Development, 2000) findings, we learned that if many different, unrelated skills are targeted simultaneously, the consequences are not nearly as strong compared to interventions that focus on one skill or a set of inter-related skills. The same appears to be the case for early literacy learning, the implications of which are to employ focused interventions targeted at specific outcomes. Intervention aimed at affecting changes in specific early literacy areas is more likely to be effective than attempts to change behavior in too many areas (e.g., Tyler, Lewis, Haskill, & Tolbert, 2003).

A companion research summary to this synthesis (*CELL*notes, Volume 1, Number 3) includes information highlighting the major findings reported in this paper. That summary should be useful to practitioners and parents interested in a nontechnical description of the NELP findings and our secondary analysis of the NELP results. Information reported in this paper as well as information gleaned from studies not included in the NELP review are being used to develop evidence-based practice guides that can be used to promote the early literacy learning skills of infants, toddlers, and preschoolers.

References

Adams, M. (1990). *Beginning to read: Thinking and learning about print*. Cambridge, MA: MIT Press.

Aram, D. (2006). Early literacy interventions: The relative roles of storybook reading, alphabetic activities, and their combination. *Reading and Writing, 19*, 489-515.

Ball, E. W., & Blachman, B. A. (1991). Does phoneme awareness training in kindergarten make a difference in early word recognition and developmental spelling? *Reading Research Quarterly, 26*, 49-66.

Baxendale, J., & Hesketh, A. (2003). Comparison of the effectiveness of the Hanen Parent Programme and traditional clinic therapy. *International Journal of Language and Communication Disorders, 38*, 397-415.

Byrne, B., & Fielding-Barnsley, R. (1991). Evaluation of a program to teach phonic awareness to young children. *Journal of Educational Psychology, 83*, 451-455.

Cole, K. N., Mills, P. E., Dale, P. S., & Jenkins, J. R. (1996). Preschool language facilitation methods and child characteristics. *Journal of Early Intervention, 20*, 113-131.

Donachy, W. (1976). Parent participation in pre-school education. *British Journal of Educational Psychology, 46*, 31-39.

Dunst, C. J. (2007). Making sense of school readiness research for informing practice. *Early Childhood Services: An Interdisciplinary Journal of Effectiveness, 1*(1), 1-15.

Dunst, C. J., Hamby, D. W., & Trivette, C. M. (2004). Guidelines for calculating effect sizes for practice-based research syntheses. *Centerscope, 2*(2), 1-10. Available at http://www.researchtopractice.info/centerscopes/centerscope_vol2_no2.pdf

Dunst, C. J., Trivette, C. M., & Cutspec, P. A. (2002). Toward an operational definition of evidence-based practices. *Centerscope, 1*(1), 1-10. Available at http://www.researchtopractice.info/centerscopes/centerscope_vol1_no1.pdf

Dunst, C. J., Trivette, C. M., Masiello, T., Roper, N., & Robyak, A. (2006). Framework for developing evidence-based early literacy learning practices. *CELLpapers, 1*(1), 1-12. Available at http://www.earlyliteracylearning.org/cellpapers/cellpapers_v1_n1.pdf

Fitts, B. P. (2005, October). *National early literacy panel: A synthesis of scientific research on young children's early literacy development*. Presentation made at the Ohio Department of Education Early Childhood Conference, Columbus, OH.

Frazier, J. A., & Morrison, F. J. (1998). The influence of extended-year schooling on growth of achievement and perceived competence in early elementary school. *Child Development, 69*, 495-517.

Girolametto, L., Pearce, P. S., & Weitzman, E. (1996). Interactive focused stimulation for toddlers with expressive vocabulary delays. *Journal of Speech and Hearing Research, 39*, 1274-1283.

Harris, T. L., & Hodges, R. E. (1995). *The literacy dictionary: The vocabulary of reading and writing*. Newark, DE: International Reading Association.

Hedges, L. V. (1994). Fixed effects models. In H. Cooper & L. V. Hedges (Eds.), *The handbook of research synthesis* (pp. 285-299). New York: Russell Sage Foundation.

Jordan, G. E., Snow, C. E., & Porche, M. V. (2000). Project EASE: The effect of a family literacy project on kindergarten students' early literacy skills [Electronic version}. *Reading Research Quarterly, 35*, 524 -553.

Justice, L. M., & Ezell, H. K. (2002). Use of storybook reading to increase print awareness in at-risk children. *American Journal of Speech-Language Pathology, 11*, 17-29.

Kamil, M. L., Mosenthal, P. B., Pearson, P. D., & Barr, R. (2000). *Handbook of reading research: Volume III*. Mahwah, NJ: Erlbaum.

Lonigan, C. J. (2006). Development, assessment, and promotion of preliteracy skills. *Early Education and Development, 17*, 91-114.

Lonigan, C. J., & Whitehurst, G. J. (1998). Relative efficacy of parent and teacher involvement in a shared-reading intervention for preschool children from low-income backgrounds. *Early Childhood Research Quarterly, 13*, 263-290.

National Early Literacy Panel. (2006, March). *Findings from the National Early Literacy Panel: Providing a focus for early language and literacy development*. Presentation at the annual conference of the National Center for Family Literacy, Louisville, KY.

National Institute of Child Health and Human Development. (2000). *Report of the National Reading Panel. Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading instruction. Reports of the subgroups* (NIH Publication No. 00-4754). Washington, DC: Author.

Nelson, T. M., Nilsson, T. H., & Frascara, J. (1981). Information in letter backgrounds and acquistion of reading skills. *Reading Improvement, 18*, 287-294.

Neuman, S. B., & Dickinson, D. K. (Eds.). (2002). *Handbook of early literacy research*. New York: Guilford Press.

Peterson, C., Jesso, B., & McCabe, A. (1999). Encouraging narratives in preschoolers: An intervention study. *Journal of Child Language, 26*, 49-67.

Register, D. (2001). The effects of an early intervention music curriculum on prereading/writing. *Journal of Music Theory, 38*, 239-248.

Roberts, J. E., Rabinowitch, S., Bryant, D. M., Burchinal, M. R., Koch, M. A., & Ramey, C. T. (1989). Language skills of children with different preschool experiences. *Journal of Speech and Hearing Research, 32*, 773-786.

Roberts, T. A. (2003). Effects of alphabet-letter instruction on young children's word recognition. *Journal of Educational Psychology, 95*, 41-51.

Rodríguez, J. L., Díaz, R. M., Duran, D., & Espinosa, L. (1995). The impact of bilingual preschool education on the language development of Spanish-speaking children. *Early Childhood Research Quarterly, 10*, 475-490.

Schatsclneider, C., & Westberg, L. (2006). *Findings from the National Early Literacy Panel: Implications for early screening*. Manuscript in preparation.

Shanahan, T. (2005). What the National Early Literacy Panel tells us about early literacy [Summary]. In C. M. Connor & P. J. Tiedemann (Eds.), *International Reading Association--National Institute for Child Health and Human Development Conference on Early Childhood Literacy Research: A summary of presentations and discussions* (pp. 9-13). Newark, DE: International Reading Association. Retrieved March 15, 2007, from http://www.reading.org/downloads/resources/092005IRA-NICHD_summary.pdf

Snow, C. E., Burns, M. S., & Griffin, P. (Eds.). (1998). *Preventing reading difficulties in young children*. Washington, DC: National Academy Press.

Strickland, D. S., & Shanahan, T. (2004). Laying the groundwork for literacy: The National Early Literacy Panel releases preliminary findings in its synthesis of research on early literacy education. *Educational Leadership, 6*, 74-77.

Tyler, A. A., Lewis, K. E., Haskill, A., & Tolbert, L. C. (2003). Outcomes of different speech and language goal attack strategies. *Journal of Speech, Language and Hearing Research, 46*, 1077-1094.

Ulrey, G. L., Alexander, K., Bender, B., & Gillis, H. (1982). Effects of length of school day on kindergarten school performance and parent satisfaction. *Psychology in the Schools, 19*, 238-242.

Valdez-Menchaca, M. C., & Whitehurst, G. J. (1988). The effects of incidental teaching on vocabulary acquistion by young children. *Child Development, 59*, 1451-1459.

van Kleeck, A. (1998). Preliteracy domains and stages: Laying the foundations for beginning reading. *Journal of Children's Communication Development, 20*, 33-51.

Vernon-Feagans, L., & Blair, C. (Eds.). (2006). *Measurement of school readiness* (Early Education and Development Vol. 17, No. 1). Brandon, VT: Psychology Press.

Wasik, B. A., & Bond, M. A. (2001). Beyond the pages of a book: Interactive book reading and language development in preschool classrooms. *Journal of Educational Psychology, 93*, 243-250.

Zevenbergen, A. A., & Whitehurst, G. J. (2003). Dialogic reading: A shared picture book reading intervention for preschoolers. In A. van Kleeck, S. A. Stahl, & E. B. Bauer (Eds.), *On reading books to children: Parents and teachers* (pp. 177-200). Mahwah, NJ: Erlbaum.

AUTHORS

Carl J. Dunst, Ph.D., and Carol M. Trivette, Ph.D., are Research Scientists and Co-Directors at the Orelena Hawks

Puckett Institute in Asheville and Morganton, North Carolina. They are Co-Principal Investigators at the Center for Early Literacy Learning (CELL). Deborah W. Hamby, M.P.H., is Research Analyst at the Puckett Institute.

Table 1

Definitions of the Predictors of Later Decoding, Spelling, and Comprehension

Predictor Variables ( )[a]	Definition
Alphabet Knowledge (P)	Ability to distinguish the key features of each letter, ability to recognize the fact that different letters have different features, saying the name of a letter, etc.
Concepts About Print (P)	Rules necessary to record oral language into a written language, including an understanding that print carries a message, printed language consists of letters, words, sentences, etc.
Concepts (Not Otherwise Specified) (N)	Mental capacity to represent ideas in some coherent form or pattern.
Decoding Nonwords (L)	Ability to break down nonwritten information into understandable parts such as in pictures.
Decoding Words (L)	Breaking down words into parts or syllables.
Decoding (Not Otherwise Specified) (L)	Mental process of deconstructing information into understandable or recognizable parts.
Environmental Print (P)	Printed materials that are part of everyday life such as street signs, billboards, logos, labels, building signs, etc.
Invented Spelling (P)	Ability to attempt to spell or write words or sentences in forms not already known or mastered.
Oral Language (L)	Ability to use words to communicate ideas and thoughts to others and to understand what others have said.
Phonological Awareness (L)	Ability to notice and work with the sounds in language, including alliteration, rhymes, and separating individual syllables into sounds.
Phonological Awareness (Not Otherwise Specified) (L)	General ability to attend to the sounds of words distinct from their meaning.
Phonological Short Term Memory (L)	Ability to remember and repeat words heard or spoken.
Print Awareness (P)	Recognition of the characteristics and conventions of written language, including directionality in reading text and that printed words correspond to speech.
Rapid Automatized Naming (Digits/Letters) (P)	Processing speed in naming letters and numbers (Graphological RAN).
Rapid Automatized Naming (Objects/Colors) (P)	Processing speed in naming objects and colors (Nongraphological RAN).
Readiness (N)	General sense of preparedness necessary to facilitate learning.
Reading (Not Otherwise Specified) (P)	Recognition and comprehension of written text.
Reading Comprehension (P)	Process of constructing and understanding the meaning of text.
Spelling (P)	Convention governing the representation of words by letters in written language.
Visual Memory (V)	Ability to remember information presented visually such as objects, pictures, letters, words, etc.
Visual Motor Skills (V)	Ability to coordinate visual information with fine or gross motor skills.
Visual Perceptual Skills (V)	Ability to accurately interpret and give meaning to what is seen.
Writing/Writing Name (P)	Ability to print or write one's name or words.

[a]Indicates the category to which the predictor was assigned: P = Print-related skills, L = Linguistic processing skills, V = Visual processing skills, and N = Not assigned.

Table 2

Subcategories of the Predictors of Later Decoding, Spelling, and Comprehension

Print-Related Skills	Linguistic Processing Skills	Visual Processing Skills
Alphabet Awareness	*Oral Language*	*Visual Processing*
Alphabet knowledge		Visual memory
Invented spelling	*Phonemic Understanding*	Visual motor
Spelling	Phonological awareness	Visual perceptual
Writing/writing name	Phonological awareness (NOS)[b]	
	Phonological awareness (STM)[c]	
Print Knowledge		
Concepts about print	*Decoding*	
Environmental print	Decoding nonwords	
Print awareness	Decoding NOS	
	Decoding words	
Reading		
RAN[a] (digits/letters)		
RAN (objects/colors)		
Reading		
Reading comprehension		

[a]RAN = Rapid automatized naming
[b]NOS = Not otherwise specified
[c]STM = Short term memory

Table 3

Average Effect Sizes Between the Predictor Variables and Three Literacy-Related Outcomes

| | Outcomes | | | | | |
| | Comprehension | | Decoding | | Spelling | |
Predictors	Mean	95% CI	Mean	95% CI	Mean	95% CI
Linguistic Processing Skills						
Oral Language	.33	.30–.36	.33	.31–.34	.36	.32–.40
Phonemic Understanding						
Phonological awareness	.44	.41–.48	.40	.39–.42	.40	.37–.44
Phonological awareness (NOS)[a]	—	—	.31	.17–.44	—	—
Phonological awareness (STM)[b]	.39	.35–.43	.26	.24–.29	.31	.27–.36
Decoding						
Decoding nonwords	.41	.30–.50	.72	.68–.75	.54	.45–.63
Decoding NOS	—	—	.53	.48–.57	—	—
Decoding words	.41	.34–.45	.52	.49–.55	.54	.49–.58
Print-Related Skills						
Alphabet Awareness						
Alphabet knowledge	.48	.45–.51	.49	.48–.52	.54	.51–.57
Invented spelling	—	—	.58	.53–.62	.69	.63–.73
Spelling	—	—	.60	.56–.63	.78	.73–.82
Writing/writing name	.33	.26–.41	.48	.45–.53	.36	.27–.44
Print Knowledge						
Concepts about print	.54	.48–.61	.34	.31–.37	.43	.35–.49
Environmental print	—	—	.28	.22–.34	.25	.18–.31
Print awareness	.48	.39–.56	.29	.22–.35	—	—
Reading						
RAN[c] (digits/letters)	.43	.34–.52	.40	.36–.43	—	—
RAN (objects/colors)	.42	.38–.47	.32	.29–.35	.31	.25–.36
Reading NOS	—	—	.57	.54–.60	—	—
Reading comprehension	—	—	.52	.47–.58	—	—
Visual Processing Skills						
Visual memory	.17	.10–.23	.22	.17–.26	—	—
Visual motor	.22	.16–.27	.25	.20–.29	.27	.18–.36
Visual perceptual	.26	.21–.31	.22	.18–.26	.44	.37–.51

[a]NOS = Not otherwise specified
[b]STM = Short term memory
[c]RAN = Rapid automatized naming

Table 4

Average Effect Sizes for the Outcomes Included in the Different Intervention Studies

| | Interventions | | | | | | | |
| | Making Sense of Print | | Reading | | PreK/K Programs | | Language Enhancement | |
Outcomes	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
Oral Language	.34	.07, .60	.64	.18, 1.11	.20	−.07, .47	.61	.40, .82
Phonological Awareness	.83	.67, .10	.07	−.14, .28	—	—	.53	.13, .93
Alphabet Knowledge	.43	.21, .66	.30	−.13, .74	.07	−.33, .48	—	—
Concepts About Print	.42	.10, .73	.47	−.49, 1.42	—	—	—	—
Decoding	.43	.24, .63	—	—	1.65	−1.51, 4.80	—	—

NOTE: A confidence interval including zero indicates that the average effect size is not significantly different than zero.