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Finding, Analyzing, and Implementing a Phonemic Awareness Intervention: Guidelines to a Decision-Making Process

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Finding, Analyzing, and Implementing a Phonemic Awareness Intervention: Guidelines to a Decision-Making Process

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It's the end of the first marking period at the East Point Elementary School. The school reading specialist, Marc, consults with Laila, the school speech-language pathologist (SLP), about a student (HC) they both have been working with in their caseload. HC is in a regular third-grade classroom but is reading almost 2 years below grade level. HC has been diagnosed with a reading disability by the school psychologist and receives small group instruction with Marc four days per week for twenty minutes. In addition, HC receives pull-out speech-language therapy twice a week for 30 minutes in a small group to address auditory processing difficulties. Despite this extra support, HC continues to have a great deal of difficulty learning to read and is rapidly falling behind other students in the class.

When Marc and Laila looked at HC's test scores on standardized measures of reading, they found that HC was showing substantial difficulties in decoding both regular real words and pseudowords. His oral reading was slow and labored and results on tasks of rapid naming revealed slow and inaccurate naming ability. After a discussion of HC's progress and the test data, they decided to include phonemic awareness training in their intervention plans. Marc and Laila requested a modification to HC's Individualized Education Plan (IEP) at the School Placement Committee meeting. However, in order to modify their instructional programs, Marc and Laila were told that they needed to provide scientific evidence to support their request for an IEP change.

The lower the quality of the research, the less credible the evidence for making clinical decisions.

Understanding and using research to assess the quality of the evidence used for decisions about intervention or program adoption requires that Marc and Laila have a basic understanding of the principles that underlie those data. The American Speech-Language-Hearing Association's (ASHA) National Center for Evidence-Based Practice in Communication Disorders (N-CEP) (2008) uses a six-tier hierarchy of research evidence that can provide guidance in the clinical application of research and the accompanying data:

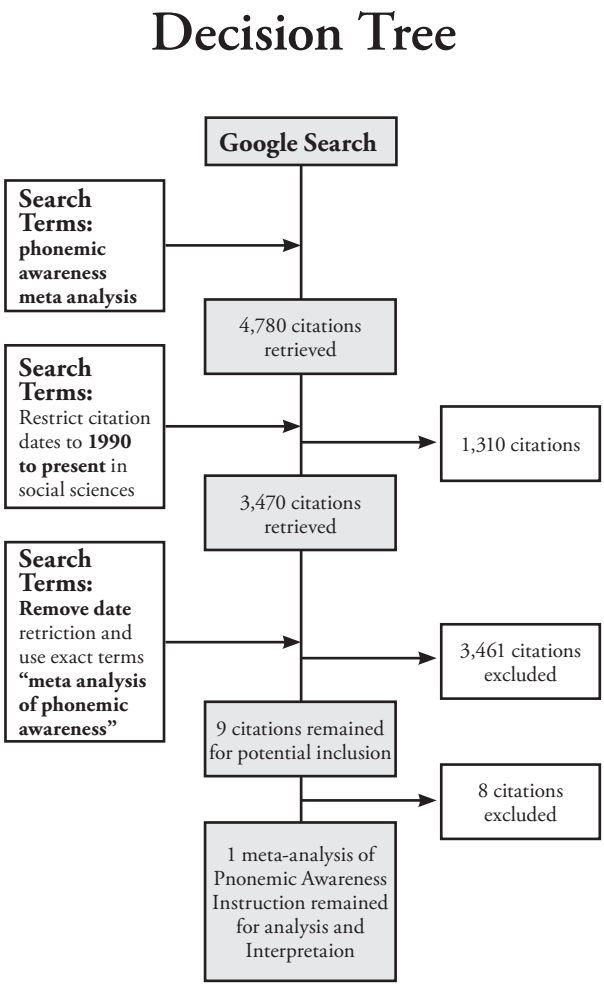
Level of Research Quality	Description
1. (Ia) Well-designed meta-analysis of >1 randomized controlled study	Meta-analysis includes the quantitative summary of two or more randomized controlled trial studies in which post-treatment results are combined.
2. (Ib) Well-designed randomized controlled study	A randomized controlled study is a study in which the participants are assigned to treatment or control groups immediately prior to implementation of the intervention.
3. (IIa) Well-designed controlled study without randomization	A comparison post-treatment and control group study in which participants may have been randomly selected but are assigned to groups on a non-random basis.
4. (IIb) Well-designed quasi-experimental study	Quasi-experimental studies include those studies in which participants are selected and assigned to treatment or control groups in a manner other than randomization.
5. (III) Well-designed non-experimental studies, i.e., correlational and case studies	Non-experimental studies would include pre-post single group design, single-subject design, case study, or a correlational study.
6. (IV) Expert committee report, consensus conference, clinical experience of respected authorities	Expert evidence may include non-quantitative opinions, decisions, or summaries by individuals or groups representing a professional position.

Each of these types of evidence may play an important role in the development of the professional's knowledge of the effect of an intervention; however, the lower the quality of the research, the less credible the evidence for making clinical decisions. What follows is the framework that Marc and Laila used for obtaining, analyzing, interpreting, and applying evidence to inform their decisions about an IEP change for HC.

Searching for and Retrieving the Evidence

Neither Marc nor Laila had access to a university library or an extensive collection of databases so they decide to start with **www.scholar.google.com**. The Decision Tree *(see Figure 1)* is a graphic illustration of the process Marc and Laila used to search for and retrieve the best evidence available to inform their program decision.

Figure 1.



Since Laila knew that ASHA's technical report by the Research and Scientific Affairs Committee (2004) recognized that high quality meta-analyses provided the most compelling level of scientific evidence, they began their search by inputting the terms *phonemic awareness meta analysis.*

What they found was both encouraging and discouraging. They were encouraged to find that there were meta-analyses on the topic of phonemic awareness (PA), but a bit dismayed to find 4,780 citations listed when they used their search terms. They decided to restrict the search to only citations reported since 1990 and in the Social Sciences. They ran the search again and still got 3,470 references, far too many for them to sift through. Next they decided to remove the date restrictions and search for the exact terms of "meta analysis **of** phonemic awareness" to identify only those references that were meta-analyses. This generated nine citations as potential sources of evidence, a reasonable number of sources to consider *(see Figure 2)*.

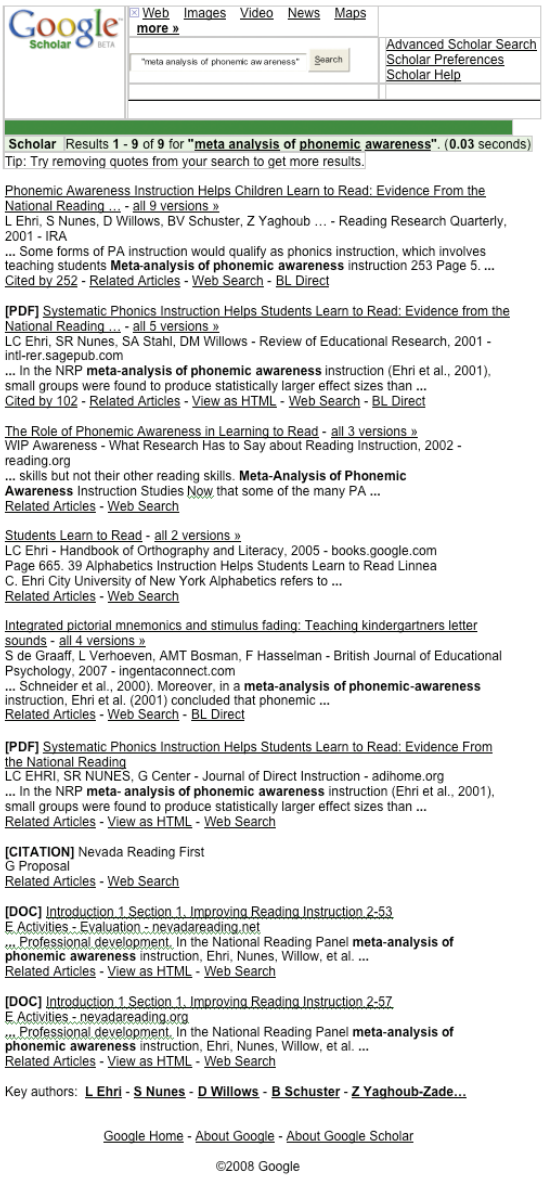
High quality meta-analyses provided the most compelling level of scientific evidence.

Marc and Laila began by evaluating each of the nine citation abstracts. When they read the citation descriptions, six of the nine citations included the search terms as descriptors referring to the first article listed by Ehri, Nunes, Willows, Schuster, Yaghoub-Zadeh and Shanahan (2001), one citation provided no description or link, and another citation was a meta-analysis of phonics instruction. The remaining citation by Ehri et al. (2001) was the only reference of the nine retrieved citations that reported a meta-analysis of PA instruction. Marc and Laila found that they could purchase a copy of the Ehri et al. meta-analysis paper for $8.75 from the online provider.

Assessing the Evidence

How will Marc and Laila assess this information? Is it really the kind of "evidence" they need to better understand what might work best for HC? How can they know if this meta-analysis is appropriate for their situation? What standards will they use to determine if the meta-analysis is of adequate scientific quality? While Marc and Laila understood that meta-analyses provide the strongest form of evidence, they knew very little about meta-analysis. To help with their understanding, they consulted a recent tutorial on meta-analysis for speech-language pathologists (Turner & Bernard, 2006).

Figure 2.



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"meta analysis of phonemic awareness" Search

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Tip: Try removing quotes from your search to get more results.

Phonemic Awareness Instruction Helps Children Learn to Read: Evidence From the National Reading ... - all 9 versions »
L Ehri, S Nunes, D Willows, BV Schuster, Z Yaghoub ... - Reading Research Quarterly, 2001 - IRA
... Some forms of PA instruction would qualify as phonics instruction, which involves teaching students **Meta-analysis of phonemic awareness** instruction 253 Page 5. ...
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[PDF] Systematic Phonics Instruction Helps Students Learn to Read: Evidence from the National Reading ... - all 5 versions »
LC Ehri, SR Nunes, SA Stahl, DM Willows - Review of Educational Research, 2001 - intl-rer.sagepub.com
... In the NRP **meta-analysis of phonemic awareness** instruction (Ehri et al., 2001), small groups were found to produce statistically larger effect sizes than ...
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Key authors: L Ehri - S Nunes - D Willows - B Schuster - Z Yaghoub-Zade...

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They found that meta-analysis provides a statistical summary of the magnitude of the effect of an intervention and the percentage of treated individuals who may benefit from the intervention. The primary statistics in the meta-analysis are the **effect size** and the **confidence interval** of the effect size. The effect size is simply the difference between the treated and control participants at the conclusion of the intervention program as measured in standard deviation units.[1] The effect size is often represented with the symbol Cohen's (1988) ***d*** (difference) and is interpreted on the basis of small (<.2), medium (.2 to .7), or large (>.7) effects as measured in standard deviation units.

The confidence interval (***CI***) of the effect size accounts for the possibility that the measurement of an outcome (e.g., phonemic awareness) is not perfect and the effect size is a "best estimate" result. The 95% CI tells us the potential range of effect sizes that could be expected. For example, if a study reported that the average effect size for the improvement of PA after intervention was *d* =.50, we need to know how precise that effect size is in describing the effect of the intervention. Assume that the 95% CI is .30 to .70. This means that 95% of the time we can be confident that the true effect size will be between .30 and .70 standard deviations, suggesting that between 62% and 76% of the children participating in the intervention would show a positive benefit from the program when compared to children not participating in the intervention.

Meta-analyses provide a statistical summary of the magnitude of the effect of an intervention and the percentage of treated individuals who may benefit from the intervention.

However, suppose the 95% CI was -0.10 to 1.10. Now we have a very different situation. Anytime an effect size includes zero or a negative value (e.g., -0.10), the results indicate a possibility that the control group could perform better than the treated group. That is, the true effect size *could* favor the children who did NOT receive the intervention. In this case, because the confidence interval of the effect size contains zero, we also would need to conclude that the difference between the treated and control groups was not statistically significant and any difference between groups could be due to chance or other factors.[2]

Now that Marc and Laila had a basic understanding of the statistics underlying a meta-analysis and its interpretation, they were ready to review and evaluate the Ehri et al. (2001) study as a basis for making an evidence-based decision to modify the IEP for HC.

Main Results of Ehri (2001)

Source of Evidence

The data for the meta-analysis conducted by Ehri et al. (2001) was obtained by searching two databases, ERIC and PsycINFO, resulting in a total of 637 articles from

1. We recognize that the calculation of the effect size is mathematically and statistically more complicated than presented here. However, the basic principle of the effect of the intervention is a comparison of the treated and control participants, and this is the conceptual basis for the effect size. For more information on the statistical basis of the effect size calculation, the reader is referred to Lipsey and Wilson (2001).

2. Statistical Hint: The smaller the CI, the more closely the individual scores are to the average effect size (less variability) and the more precise the effect size in representing the sample or population being studied. The larger the CI, the more different the individual scores are to the average effect size (greater variability) and potentially the less representative the effect size in representing the sample or population. We always would like to see a more narrow CI.

ERIC and 1,325 articles from PsycINFO. A total of 52 studies met all the criteria for inclusion and resulted in data for 96 treatment versus control group comparisons. These comparisons served as the basis for the analysis of the effect of PA intervention for at-risk, reading disabled, and typically developing children.

Once Ehri and colleagues (2001) had collected the 52 studies, they coded each study for variables that might help clarify and explain the factors that would influence the degree of the effect of the PA intervention. The categories of variables they assessed included: research design (e.g., type of design), participant characteristics (e.g., age, gender, reading level), publication characteristics (e.g., date of publication), intervention characteristics (e.g., length of instruction, skills taught), and outcome characteristics (e.g., segmentation, blending, deletion). In addition, the data needed to calculate the effect size was extracted from the results section and the effect size for each comparison in each study recorded.

Quality of Evidence

The authors screened the articles for research quality using Troia's (1999) criteria for measuring methodological rigor that included an assessment of internal validity (the degree to which the outcome can be attributed to the intervention) and external validity (the degree to which the results can be generalized to a larger population). When examining the PA outcomes, Ehri et al. (2001) found that the most scientifically rigorous studies produced statistically significantly larger effect sizes.

Effects of Evidence

Overall Impact of PA Training on PA

The primary outcomes measured across the 52 studies for which an effect size was calculated were PA, reading, and spelling. Effect-size calculations also were provided for moderator variables (i.e., factors that might help explain a study result), including time of posttest, outcome measures of PA (segmentation, blending, deletion, and other), characteristics of participants, PA intervention, delivery unit (individual, small group, classroom), and research design (random assignment, treated controls, untreated controls, sample size). Comparisons of posttest treatment outcomes for PA yielded an overall effect size of d = .86. The effect sizes for moderator variables ranged from .48 to 2.37 and were all statistically significant *(see Table 2 in Ehri et al. 2001)*.

The most scientifically rigorous studies produced statistically significantly larger effect sizes.

The data also revealed that PA training produced significantly positive performance on PA tasks for children identified as reading disabled (d = .62). Ehri et al. (2001) also assessed the impact of PA training for grade level and found that children in grades two through six improved PA performance (d = .70).

Overall Impact of PA Training on Reading

The overall effect size for reading outcomes was d = .53, which was significantly larger than zero (95% CI .47 to .58), providing evidence to suggest that PA training positively impacted reading performance. Effect sizes also were calculated for all moderator variables and ranged from .21 to 1.33 (as in the PA analysis above) and were all statistically significant.

PA training positively impacted reading performance.

In addition, the data revealed that PA training produced significantly positive reading performance for children identified as reading disabled (d = .45). Ehri et al. (2001) also assessed the impact of PA training for grade level and found that children in grades two through six improved reading performance (d = .49).

Impact of Program Delivery

The effect sizes associated with the major components of the PA training programs are summarized in *Table 1 (See p. 7)*.

These data suggested that PA training that included one or two PA skills resulted in largest effects for both PA and reading outcomes. Similarly, children receiving PA training in a small group format showed the greatest gains in PA and reading performance. It was also the case that children showed the largest gains in PA and reading performance when the length of the PA training programs was between 5 and 18 hours.

However, it is important to note that these gains in PA performance reflect an average of all studies reporting on a given variable. The most accurate interpretation does not allow us to suggest that any individual outcome is associated with any other individual outcome. For example, children being taught one skill (e.g., blending) may have received training in either individual, small group, or classroom settings. Thus, it cannot be assumed that being taught one skill in a small group is the most effective intervention for teaching PA skills.

Ehri et al. (2001) point out a number of additional issues that are not addressed by their review that might impact the effect of PA intervention including:

1. Student Characteristics: participant definition (e.g., at-risk, SES); age-related impact
2. Instructional Features: multiple-skill instruction; hierarchy of instruction; causal link of PA to reading mastery; length of instructional program
3. Reading Comprehension Impact: reading ability; type of outcome measure
4. Research Design: instructional fidelity
5. Moderators: dialectal differences; bilingualism

Application of Evidence

It is clear from the data provided in the Ehri et al. (2001) meta-analysis that reading disabled, at-risk, and typically developing children instructed in PA could be expected to show substantial improvements in PA (v = .86) and reading (*d* = .53). In addition, Ehri et al. provided data to support the acquisition of PA skills for reading disabled students (*d* = .62) and for students in grades two through six (*d* = .70). The Ehri et al. data also support the acquisition of reading skills for the reading disabled student (*d* = .45) and for students in grades two through six (*d* = .49). From these findings, Marc and Laila concluded that there is a scientific basis for PA training and that PA training should improve not only HC's ability to detect individual sounds in spoken words but also improve his reading performance; thus, a change in HC's IEP is warranted.

Children instructed in PA could be expected to show substantial improvements in PA (*d* = .86) and reading (*d* = .53).

A question remains, however: What exactly will the intervention approach look like that Marc or Lalia will implement as a result of the evidence they have uncovered? Based on their review of the intervention effects associated with the different outcomes, Marc and Lalia decide to develop an intervention program that includes teaching two PA skills [segmenting, blending, or deletion (*d* range .61 to .87)], using small group instruction (*d* = 1.38) for at least 10 instructional hours (*d* = 1.37).

While Marc and Laila have found evidence to support PA training, they are aware that the evidence and their intervention plan are incomplete in many important respects. For example, the Ehri et al. (2001) meta-analysis does not address such questions as how many instructional sessions to conduct, how long each session should last, who should deliver the PA training, what the instructional components of the intervention should be, and a host of other possible questions that Marc and Laila might encounter while developing the new intervention plan for HC. These questions will need to be addressed based on Marc and Laila's clinical experience and expertise.

DISCUSSION

This scenario leads us to recognize that research does not and cannot provide a complete answer to all questions of clinical practice. It is the combination of scientific evidence and clinical experience and expertise that ultimately guides us in designing and delivering high quality, evidence-based interventions.

In general Ehri and colleagues (2001) have provided a comprehensive assessment of the available evidence for the effects of PA instruction across ages, programs, and abilities. The conclusions drawn by Ehri et al. are appropriate for the data presented and potential shortcomings recognized are appropriate. Specific to the SLP, Ehri et al. provide a summary of the evidence regarding the components of PA that are impacted by intervention, recommend a hierarchy of intervention tasks, and provide information regarding available commercial intervention programs. Their meta-analysis also is a tool that the SLP can use to help guide teachers in the classroom and to support evidence-based instruction in the classroom through a collaborative, consultative, or inclusive model.

While the process and resulting decisions made by Marc and Lalia are reasonable and justified based on the available research, it is also the case that Marc and Laila cannot devise a more exacting plan of intervention due to the limitations of the data available. This is not to suggest that the final decision to implement a PA training program is inaccurate, but a fuller description and implementation of the intervention program is where their clinical experience and training become part of the evidence-based-practice equation. Marc and Laila have done the best they can as clinical professionals. The evidence available to them limits their decisions and actions in designing a program for HC. It is their clinical experience and expertise that will really define the success of the PA training program they design and deliver for HC.

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Table 1. Effect size associated with PA and Reading outcomes

Variable	PA Outcomes	Reading Outcomes
Reading Group		
At Risk	0.95	0.86
Disabled	0.62	0.45
Normal Profress	0.93	0.47
Grade		
Preschool	2.37	1.25
Kindergarter	0.95	0.48
First	0.48	0.49
Second-Sixth	0.70	0.49
Skills Taught		
One Skill	1.16	0.71
Two Skills	1.03	0.79
Three or More Skills	0.70	0.27
Blend & Segment Only	0.81	0.67
Delivery Unit		
Individual	0.60	0.45
Small Group	1.38	0.81
Classroom	0.67	0.35
Length of Instruction		
1 to 4.5 hours	0.61	0.61
5 to 9.3 hours	1.37	0.76
10 to 18 hours	1.14	0.86
20 to 75 hours	0.65	0.31