What Works Clearinghouse

INSTITUTE OF EDUCATION SCIENCES

Early Childhood Education Interventions for Children with Disabilities June 2012

Phonological Awareness Training

Program Description[1]

Phonological awareness, or the ability to detect or manipulate the sounds in words independent of meaning, has been identified as a key early literacy skill and precursor to reading. For the purposes of this review, *phonological awareness training* refers to any practice targeting young children's phonological awareness abilities.

Phonological awareness training can involve various activities that focus on teaching children to identify, detect, delete, segment, or blend segments of spoken words (i.e., words, syllables, onsets and rimes, phonemes) or to identify, detect, or produce rhyme or alliteration. *Phonologic awareness training* can occur in both regular and special education classrooms. Various curricula are available to support this training.

Research[2]

Four studies of *phonological awareness training* that fall within the scope of the Early Childhood Education Interventions for Children with Disabilities review protocol meet What Works Clearinghouse (WWC) evidence standards without reservations. The four studies included 78 children with disabilities or developmental delays attending preschool in four locations across the United States. Based on these four studies, the WWC considers the extent of evidence of *phonological awareness training* on children with learning disabilities in early education settings to be small for one domain: communication/language competencies. Six other domains are not reported in this intervention report. (See the Effectiveness Summary for further description of all domains.)

Effectiveness

Phonological awareness training was found to have potentially positive effects on communication/language competencies for children with learning disabilities in early education settings.

Table 1. Summary of findings[3]

Outcome domain	Rating of effectiveness	Improvement index *(percentile points)*		Number of studies	Number of students	Extent of evidence
		Average	Range			
Communication/language competencies	Potentially positive effects	+13	–16 to +46	4	78	Small

Report Contents

Program Information

Background

Phonological awareness training does not have a single developer responsible for providing information or materials. The interventions described in this report were developed by the study authors and are not available for distribution through a common developer. However, many online resources are available for readers interested in using *phonological awareness training* practices. A list of examples follows, although these sources have not been reviewed or endorsed by the WWC:

- Florida Center for Reading Research: http://www.fcrr.org
- Foundations of Reading: Effective Phonological Awareness Instruction and Progress Monitoring: http://www.meadowscenter.org/vgc/materials/primary_phono_awareness.asp
- Ideas and Activities for Developing Phonological Awareness Skills: A Teacher Resource Supplement to the Virginia Early Intervention Reading Initiative: http://www.doe.virginia.gov/instruction/response_intervention/resources/ideas_activities_develop_phonological.pdf
- Improving Reading Fluency: Phonological Awareness Training: http://www.speechpathology.com/Articles/article_detail.asp?article_id=68
- National Reading Panel: http://www.nationalreadingpanel.org
- Phonological Awareness: Instructional and Assessment Guidelines: http://www.ldonline.org/article/6254
- Phonological Awareness Skills and Spelling Skills: http://cla.calpoly.edu/~jrubba/phon/phonaware.html
- Reading Recovery Council of North America: Phonics: http://www.readingrecovery.org/reading_recovery/phonics/index.asp
- Reading Rockets: Teacher Toolbox—Phonological Awareness: The Phive Phones of Reading: http://www.readingrockets.org/firstyear/fyt.php?SUB=33
- Target the Problem! Phonological and Phonemic Awareness: http://www.readingrockets.org/helping/target/phonologicalphonemic
- University of Oregon–Center on Teaching and Learning: Big Ideas in Beginning Reading: http://reading.uoregon.edu/

Program details

Phonological awareness training practices vary in their scope and may include a variety of activities that are intended to enable children to detect and understand sounds in language.[4] In particular, *phonological awareness training* practices tend to focus on teaching children to rhyme or to detect alliteration in language. Examples of these activities include:

- rhyme detection training (e.g., teachers engage children in a game involving rhyming words and questions about which word in a series of three does not sound like the others),
- blending training (e.g., teachers say three sounds and teach children how to blend the sounds together to make a word), and
- segmentation training (e.g., teachers say a short word such as “cat” and teach children how to separate the word into the three sounds that make up the word) at the phoneme, syllable, or word level.

Phonological awareness training practices can be used by teachers or practitioners with children individually, in pairs, or in small groups. These practices may be part of the core curriculum or used as a supplement to the regular classroom curriculum, and they have been used with specific subpopulations of children, such as those with developmental delays and speech/language or learning disabilities.

Cost

Information is not available about the costs of teacher or practitioner training and implementation of *phonological awareness training* practices.

Research Summary

Two hundred twenty-five studies reviewed by the WWC investigated the effects of *phonological awareness training* on children with learning disabilities in early education settings. Four studies (O'Connor, Jenkins, Leicester, & Slocum, 1993; Sweat, 2003; Tyler, Lewis, Haskill, & Tolbert, 2003; Tyler, Gillon, Macrae, & Johnson, 2011) are randomized controlled trials that meet WWC evidence standards without reservations. Those four studies are summarized in this report. The remaining 221 studies do not meet either WWC eligibility screens or evidence standards. (See references beginning on p. 6 for citations for all 225 studies.)

Table 2. Scope of reviewed research

Grade	Pre-kindergarten
Delivery method	Individual/Small group
Program type	Practice/Curriculum
Studies reviewed	225
Meets WWC standards without reservations	4 studies
Meets WWC standards with reservations	0 studies

Four additional studies were reviewed against the pilot Single-Case Design standards. One study met the pilot Single-Case Design standards without reservations, no studies met the pilot Single-Case Design standards with reservations, and three did not meet pilot Single-Case Design standards. Studies reviewed against pilot Single-Case Design standards are listed in Appendix E and do not contribute to the intervention's rating of effectiveness.

Summary of studies meeting WWC evidence standards without reservations

O'Connor et al. (1993) examined the effects of *phonological awareness training* on 22 children ages 4 to 6 with developmental delays in a university preschool. The study used a randomized block design, stratifying children by age and whether they were in a morning or afternoon class, and ranking them by a cognitive pretest. Children were assigned to one of three types of *phonological awareness training* or a no-treatment comparison group, but only one set of contrasts across the groups met WWC standards: *phonological awareness training with a blending focus* versus the comparison group.[5] Children in the *phonological awareness training with a blending focus* group participated in small groups (three to five children) for 10 minutes a day, four times a week, for seven weeks.

Sweat (2003) randomly assigned 20 children ages 3 to 5 with morphological and phonological impairments to one of two groups. Children in the intervention group received *phonological awareness training*, and children in the comparison group participated in a morphosyntactic intervention, which focused on finite morphemes (e.g., /s/ as in "sleeps" or /d/ as in "happened"). Both interventions included weekly individual and group sessions over a 12-week period. The children in the sample attended one of four preschools.

Tyler et al. (2003) examined the effects of *phonological awareness training* (relative to a morphosyntactic intervention) in a sample of 20 children ages 3 to 5 with co-occurring speech and language impairments. Children in the intervention group received *phonological awareness training*, which included goal attack strategies related to awareness of target sounds, differences and similarities between target sounds, and production practice. Children in the comparison group received a morphosyntactic intervention, which included goal attack strategies related to awareness of morphosyntactic targets in the context of children's books and songs, focused stimulation, and elicited production of target morphemes. Both of the interventions included weekly individual and group sessions over a 12-week period.

Tyler et al. (2011) randomly assigned children ages 3 to 5 with co-occurring speech and language impairments, using a matched pairs design. The children attended preschool in one of two sites, either the United States or New Zealand; this WWC review includes 16 children attending the US site.[6] Children in the intervention group received a phonemic awareness intervention, with an integrated direct speech focus. Children in the comparison group received a morphosyntactic intervention, focusing on morphophonemic interactions and finite morphemes. Each

group received its assigned intervention in a small-group setting, with instruction totaling 24 hours administered over 12 weeks separated into two blocks.

Summary of studies meeting WWC evidence standards with reservations

No studies of *phonological awareness training* meet WWC evidence standards with reservations.

Effectiveness Summary

The WWC review of interventions for Early Childhood Education Interventions for Children with Disabilities addresses student outcomes in seven domains: cognitive development, communication/language competencies, literacy, math achievement, social-emotional development and behavior, functional abilities, and physical well-being. The four studies that contribute to the effectiveness rating in this report cover one domain: communication/language competencies. The findings below present the authors' estimates and WWC-calculated estimates of the size and statistical significance of the effects of *phonological awareness training* on children with learning disabilities in early education settings. For a more detailed description of the rating of effectiveness and extent of evidence criteria, see the WWC Rating Criteria on p. 41.

Summary of effectiveness for the communication/language competencies domain

Four studies reported findings in the communication/language competencies domain.

O'Connor et al. (1993) found, and the WWC confirmed, three statistically significant positive differences between the intervention (*phonological awareness training with a blending focus*) and comparison groups on outcomes targeting "blending" knowledge in the communication/language competencies domain. Because there were three statistically significant positive impacts and no statistically significant negative impacts, this study is characterized as having statistically significant positive effects.

Sweat (2003) found two statistically significant differences between the intervention and comparison groups.[7] However, according to WWC calculations, neither of these differences was statistically significant. The average effect size across all findings is large enough to be considered substantively important. Therefore, the study is characterized as having substantively important positive effects according to WWC criteria (that is, at least 0.25 standard deviation).

Tyler et al. (2003) found, and the WWC confirmed, no statistically significant differences between the intervention and comparison groups. According to WWC criteria, this study is characterized as having an indeterminate effect.

Tyler et al. (2011) found, and the WWC confirmed, no statistically significant differences between the intervention and comparison groups. According to WWC criteria, this study is characterized as having an indeterminate effect.

Thus, for the communication/language competencies domain, one study showed a statistically significant positive effect, one study showed a substantively important positive effect, no studies showed a statistically significant or substantively important negative effect, and two studies showed an indeterminate effect. This results in a rating of potentially positive effects, with a small extent of evidence.

Table 3. Rating of effectiveness and extent of evidence for the communication/language competencies domain

Rating of effectiveness	Criteria met
Potentially positive effects *Evidence of a positive effect with no overriding contrary evidence.*	The review of *phonological awareness training* in the communication/language competencies domain had one study showing a statistically significant positive effect, one study showing a substantively important positive effect, no studies showing a statistically significant or substantively important negative effect, and two studies showing an indeterminate effect.
Extent of evidence	**Criteria met**
Small	The review of *phonological awareness training* in the communication/language competencies domain was based on four studies that included 10 locations and 78 children.

References

Studies that meet WWC evidence standards without reservations

O'Connor, R. E., Jenkins, J. R., Leicester, N., & Slocum, T. A. (1993). Teaching phonological awareness to young children with learning disabilities. *Exceptional Children, 59*(6), 532–546.

Sweat, L. M. (2003). Comparing the effects of morphosyntax and phonology intervention on final consonant clusters in finite morphemes and final consonant inventories. *Masters Abstracts International, 42*(01), 31-231.

Tyler, A. A., Gillon, G., Macrae, T., & Johnson, R. L. (2011). Direct and indirect effects of stimulating phoneme awareness vs. other linguistic skills in preschoolers with co-occurring speech and language impairments. *Topics in Language Disorders, 31*(2), 128–144.

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*(5), 1077–1094.

Studies that do not meet WWC evidence standards

Klein, E. S. (1996). Phonological/traditional approaches to articulation therapy: A retrospective group comparison. *Language, Speech, and Hearing Services in Schools, 27*(4), 314–323. The study does not meet WWC evidence standards because it uses a quasi-experimental design in which the analytic intervention and comparison groups are not shown to be equivalent.

Laing, S. P., & Espeland, W. (2005). Low intensity phonological awareness training in a preschool classroom for children with communication impairments. *Journal of Communication Disorders, 38*(1), 65–82. The study does not meet WWC evidence standards because it uses a quasi-experimental design in which the analytic intervention and comparison groups are not shown to be equivalent.

Tyler, A. A., Lewis, K. E., Haskill, A., & Tolbert, L. C. (2002). Efficacy and cross-domain effects of a morphosyntax and a phonology intervention. *Language, Speech, and Hearing Services in Schools, 33*(1), 52–66. The study does not meet WWC evidence standards because it uses a quasi-experimental design in which the analytic intervention and comparison groups are not shown to be equivalent.

Tyler, A. A., & Watterson, K. H. (1991). Effects of phonological versus language intervention in preschoolers with both phonological and language impairment. *Child Language Teaching and Therapy, 7*(2), 141. The study does not meet WWC evidence standards because it is a randomized controlled trial in which the combination of overall and differential attrition rates exceeds WWC standards for this area, and the subsequent analytic intervention and comparison groups are not shown to be equivalent.

Van Kleeck, A., Gillam, R. B., & McFadden, T. U. (1998). A study of classroom-based phonological awareness training for preschoolers with speech and/or language disorders. *American Journal of Speech-Language Pathology, 7*(3), 65–76. The study does not meet WWC evidence standards because it uses a quasi-experimental design in which the analytic intervention and comparison groups are not shown to be equivalent.

Wolfe, V., Presley, C., & Mesaris, J. (2003). The importance of sound identification training in phonological intervention. *American Journal of Speech-Language Pathology, 12*(3), 282–288. The study does not meet WWC evidence standards because the measures of effectiveness cannot be attributed solely to the intervention—there was only one unit assigned to one or both conditions.

Studies that are ineligible for review using the Early Childhood Education Interventions for Children with Disabilities Evidence Review Protocol

Abadzi, H. (2003). *Teaching adults to read better and faster: Results from an experiment in Burkina Faso* (Policy Research Working Paper Series: 3057). Washington, DC: The World Bank. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

Abshire, S. A. (2006). *Exploring implicit versus explicit methods of teaching phonemic awareness instruction to kindergarten students* (Unpublished doctoral dissertation). Louisiana State University, Baton Rouge. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

Adema, S. S. (1998). *An examination of phonological awareness training and kindergarten children's spelling* (Unpublished master's thesis). Calvin College, Grand Rapids, MI. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

Alexander, A. W., Andersen, H. G., Heilman, P. C., & Voeller, K. K. (1991). Phonological awareness training and remediation of analytic decoding deficits in a group of severe dyslexics. *Annals of Dyslexia, 41*, 193–206. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

Almost, D., & Rosenbaum, P. (1998). Effectiveness of speech intervention for phonological disorders: A randomized controlled trial. *Developmental Medicine and Child Neurology, 40*(5), 319–325. The study is ineligible for review because it does not take place in the geographic area specified in the protocol.

Al Otaiba, S., Puranik, C. S., Ziolkowski, R. A., & Montgomery, T. M. (2009). Effectiveness of early phonological awareness interventions for students with speech or language impairments. *Journal of Special Education, 43*(2), 107–128. The study is ineligible for review because it is a secondary analysis of the effectiveness of an intervention, such as a meta-analysis or research literature review.

Aoyama, K., Peters, A. M., & Winchester, K. S. (2010). Phonological changes during the transition from one-word to productive word combination. *Journal of Child Language, 37*(1), 145–157. The study is ineligible for review because it does not use a comparison group design or a single-case design.

Arrow, A. W. (2007). *Potential precursors to the development of phonological awareness in preschool children* (Unpublished doctoral dissertation). University of Auckland, New Zealand. The study is ineligible for review because it does not take place in the geographic area specified in the protocol.

Asfendis, G. (2009). Phonemic awareness and early intervention: An evaluation of a pilot phonemic awareness program. *Dissertation Abstracts International, 69(*8-A), 3027. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

Atwill, K., Blanchard, J., Christie, J., Gorin, J. S., & Garcia, H. S. (2010). English-language learners: Implications of limited vocabulary for cross-language transfer of phonemic awareness with kindergartners. *Journal of Hispanic Higher Education, 9*(2), 104–129. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

Barker, T., & Torgesen, J. K. (1995). An evaluation of computer-assisted instruction in phonological awareness with below average readers. *Journal of Educational Computing Research, 13*(1), 89–103. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

Barron, R. W., Golden, J. O., Seldon, D. M., & Tait, C. F. (1992). Teaching prereading skills with a talking computer: Letter-sound knowledge and print feedback facilitate nonreaders' phonological awareness training. *Reading and Writing, 4*(2), 179–204. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

Beach, D. W. (2004). *The effects of a school district's kindergarten readiness summer program on phonological awareness skills of at-risk prekindergarten students: A regression discontinuity analysis* (Unpublished doctoral dissertation). Utah State University, Logan. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample either includes less than 50% students with identified disabilities or more than 50% students with autism.

Bennett, L. S. M. (1998). Teaching phonological awareness with an emphasis on linkage to reading. *Dissertation Abstracts International, 60*(06A), 211-1962. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

Bentin, S., & Leshem, H. (1993). On the interaction between phonological awareness and reading acquisition: It's a two-way street. *Annals of Dyslexia, 43,* 125–148. The study is ineligible for review because it does not take place in the geographic area specified in the protocol.

Berninger, V. W., Vaughan, K. B., Abbott, R. D., Abbott, S. P., Rogan, L. W., Brooks, A.,…Graham, S. (1997). Treatment of handwriting problems in beginning writers: Transfer from handwriting to composition. *Journal of Educational Psychology, 89*(4), 652–666. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

Bianco, M., Bressoux, P., Doyen, A., Lambert, E., Lima, L., Pellenq, C., & Zorman, M. (2010). Early training in oral comprehension and phonological skills: Results of a three-year longitudinal study. *Scientific Studies of Reading, 14*(3), 211–246. The study is ineligible for review because it does not take place in the geographic area specified in the protocol.

Biwer, D. L. (2002). Effects of three phonological awareness programs on kindergarten students identified as at risk for reading failure. *Dissertation Abstracts International, 63*(06A), 140-2106. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

Blachman, B. A. (1991). Early intervention for children's reading problems: Clinical applications of the research in phonological awareness. *Topics in Language Disorders, 12*(1), 51–65. The study is ineligible for review because it is a secondary analysis of the effectiveness of an intervention, such as a meta-analysis or research literature review.

Blachman, B. A. (1994). What we have learned from longitudinal studies of phonological processing and reading, and some unanswered questions: A response to Torgesen, Wagner, and Roshotte. *Journal of Learning Disabilities, 27*(5), 287–291. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

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*(3), 239–273. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

Blumsack, J. B. (1998). Teaching phonological awareness to children with language impairments. *Dissertation Abstracts International Section A: Humanities and Social Sciences, 58*(7-A), 2587. The study is ineligible for review because it does not disaggregate findings for the age or grade range specified in the protocol.

Bodé, S., & Content, A. (2011). Phonological awareness in kindergarten: A field study in Luxembourgish schools. *European Journal of Psychology of Education, 26*(1), 109–128. The study is ineligible for review because it does not take place in the geographic area specified in the protocol.

Bowers, P. N., Kirby, J. R., & Deacon, S. H. (2010). The effects of morphological instruction on literacy skills: A systematic review of the literature. *Review of Educational Research, 80*(2), 144–179. The study is ineligible for review because it is a secondary analysis of the effectiveness of an intervention, such as a meta-analysis or research literature review.

Bowyer-Crane, C., Snowling, M. J., Duff, F. J., Fieldsend, E., Carroll, J. M., Miles, J.…Hulme, C. (2008). Improving early language and literacy skills: Differential effects of an oral language versus a phonology with reading intervention. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 49*(4), 422–432. The study is ineligible for review because it does not take place in the geographic area specified in the protocol.

Brady, S., Fowler, A., Stone, B., & Winbury, N. (1994). Training phonological awareness: A study with inner-city kindergarten children. *Annals of Dyslexia, 44,* 26–59. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

Brennan, F., & Ireson, J. (1997). Training phonological awareness: A study to evaluate the effects of a program of metalinguistic games in kindergarten. *Reading and Writing, 9*(4), 241–263. The study is ineligible for review

because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

Brooks, G. (1999). What works for slow readers? *Support for Learning, 14*(1), 27. The study is ineligible for review because it is a secondary analysis of the effectiveness of an intervention, such as a meta-analysis or research literature review.

Burrows, C., Marinac, J. V., & Pitty, K. (2009). *Phonological awareness training for high schools (PATHS).* San Diego, CA: Plural Publishing. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

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*(3), 403–414. The study is ineligible for review because it is a secondary analysis of the effectiveness of an intervention, such as a meta-analysis or research literature review.

Butler, K. G. (1999). From oracy to literacy: Changing clinical perceptions. *Topics in Language Disorders, 20*(1), 14–32. The study is ineligible for review because it is a secondary analysis of the effectiveness of an intervention, such as a meta-analysis or research literature review.

Cardoso-Martins, C., Mesquita, T. C. L., & Ehri, L. (2011). Letter names and phonological awareness help children to learn letter-sound relations. *Journal of Experimental Child Psychology, 109*(1), 25–38. The study is ineligible for review because it does not take place in the geographic area specified in the protocol.

Casalis, S., & Cole, P. (2009). On the relationship between morphological and phonological awareness: Effects of training in kindergarten and in first-grade reading. *First Language, 29*(1), 113–142. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

Chen, S. (2004). *Identifying reading disabilities in Taiwanese aboriginal students* (Unpublished doctoral dissertation). National Taiwan Normal University, Taipei. The study is ineligible for review because it does not take place in the geographic area specified in the protocol.

Chen, Y. (2005). The role of phonological and morphological awareness in early Chinese reading of young children who are deaf or hard of hearing in Taiwan. *Dissertation Abstracts International, 66*(05A), 152-1712. The study is ineligible for review because it does not examine an intervention conducted in English.

Chera, P., & Wood, C. (2003). Animated multimedia "talking books" can promote phonological awareness in children beginning to read. *Learning and Instruction, 13*(1), 33–52. The study is ineligible for review because it does not take place in the geographic area specified in the protocol.

Chih-Hsin, L. (2006). *The role of phonological awareness in Taiwanese students' English reading and pronunciation acquisition* (Unpublished master's thesis). National Tsing Hua University, Hsinchu City, Taiwan. The study is ineligible for review because it does not take place in the geographic area specified in the protocol.

Claessen, M., Heath, S., Fletcher, J., Hogben, J., & Leitao, S. (2009). Quality of phonological representations: A window into the lexicon? *International Journal of Language & Communication Disorders, 44*(2), 121–144. The study is ineligible for review because it does not take place in the geographic area specified in the protocol.

Cologon, K., Cupples, L., & Wyver, S. R. (2006). *Phonological awareness and "silent reading": The benefits of intervention and early intervention in reading for children who have Down syndrome* (Unpublished doctoral dissertation). Macquarie University, Sydney, Australia. The study is ineligible for review because it does not take place in the geographic area specified in the protocol.

Colon, E. P. (2006). Utility of the Lindamood Phoneme Sequencing Program (LiPS) for classroom-based reading instruction. *Dissertation Abstracts International, 67*(1-A), 131. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

Constantine, J. L. (2001). Integrating thematic-fantasy play and phonological awareness activities in a speech-language preschool environment. *Journal of Instructional Psychology, 28*(1), 9–14. The study is ineligible for review because it does not use a comparison group design or a single-case design.

Conway, T. W. (2003). *Measuring phonological processing and phonological working memory in adults with developmental dyslexia: A functional magnetic resonance imaging study* (Unpublished doctoral dissertation). University of Florida, Gainesville. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

Cooke, N. L., Galloway, T. W., Kretlow, A. G., & Helf, S. (2011). Impact of the script in a supplemental reading program on instructional opportunities for student practice of specified skills. *The Journal of Special Education, 45*(1), 28–42. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

Dahlen, K. (2008). Aptitude, rehearsal, and skin conductance response in foreign vocabulary learning. *Dissertation Abstracts International, 69*(01A), 177-199. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

Davis, C. A., Lane, K. L., Sutherland, K., Gunter, P. L., Denny, R. K., Pickens, P., & Wehby, J. (2004). *Differentiating curriculum and instruction on behalf of students with emotional and behavioral disorders within general education settings.* Arlington, VA: Council for Exceptional Children. The study is ineligible for review because it is a secondary analysis of the effectiveness of an intervention, such as a meta-analysis or research literature review.

de Jong, P. F. (2007). Phonological awareness and the use of phonological similarity in letter-sound learning. *Journal of Experimental Child Psychology, 98*(3), 131–152. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

Denne, M., Langdown, N., Pring, T., & Roy, P. (2005). Treating children with expressive phonological disorders: Does phonological awareness therapy work in the clinic? *International Journal of Language & Communication Disorders, 40*(4), 493–504. The study is ineligible for review because it does not take place in the geographic area specified in the protocol.

Desmond, S. K. (2008). The effects of rhyme on phonological sensitivities. *Dissertation Abstracts International, 69*(08A), 108. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample either includes less than 50% students with identified disabilities or more than 50% students with autism.

Dodd, B., & Gillon, G. (2001). Exploring the relationship between phonological awareness, speech impairment, and literacy. *Advances in Speech Language Pathology, 3*(2), 139–147. The study is ineligible for review because it is a secondary analysis of the effectiveness of an intervention, such as a meta-analysis or research literature review.

Dodd, B., McCormack, P., & Woodyatt, G. (1993). Evaluation of an intervention program: Relation between children's phonology and parents' communicative behavior. *American Journal on Mental Retardation, 98*(5), 632–645. The study is ineligible for review because it does not take place in the geographic area specified in the protocol.

Dwyer, J. E., & Rule, D. L. (1997). *The effects of a kindergarten prevention program on special education referrals, classifications and retentions* (ERIC Document Reproduction Service No. ED 406 806). The study is ineligible for review because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

Edwards, L. L. (2000). The role of spelling and handwriting in kindergarten instruction: An examination of the effects of two beginning reading instructional interventions on the reading and spelling achievement of kindergarten students at-risk of reading disabilities. *Dissertation Abstracts International, 61*(09A), 223-3512. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

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Appendix A.1: Research details for O'Connor et al., 1993

O'Connor, R. E., Jenkins, J. R., Leicester, N., & Slocum, T. A. (1993). Teaching phonological awareness to young children with learning disabilities. *Exceptional Children, 59*(6), 532–546.

Table A1. Summary of findings

Meets WWC evidence standards without reservations

		Study findings	
Outcome domain	Sample size	Average improvement index *(percentile points)*	Statistically significant
Communication/language competencies	1 school/22 children	+20	No

Setting

The study was conducted in six preschool classrooms in the Experimental Education Unit at the University of Washington.

Study sample

Fifty-five children aged 4–6 with developmental delays were pretested for the study. The authors excluded four children who scored 30% or better on a phonological pretest and one child with autism, who was nonverbal.[8] Children were stratified by class (morning or afternoon), age, and the results of the cognitive ability pretest. Within strata, children were randomly assigned to either one of three *phonological awareness training* conditions or a comparison group. Only one comparison, *phonological awareness training with a blending focus* versus the comparison group, meets WWC standards and is included in this report.[9] Twelve children were randomly assigned to the *phonological awareness training with a blending focus* condition and 13 to the comparison group, but three children left the program before the completion of the study, leaving an analytic sample of 22 children (11 each in the intervention and comparison groups). For the whole sample (including all three *phonological awareness training* conditions), 80% of the children had significant language delays and some physical handicaps, behavioral disorders, or an intellectual disability.

Intervention group

Children met in groups of three to five for 10-minute sessions, four times a week. Instruction lasted seven weeks. In the first three weeks, children in the blending focused (intervention) condition practiced blending two to three phonemes in elongated words with continuous sounds. For example, "I'll say words the slow way. You'll say them fast. Sseeeeeennnn. What word?" (p. 536). At the end of the three weeks, children were tested on the set of phonological skills that was taught and one that was not taught (e.g., blending and segmentation). During the last four weeks, the skills were reviewed and instruction was extended to other tasks. Children were taught to blend words beginning with stop sounds, all sounds separated, and onset-rime.

Comparison group

Children participated in routine preschool activities, such as listening to stories read by the teacher or "circle time" oral language activities. The authors were concerned that children in the intervention group would have more experience with "sounds in isolation" than children in the comparison group, which could result in the outcome measures favoring the intervention groups. To address this, the researchers met with each comparison group child twice during the implementation period to practice the isolated sounds used in training. For example, the researcher would say, "Today we're going to practice saying sounds. Say this sound." The researcher would model, and the children would then repeat the sounds.

Outcomes and measurement

Nine subtests of auditory phonological skills (three each for rhyming, blending, and segmenting) were developed by the study team. The blending outcomes were continuous phonemes, onset-rime, and separate sounds. The segmenting outcomes were all sounds, onset-rime, and first sound. The rhyming outcomes were production, oddity, and recognition. Children were tested in the week prior to the start of the study and directly after the cessation of instruction for the intervention groups. For a more detailed description of these outcome measures, see Appendix B.

Support for implementation

The intervention was conducted by three graduate students, all of whom had teaching experience. Each graduate student teacher led all three interventions to minimize potential teacher effects. Each Monday, the three teachers practiced the formats to be used for the week with the first author. The teachers met daily to discuss and resolve problems. In addition, the teachers were randomly audiotaped to ensure that protocols were being implemented as designed.

Appendix A.2: Research details for Sweat, 2003

Sweat, L. M. (2003). Comparing the effects of morphosyntax and phonology intervention on final consonant clusters in finite morphemes and final consonant inventories. *Masters Abstracts International, 42*(01), 31-231.

Table A2. Summary of findings **Meets WWC evidence standards without reservations**

		Study findings	
Outcome domain	Sample size	Average improvement index *(percentile points)*	Statistically significant
Communication/language competencies	4 schools/20 children	+28	No

Setting

The study was conducted in early childhood programs in four elementary schools in the Washoe County School District in Reno, Nevada.

Study sample

The study included 3- to 5-year-old children with morphosyntax and phonological impairments.

To be eligible, the children had to meet the following criteria:

(a) speech performance at least one standard deviation below the mean on the Bankson-Bernthal Test of Phonology;
(b) expressive language scores at least one standard deviation below the mean on the Preschool Language Scale 3 or the Clinical Evaluation of Language Fundamentals–Preschool, or a score for mean length of utterances in morphemes greater than one and one-half standard deviations below the mean;
(c) nonverbal cognitive functioning within one and one-half standard deviations from the mean on the Columbia Mental Maturity Scale;
(d) normal functioning on oral motor assessment; and
(e) normal functioning on neurological, behavioral, hearing, and motor skills.[10]

Twenty children (18 boys and two girls) were randomly assigned to either *phonological awareness training* or a morphosyntactic intervention.

Intervention group

Children in the intervention group received *phonological awareness training* in weekly 30-minute individual and 45-minute group sessions with clinicians over a 12-week period. Children were given four goals based on their initial speech and language results (e.g., phonetic inventory, sound classes affected). The goals were rotated and targeted three times over the 12-week period. The intervention included auditory awareness activities (such as listening to word lists and books that frequently used a targeted sound), conceptual activities (contrasting and classifying sounds), production practice (drills and imitation of phonetic placement), and phonological awareness activities (rhyme, sound identification). The intervention also included "naturalistic" activities, in which the clinician provided the child with opportunities to produce targeted sounds during conversations. The information in this report examined the children at the end of the 12-week block. As part of a larger study, children were then given the opposite intervention for another 12-week period (i.e., children receiving the *phonological awareness training* program in the first 12 weeks received the morphosyntactic intervention in the second 12-week period). The information for this additional contrast is not reported in this report, as this would only demonstrate intervention *ordering* effects. That is, the assessment at the 24-week period would only illustrate the effects of receiving the *phonological awareness training* first and then the morphosyntactic intervention second, relative to receiving morphosyntactic training first and then *phonological awareness training* second, and would only illustrate the effectiveness of the ordering of the interventions, not the independent effects of the interventions themselves.

Comparison group

Children in the comparison group received the morphosyntactic intervention over the same 12-week period, with weekly 30-minute individual and 45-minute group sessions with clinicians. As with the intervention condition, children were given four goals, which were rotated and targeted three times during the 12-week period. For the morphosyntactic intervention, the goals were based on morphemes that the child produced with less than 50% accuracy during pretest. However, preference was given to goals that were similar for all children in the group, so the 50% accuracy rule was not always followed. The comparison group program used themes of food, animals, and water. The comparison condition included auditory awareness activities (books and songs with opportunities to produce the target sounds), focused stimulation activities (expansions of the children's utterances), and elicited production activities (to encourage the use of target morphemes). Clinicians decreased their support over the 12-week period.

Outcomes and measurement

Three eligible outcomes of children's language were used. Two of the measures were based on the final consonant clusters: regular past tense and contractible copula. The third measure was an inventory of final consonants. For a more detailed description of these outcome measures, see Appendix B.

Support for implementation

Both the *phonological awareness training* and morphosyntactic interventions were led by four graduate student interns and four certified speech-language pathologists. No other information is provided.

Appendix A.3: Research details for Tyler et al., 2003

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*(5), 1077–1094.

Table A3. Summary of findings

Meets WWC evidence standards without reservations

		Study findings	
Outcome domain	Sample size	Average improvement index *(percentile points)*	Statistically significant
Communication/language competencies	4 sites/20 children	–8	No

Setting

The study was conducted in early childhood programs in four elementary schools in the Washoe County School District in Reno, Nevada, and in an early education clinic at the University of Nevada, Reno. Participants in the two groups included in the WWC review were located in four of these five sites.[11]

Study sample

The study sample included 47 preschoolers between ages 3 years and 5 years 11 months who had received speech-language evaluations and were identified as eligible for speech-language services by the speech-language pathologist.

Eligibility criteria included:

(a) documentation of expressive language scores at least one standard deviation below the mean on the Preschool Language Scale–3 (PLS-3) or the Clinical Evaluation of Language Fundamentals–Preschool (CELF-P) or mean length of utterance in morphemes (MLUm) greater than one and one-half standard deviations below the mean based on Leadholm and Miller's normative data;
(b) documentation of speech performance at least one standard deviation below the mean on the Bankson-Bernthal Test of Phonology (BBTOP);
(c) documentation of nonverbal cognitive functioning within one and one-half standard deviations of the mean on the Columbia Mental Maturity Scale (CMMS);
(d) normal hearing, as indicated by pure-tone screening;
(e) normal functioning on oral motor assessment; and
(f) neurological, behavioral, and motor skills reported within normal limits in assessment results.[10]

Forty children were randomly assigned to four intervention groups, and the remaining seven children were placed in a no-treatment comparison group.

The four interventions being compared were:

(a) phonology instruction for 12 weeks, followed by morphosyntactic instruction for 12 weeks;
(b) morphosyntactic instruction for 12 weeks, followed by phonology instruction for 12 weeks;
(c) instruction in phonology and morphosyntactic goals that alternated from one topic to the other on a weekly basis for 24 weeks; and
(d) simultaneous instruction in both phonology and morphosyntactic goals, whereby both types of instruction occurred each day for the 24-week period.

For the purposes of this review, the only comparisons that were considered eligible were between the phonology first condition (Group A) and the morphosyntax first condition (Group B), for which assessment occurred at the 12-week midpoint (before the experiences of the groups changed).[12] These groups are referred to as the "intervention group" and the "comparison group" in the remainder of this appendix.

Intervention group

The phonological intervention was a 12-week program designed for this study that addressed both segmental and syllable structure forms. It focused on four goals for phonology for each child; one goal was targeted during each week in a four-week cycle, and then the sequence (cycle) was repeated twice.

The intervention included four components:

(a) auditory awareness activities designed to heighten children's awareness of target sounds and direct their attention to the sounds' auditory-acoustic attributes;
(b) conceptual activities designed to develop children's awareness of the difference and similarities between target sounds and their contrasts;
(c) production practice activities, both drill play and naturalistic, designed to help establish production of a new sound, to facilitate practice of that sound in communicative contexts, and to increase awareness of the success-failure in communicating an intended message; and
(d) one phonological awareness activity designed to stimulate preliteracy skills by increasing awareness of the speech sound system.

Children received these services in one 30-minute individual session and one 45-minute group session per week.

Comparison group

Children in the comparison condition were assigned to the morphosyntax-first group. They participated in a program that addressed finite morphemes and focused on four goals for morphology for each child. One goal was targeted during each week in a four-week cycle. Then the sequence (cycle) was repeated twice.

Morphosyntax activities included:

(a) auditory awareness activities, to increase children's awareness of the morphosyntactic targets in the context of children's books and songs that were read and sung in each session;
(b) focused stimulation activities, designed to provide children with multiple models of target structures in naturalistic communicative context; and
(c) elicited production activities, with the goal of eliciting 20 to 30 productions of each targeted morpheme.

Children received these services in one 30-minute individual session and one 45-minute group session per week.

Outcomes and measurement

The study includes two outcomes obtained from analysis of a spontaneous language sample and a single word citation sample obtained from the BBTOP. This was supplemented with 15 additional words to ensure that the 24 consonants occurred a minimum of three times each in initial and final word positions. These outcomes include the finite morpheme composite (FMC) and the target generalization composite (TGC). For a more detailed description of these outcome measures, see Appendix B.

Support for implementation

Sessions for both the intervention and comparison groups were provided by graduate students under the supervision of the early childhood or university program's speech-language pathologists. Interns attended a training session in which they viewed videotapes of intervention procedures and were provided with a comprehensive manual explaining the procedures and containing instructions for their implementation.

Appendix A.4: Research details for Tyler et al., 2011

Tyler, A. A., Gillon, G., Macrae, T., & Johnson, R. L. (2011). Direct and indirect effects of stimulating phoneme awareness vs. other linguistic skills in preschoolers with co-occurring speech and language impairments. *Topics in Language Disorders, 31*(2), 128–144.

Table A4. Summary of findings

Meets WWC evidence standards without reservations

Outcome domain	Sample size	Study findings	
		Average improvement index *(percentile points)*	Statistically significant
Communication/language competencies	1 school/16 children	+9	No

Setting

The study was conducted in two preschools in the United States and New Zealand. This WWC review includes only children attending the US site. The authors do not describe the location or setting of the US preschool site.

Study sample

The children participating in the study were between 3.1 and 5.2 years of age and all displayed co-occurring speech and language impairments, including:

(a) a speech sound disorder (SSD) confirmed by a score of at least one standard deviation below the mean on the Goldman-Fristoe Test of Articulation–Second Edition (GFTA-2);
(b) documentation of an expressive language score of at least one standard deviation below the mean on the Structured Photographic Expressive Language Test–Preschool 2 (SPELT-P2) and/or one and one-half standard deviations below the mean MLU for the child's age based on Miller and Chapman's (2000) normative data;
(c) age-appropriate receptive vocabulary, as confirmed by a score within one and one-half standard deviations of the mean on the Peabody Picture Vocabulary Test–Third Edition (PPVT-III);
(d) normal functioning on oral motor assessment; and
(e) neurological, behavioral, hearing, and motor skills reported within normal limits.[13]

Children in each geographic location were matched in pairs based on age and severity of speech disorder (receptive vocabulary and gender also were considered). One child in each pair was assigned to the intervention group, and the other was assigned to the comparison group. One pair that spanned two cohorts was excluded from this review because the children in this pair were not randomly assigned to conditions.

Intervention group

Children assigned to a phonemic awareness intervention participated in two six-week blocks of instruction, separated by a six- to seven-week break from the intervention. The intervention included twice-weekly 60-minute instructional sessions in small-group settings, for a total of 24 hours of instruction. The intervention involved phoneme awareness and letter/sound knowledge, integrated with speech sound production. The intervention embedded phoneme awareness and letter knowledge activities into clinician-directed play activities. Intervention materials included an instructional manual, scripted lessons, material lists and patterns, stimulus pictures, and activity books.

Comparison group

Children in the comparison group received a morphosyntactic intervention and a speech sound intervention provided in alternate weeks. The morphosyntactic intervention included auditory awareness activities, focused stimulation activities, and elicited production activities. The speech sound intervention included auditory awareness activities and production practice in drill play and naturalistic activities. It did not target phoneme awareness or letter/sound production directly. The time frame, time of instruction, and instructional setting were identical to those in the intervention group. Intervention materials included an instructional manual, scripted lessons, material lists and patterns, stimulus pictures, and activity books.

Outcomes and measurement

There were six outcomes used in the study:

(a) finite morpheme composite (FMC),
(b) letter name (LN),
(c) mean length of utterance in morphemes (MLUm),
(d) percent consonant correct (PCC),
(e) phoneme identity (PID), and
(f) /s/-cluster accuracy.

Baseline data were collected two weeks prior to the start of the interventions, and outcome data were collected within two weeks following the conclusion of the second instructional block. Data also were collected during the break period between the two instructional blocks, but these intermediate outcomes are not considered in this review, since the full intervention had not been implemented. For a more detailed description of these outcome measures, see Appendix B.

Support for implementation

The instructional sessions for both intervention and comparison students were taught by undergraduate senior or master's-level speech-language pathology students. They were supervised by certified doctoral students or professional speech-language pathologists. The study authors trained staff to implement and supervise the interventions through reviews of instructional manuals and videotaped examples of instructional sessions.

Appendix B: Outcome measures for each domain[14]

Communication/language competencies	
Blending: Continuous phonemes	This author-developed subtest measured children's ability to blend stretched sounds; for example, "Ssssaaaammm." Each subtest began with three non-scored examples on which subjects were given corrective feedback and 10 scored items on which no feedback was provided beyond encouragement to continue the test. None of the items on the subtests was used during training, although the formats were similar (as cited in O'Connor et al., 1993).
Blending: Onset-rime	This author-developed subtest measured children's ability to blend onset-rime; for example, "S (pause) -am." Each subtest began with three non-scored examples on which subjects were given corrective feedback and 10 scored items on which no feedback was provided beyond encouragement to continue the test. None of the items on the subtests was used during training, although the formats were similar (as cited in O'Connor et al., 1993).
Blending: Separate sounds	This author-developed subtest measured children's ability to blend separated sounds; for example, "S (pause) -a (pause) -m." Each subtest began with three non-scored examples on which subjects were given corrective feedback and 10 scored items on which no feedback was provided beyond encouragement to continue the test. None of the items on the subtests was used during training, although the formats were similar (as cited in O'Connor et al., 1993).
Final consonant clusters: Contractible copula	This measure indicates the difference in the percentage correct at pre- and posttest of contractible copula consonant clusters at the end of words. The outcomes are based on spontaneous language samples of at least 200 utterances, collected during a conversation between the child and researcher, while the child was playing with a toy house or looking at pictures in a book. Samples were transcribed and coded according to the guidelines of the Kansas Language Transcription Database manual and analyzed with the SALT program (as cited in Sweat, 2003).
Final consonant clusters: Regular past tense	This measure indicates the difference in the percentage correct at pre- and posttest of past tense consonant clusters at the end of words. The outcomes are based on spontaneous language samples of at least 200 utterances, collected during a conversation between the child and researcher, while the child was playing with a toy house or looking at pictures in a book. Samples were transcribed and coded according to the guidelines of the Kansas Language Transcription Database manual and analyzed with the Systematic Analysis of Language Transcripts (SALT) program (as cited in Sweat, 2003).
Finite morpheme composite	Spontaneous language samples of at least 200 utterances were obtained from conversations between a research assistant and child. The utterances were transcribed and coded using guidelines from the Kansas Language Transcription Database manual to enable subsequent analysis with the SALT program. A finite morpheme composite was calculated by determining the percentage of correct usage of the following finite morphemes: regular past tense *–ed*, third person singular regular *–s*, contractible and uncontractible copula *be* verbs, and uncontractible and contractible auxiliary *be* verbs (as cited in Tyler et al., 2003; Tyler et al., 2011).
Letter name	Letter name knowledge refers to a child's ability to differentiate between letters and to identify letters. Child performance in letter name knowledge was measured using a 12-item assessment (as cited in Tyler et al., 2011).
Mean length of utterance in morphemes (MLUm)	The data for the MLUm outcome were obtained from spontaneous language samples that were collected during an interactive narrative retelling of the wordless picture book *Carl Goes Shopping* (*Carl* series by Alexandra Day, 1995). The script that was used during the retelling of the book provided opportunities for children to produce morphemes of interest, and these utterances were coded using the SALT program described earlier (as cited in Tyler et al., 2011).
Percent consonants correct	Participant responses from the Goldman-Fristoe Test of Articulation–Second Edition (a speech assessment used to screen children in the study for speech sound disorder) and 25 additional words were transcribed and then analyzed via computer and assessed for the percentage of consonants spoken correctly (as cited in Tyler et al., 2011).
Percentage added sounds to the final consonant inventory	The inventory of sounds was based on spontaneous language samples described earlier and the Bankson-Bernthal Test of Phonology (BBTOP), supplemented with 15 additional words so that all 24 consonants occurred at least three times both in the initial and final positions of words. The number of final consonants the child uttered in the spontaneous language and the BBTOP was divided by the total number of final consonants in the English language. The reported outcome is the difference in the pre- and posttest percentages (as cited in Sweat, 2003).
Phoneme identity	Phoneme identity is determined by having children identify similar sounds across words. This skill was measured using a 10-item assessment that included tasks both with and without printed words (as cited in Tyler et al., 2011).
Rhyming: Oddity	This author-developed subtest measured children's ability to identify words that do not rhyme; for example, "cat, hat, bell." Each subtest began with three non-scored examples on which subjects were given corrective feedback and 10 scored items on which no feedback was provided beyond encouragement to continue the test. None of the items on the subtests was used during training, although the formats were similar (as cited in O'Connor et al., 1993).

Rhyming: Production	This author-developed subtest measured children's ability to recognize rhyme; for example, "*dime/time*: do these words rhyme?" Each subtest began with three non-scored examples on which subjects were given corrective feedback and 10 scored items on which no feedback was provided beyond encouragement to continue the test. None of the items on the subtests was used during training, although the formats were similar (as cited in O'Connor et al., 1993).
Rhyming: Recognition	This author-developed subtest measured children's ability to produce rhyme; for example, "tell me a word that rhymes with *land*." Each subtest began with three non-scored examples on which subjects were given corrective feedback and 10 scored items on which no feedback was provided beyond encouragement to continue the test. None of the items on the subtests was used during training, although the formats were similar (as cited in O'Connor et al., 1993).
/s/-cluster accuracy	Participants were administered a cluster probe consisting of 15 single words selected to provide five opportunities each for production of initial /sp-, st-, sl-/ clusters (as cited in Tyler et al., 2011).
Segmenting: All sounds	This author-developed subtest measured children's ability to segment phoneme words; for example, "say all the bits of *mob*." Each subtest began with three non-scored examples on which subjects were given corrective feedback and 10 scored items on which no feedback was provided beyond encouragement to continue the test. None of the items on the subtests was used during training, although the formats were similar (as cited in O'Connor et al., 1993).
Segmenting: First sound	This author-developed subtest measured children's ability to identify the first sound in a word; for example, "say the first sound in *mob*." Each subtest began with three non-scored examples on which subjects were given corrective feedback and 10 scored items on which no feedback was provided beyond encouragement to continue the test. None of the items on the subtests was used during training, although the formats were similar (as cited in O'Connor et al., 1993).
Segmenting: Onset-rime	This author-developed subtest measured children's ability to separate words into onset-rime; for example, "M -ob." Each subtest began with three non-scored examples on which subjects were given corrective feedback and 10 scored items on which no feedback was provided beyond encouragement to continue the test. None of the items on the subtests was used during training, although the formats were similar (as cited in O'Connor et al., 1993).
Target generalization composite	The BBTOP was used to elicit a sample of single words in which each of the 24 consonants occurred at least three times in the initial and final word positions. Broad transcriptions were made online during administration of the BBTOP and then checked from audiotape replay. Transcriptions were entered into the Interactive System for Phonological Analysis (ISPA). The target generalization composite was a percentage reflecting the accuracy of target and generalization sounds selected for each child from the total number of opportunities for these sounds, in the positions targeted on the BBTOP (as cited in Tyler et al., 2003).

Appendix C: Findings included in the rating for the communication/language competencies domain

Outcome measure	Study sample	Sample size	Mean (standard deviation)		WWC calculations			*p*-value
			Intervention group	Comparison group	Mean difference	Effect size	Improvement index	
O'Connor et al., 1993[a]								
Blending: Continuous phonemes	4- to 6-year-olds	1 school/ 22 children	6.60 (2.80)	2.40 (3.70)	4.20	1.23	+39	< 0.05
Blending: Onset-rime	4- to 6-year-olds	1 school/ 22 children	4.70 (3.40)	0.80 (2.10)	3.90	1.33	+41	< 0.05
Blending: Separate sounds	4- to 6-year-olds	1 school/ 22 children	4.80 (3.20)	0.70 (0.60)	4.10	1.71	+46	< 0.05
Rhyming: Oddity	4- to 6-year-olds	1 school/ 22 children	1.90 (2.50)	1.50 (3.00)	0.40	0.14	+6	nr
Rhyming: Production	4- to 6-year-olds	1 school/ 22 children	2.70 (4.20)	1.80 (4.00)	0.90	0.21	+8	nr
Rhyming: Recognition	4- to 6-year-olds	1 school/ 22 children	5.40 (2.20)	5.20 (2.30)	0.20	0.09	+3	> 0.05
Segmenting: All sounds	4- to 6-year-olds	1 school/ 22 children	0.00 (0.00)	0.00 (0.00)	0.00	0.00	0	nr
Segmenting: First sound	4- to 6-year-olds	1 school/ 22 children	0.00 (0.00)	0.00 (0.00)	0.00	0.00	0	nr
Segmenting: Onset-rime	4- to 6-year-olds	1 school/ 22 children	0.10 (0.00)	0.00 (0.00)	0.10	0.00	0	nr
Domain average for communication/language competencies (O'Connor et al., 1993)						**0.52**	**+20**	**Not statistically significant**
Sweat, 2003[b]								
Final consonant clusters: Contractible copula	3- to 5-year-olds	4 schools/ 20 children	nr	nr	nr	0.93	+32	0.04
Final consonant clusters: Regular past tense	3- to 5-year-olds	4 schools/ 20 children	nr	nr	nr	1.03	+35	0.04
Percentage added sounds to the final consonant inventory	3- to 5-year-olds	4 schools/ 20 children	nr	nr	nr	0.39	+15	> 0.05
Domain average for communication/language competencies (Sweat, 2003)						**0.78**	**+28**	**Not statistically significant**
Tyler et al., 2003[c]								
Finite morpheme composite	3- to 5-year-olds	4 schools/ 20 children	53.20 (28.87)	62.10 (15.39)	–8.90	–0.37	–14	> 0.05
Target generalization composite	3- to 5-year-olds	4 schools/ 20 children	44.20 (30.33)	44.80 (17.21)	–0.60	–0.02	–1	> 0.05
Domain average for communication/language competencies (Tyler et al., 2003)						**–0.20**	**–8**	**Not statistically significant**

Outcome measure	Study sample	Sample size	Mean (standard deviation) Intervention group	Mean (standard deviation) Comparison group	WWC calculations Mean difference	WWC calculations Effect size	WWC calculations Improvement index	*p*-value
Tyler et al., 2011[d]								
Finite morpheme composite	3- to 5-year-olds	1 school/ 16 children	23.75 (34.52)	32.00 (23.00)	–8.25	–0.27	–10	> 0.05
Letter name	3- to 5-year-olds	1 school/ 16 children	79.38 (23.70)	54.13 (38.23)	25.25	0.75	+27	> 0.05
Mean length of utterance in morphemes (MLUm)	3- to 5-year-olds	1 school/ 16 children	3.13 (1.66)	3.69 (0.83)	–0.56	–0.40	–16	> 0.05
Percent consonants correct	3- to 5-year-olds	1 school/ 16 children	57.76 (19.40)	56.24 (10.49)	1.52	0.09	+4	> 0.05
Phoneme identity	3- to 5-year-olds	1 school/ 16 children	72.50 (31.37)	53.75 (24.46)	18.75	0.63	+24	> 0.05
/s/-cluster accuracy	3- to 5-year-olds	1 school/ 16 children	46.38 (38.51)	25.00 (35.40)	21.38	0.55	+21	> 0.05
Domain average for communication/language competencies (Tyler et al., 2011)						**0.23**	**+9**	**Not statistically significant**
Domain average for communication/language competencies across all studies						**0.33**	**+13**	**na**

Table Notes: Positive results for mean difference, effect size, and improvement index favor the intervention group; negative results favor the comparison group. The effect size is a standardized measure of the effect of an intervention on student outcomes, representing the change (measured in standard deviations) in an average student's outcome that can be expected if the student is given the intervention. The improvement index is an alternate presentation of the effect size, reflecting the change in an average student's percentile rank that can be expected if the student is given the intervention. The WWC-computed average effect size is a simple average rounded to two decimal places; the average improvement index is calculated from the average effect size. The statistical significance of the study's domain average was determined by the WWC. This appendix reports findings considered for the effectiveness rating and the average improvement indices for the communication/language competencies domain. na = not applicable. nr = not reported.

[a] Comparisons of the three phonological awareness training conditions to one another from O'Connor et al. (1993) are not included in these ratings but are reported in Appendix D. For O'Connor et al. (1993), a correction for multiple comparisons was needed but did not affect significance levels. The *p*-values presented here were reported in the original study. The WWC calculated the program group mean using a difference-in-differences approach (see the WWC Procedures and Standards Handbook, Appendix B) by adding the impact of the program (i.e., difference in mean gains between the intervention and comparison groups) to the unadjusted comparison group posttest means. The WWC did not find that any of the "nr" contrasts were statistically significant. The article presents slightly different baseline results for the groups in Table 1 (p. 535) and Figures 2–4 (pp. 539–541). We have used the results from Figures 2–4 in these calculations since they also included the posttest results.

[b] For Sweat (2003), a correction for multiple comparisons was needed and results in significance levels that differ from those in the original study. The *p*-values presented here were reported in the original study. Due to the multiple comparisons adjustment, the *p*-values of 0.04 for *Final consonant clusters: Regular past tense* and 0.04 for *Final consonant clusters: Contractible copula* were higher than the critical *p*-values for statistical significance; therefore, the WWC does not find these results to be statistically significant. The author compares the difference in change scores in the percentage correct between pre- and posttest. The WWC effect size is calculated from a *t*-statistic that compares the means of the intervention and comparison groups.

[c] For Tyler et al. (2003), no corrections for clustering or multiple comparisons were needed. The authors appear to have only presented statistically significant findings in the prose of the article, and these contrasts were not mentioned as statistically significant. The WWC confirmed that the groups were not significantly different on either outcome. The WWC calculated the program group mean using a difference-in-differences approach (see the WWC Procedures and Standards Handbook, Appendix B) by adding the impact of the program (i.e., difference in mean gains between the intervention and comparison groups) to the unadjusted comparison group posttest means. The study reported gain scores and gain score standard deviations. In order to properly calculate effect sizes, the WWC obtained raw means and standard deviations from the study authors, which are reported here.

[d] For Tyler et al. (2011), no corrections for clustering or multiple comparisons were needed. The *p*-values presented here were reported in the original study. The statistical tests reported by the author used the full sample for the *Letter name*, *Percent consonants correct, Phoneme identity,* and */s/ cluster accuracy*, and only the US sample for the *Mean length of utterance in morphemes* and *Finite morpheme composite*. The WWC calculated the program group mean using a difference-in-differences approach (see the WWC Procedures and Standards Handbook, Appendix B) by adding the impact of the program (i.e., difference in mean gains between the intervention and comparison groups) to the unadjusted comparison group posttest means. The WWC obtained raw means and standard deviations from the study authors for the 16 children that had an appropriate random assignment process (see endnote 6) and used those data for WWC calculations.

Appendix D: Summary of findings comparing different types of phonological awareness training for the communication/language competencies domain

Outcome measure	Study sample	Sample size	Mean (standard deviation)		WWC calculations			*p*-value
			Intervention group	Comparison group	Mean difference	Effect size	Improvement index	
O'Connor et al., 1993 (Blending versus Rhyming)[a]								
Blending: Continuous phonemes	4- to 6-year-olds	1 school/ 23 children	8.50 (2.80)	4.70 (3.30)	3.80	1.19	+38	< 0.05
Blending: Onset-rime	4- to 6-year-olds	1 school/ 23 children	5.20 (3.40)	2.00 (2.90)	3.20	0.98	+34	< 0.05
Blending: Separate sounds	4- to 6-year-olds	1 school/ 23 children	5.20 (3.20)	2.30 (2.20)	2.90	1.03	+35	< 0.05
Rhyming: Oddity	4- to 6-year-olds	1 school/ 23 children	2.00 (2.50)	4.30 (3.40)	–2.30	–0.74	–27	< 0.05
Rhyming: Production	4- to 6-year-olds	1 school/ 23 children	2.20 (4.20)	6.40 (3.80)	–4.20	–1.01	–34	< 0.05
Rhyming: Recognition	4- to 6-year-olds	1 school/ 23 children	5.90 (2.20)	7.10 (1.90)	–1.20	–0.56	–21	> 0.05
Segmenting: All sounds	4- to 6-year-olds	1 school/ 23 children	0.00 (0.00)	0.20 (0.40)	–0.20	–0.67	–25	nr
Segmenting: First sound	4- to 6-year-olds	1 school/ 23 children	0.00 (0.00)	0.40 (1.40)	–0.40	–0.38	–15	nr
Segmenting: Onset-rime	4- to 6-year-olds	1 school/ 23 children	0.00 (0.00)	0.10 (0.30)	–0.10	–0.44	–17	nr
O'Connor et al., 1993 (Blending versus Segmenting)[a]								
Blending: Continuous phonemes	4- to 6-year-olds	1 school/ 24 children	9.10 (2.80)	6.90 (3.80)	2.20	0.63	+24	> 0.05
Blending: Onset-rime	4- to 6-year-olds	1 school/ 24 children	4.90 (3.40)	0.80 (1.50)	4.10	1.55	+44	< 0.05
Blending: Separate sounds	4- to 6-year-olds	1 school/ 24 children	4.60 (3.20)	1.60 (1.30)	3.00	1.23	+39	< 0.05
Rhyming: Oddity	4- to 6-year-olds	1 school/ 24 children	1.10 (2.50)	1.70 (2.20)	–0.60	–0.25	–10	nr
Rhyming: Production	4- to 6-year-olds	1 school/ 24 children	2.60 (4.20)	2.80 (3.80)	–0.20	–0.05	–2	nr
Rhyming: Recognition	4- to 6-year-olds	1 school/ 24 children	5.70 (2.20)	5.50 (2.20)	0.20	0.09	+3	> 0.05
Segmenting: All sounds	4- to 6-year-olds	1 school/ 24 children	0.00 (0.00)	3.70 (3.60)	–3.70	–1.34	–41	< 0.05
Segmenting: First sound	4- to 6-year-olds	1 school/ 24 children	0.10 (0.00)	2.10 (3.70)	–2.00	–0.71	–26	< 0.05
Segmenting: Onset-rime	4- to 6-year-olds	1 school/ 24 children	0.00 (0.00)	2.40 (2.80)	–2.40	–1.12	–37	< 0.05

Outcome measure	Study sample	Sample size	Mean (standard deviation)		WWC calculations			*p*-value
			Intervention group	Comparison group	Mean difference	Effect size	Improvement index	
O'Connor et al., 1993 (Rhyming versus Segmenting)[a]								
Blending: Continuous phonemes	4- to 6-year-olds	1 school/ 25 children	5.30 (3.30)	6.90 (3.80)	–1.60	–0.43	–17	< 0.05
Blending: Onset-rime	4- to 6-year-olds	1 school/ 25 children	1.70 (2.90)	0.80 (1.50)	0.90	0.38	+15	nr
Blending: Separate sounds	4- to 6-year-olds	1 school/ 25 children	1.70 (2.20)	1.60 (1.30)	0.10	0.05	+2	nr
Rhyming: Oddity	4- to 6-year-olds	1 school/ 25 children	3.40 (3.40)	1.70 (2.20)	1.70	0.58	+22	< 0.05
Rhyming: Production	4- to 6-year-olds	1 school/ 25 children	6.80 (3.80)	2.80 (3.80)	4.00	1.02	+35	< 0.05
Rhyming: Recognition	4- to 6-year-olds	1 school/ 25 children	6.90 (1.90)	5.50 (2.20)	1.40	0.66	+24	> 0.05
Segmenting: All sounds	4- to 6-year-olds	1 school/ 25 children	0.20 (0.40)	3.70 (3.60)	–3.50	–1.29	–40	< 0.05
Segmenting: First sound	4- to 6-year-olds	1 school/ 25 children	0.50 (1.40)	2.10 (3.70)	–1.60	–0.54	–21	< 0.05
Segmenting: Onset-rime	4- to 6-year-olds	1 school/ 25 children	0.10 (0.30)	2.40 (2.80)	–2.30	–1.09	–36	< 0.05
Tyler et al., 2003 (Phonology first versus Alternating)[b]								
Finite morpheme composite	3- to 5-year-olds	4 schools/ 21 children	50.10 (28.87)	67.36 (16.58)	–17.26	–0.71	–26	> 0.05
Target generalization composite	3- to 5-year-olds	4 schools/ 21 children	48.30 (30.33)	50.82 (28.53)	–2.52	–0.08	–3	> 0.05
Tyler et al., 2003 (Phonology first versus Simultaneous)[b]								
Finite morpheme composite	3- to 5-year-olds	4 schools/ 19 children	37.50 (28.87)	39.78 (29.99)	–2.28	–0.07	–3	> 0.05
Target generalization composite	3- to 5-year-olds	4 schools/ 19 children	41.50 (30.33)	49.22 (34.43)	–7.72	–0.23	–9	> 0.05
Tyler et al., 2003 (Morphological first versus Alternating)[b]								
Finite morpheme composite	3- to 5-year-olds	4 schools/ 21 children	59.00 (15.39)	67.36 (16.58)	–8.36	–0.50	–19	> 0.05
Target generalization composite	3- to 5-year-olds	4 schools/ 21 children	48.90 (17.21)	50.82 (28.53)	–1.92	–0.08	–3	> 0.05
Tyler et al., 2003 (Morphological first versus Simultaneous)[b]								
Finite morpheme composite	3- to 5-year-olds	4 schools/ 19 children	46.40 (15.39)	39.78 (29.99)	6.62	0.27	+11	> 0.05
Target generalization composite	3- to 5-year-olds	4 schools/ 19 children	42.10 (17.21)	49.22 (34.43)	–7.12	–0.25	–10	> 0.05

Outcome measure	Study sample	Sample size	Mean (standard deviation)		WWC calculations			*p*-value
			Intervention group	Comparison group	Mean difference	Effect size	Improvement index	
Tyler et al., 2003 (Alternating versus Simultaneous)[b]								
Finite morpheme composite	3- to 5-year-olds	4 schools/ 20 children	54.76 (16.58)	39.78 (29.99)	14.98	0.61	+23	> 0.05
Target generalization composite	3- to 5-year-olds	4 schools/ 20 children	44.02 (28.53)	49.22 (34.43)	–5.20	–0.16	–6	> 0.05

Table Notes: The supplemental findings presented in this table are additional findings from the studies in this report that do not factor into the determination of the intervention rating. Positive results for mean difference, effect size, and improvement index favor the intervention group; negative results favor the comparison group. The effect size is a standardized measure of the effect of an intervention on student outcomes, representing the change (measured in standard deviations) in an average student's outcome that can be expected if the student is given the intervention. The improvement index is an alternate presentation of the effect size, reflecting the change in an average student's percentile rank that can be expected if the student is given the intervention. nr = not reported.

[a] For O'Connor et al. (1993), a correction for multiple comparisons was needed and results in significance levels that differ from those in the original study. The *p*-values presented here were reported in the original study. In the comparison of the Blending group against the Rhyming group, none of the contrasts that were reported as statistically significant by the authors was found to be statistically significant by the WWC due to a multiple comparison adjustment. In the comparison of the Blending group against the Segmenting group, the contrast of *Segmenting: First sound* was not found to be statistically significant by the WWC due to a multiple comparison adjustment. In the comparison of the Rhyming group against the Segmenting group, the following contrasts were not found to be significant by the WWC due to a multiple comparison adjustment: *Segmenting: All sounds*, *Segmenting: Onset-rime*, *Segmenting: First sound*, *Rhyming: Production*, *Rhyming: Oddity.* The WWC calculated the program group mean using a difference-in-differences approach (see the WWC Procedures and Standards Handbook, Appendix B) by adding the impact of the program (i.e., difference in mean gains between the intervention and comparison groups) to the unadjusted comparison group posttest means. The WWC did not find that any of the "nr" contrasts were statistically significant. The article presents slightly different baseline results for the groups in Table 1 (p. 535) and Figures 2–4 (pp. 539–541). We have used the results from Figures 2–4 in these calculations since they also included the posttest results.

[b] For Tyler et al. (2003), no corrections for clustering or multiple comparisons were needed. The authors appear to have only presented statistically significant findings in the prose of the article, and these contrasts were not mentioned as statistically significant. The WWC confirmed that the groups were not significantly different on either outcome. The WWC calculated the program group mean using a difference-in-differences approach (see the WWC Procedures and Standards Handbook, Appendix B) by adding the impact of the program (i.e., difference in mean gains between the intervention and comparison groups) to the unadjusted comparison group posttest means. The study reported gain scores and gain score standard deviations. In order to properly calculate effect sizes, the WWC obtained raw means and standard deviations from the study authors, which are reported here.

Appendix E: Single-case design studies reviewed for this intervention

Study citation	Study disposition
Gierut, J. A. (1990). Differential learning of phonological oppositions. *Journal of Speech and Hearing Research, 33*(3), 540–549.	Meets WWC pilot Single-Case Design standards
Gierut, J. A., Morrisette, M. L., & Champion, A. H. (1999). Lexical constraints in phonological acquisition. *Journal of Child Language, 26*(2), 261–294.	The study does not meet WWC pilot Single-Case Design standards because inter-assessor agreement was not measured at least once in each phase and on at least 20% of the data points in each condition.
Tyler, A. A., & Sandoval, K. T. (1994). Preschoolers with phonological and language disorders: Treating different linguistic domains. *Language, Speech, and Hearing Services in Schools, 25*(4), 215–234.	The study does not meet WWC pilot Single-Case Design standards because it does not have at least three attempts to demonstrate an intervention effect at three different points in time.
Ziolkowski, R. A. (2004). *Effects of an emergent literacy intervention for children with language impairments from low income environments* (Unpublished doctoral dissertation). Florida State University, Tallahassee.	The study does not meet WWC pilot Single-Case Design standards because inter-assessor agreement was not measured at least once in each phase and on at least 20% of the data points in each condition.

Table Notes: The supplemental studies presented in this table do not factor in the determination of the intervention rating.

Endnotes

[1] *Phonological awareness training* does not have a single developer or official description. The descriptive information for this program was adapted from publicly available sources: descriptions of this practice (see the websites listed under Program Information) and research articles (O'Connor et al., 1993; Sweat, 2003; Tyler et al., 2003; Tyler et al., 2011). Further verification of the accuracy of the descriptive information for this program is beyond the scope of this review. The literature search for this report includes group design and single-case design studies publicly available by September 2011.

[2] The studies in this report were reviewed using WWC Evidence Standards, version 2.1, as described in the Early Childhood Education Interventions for Children with Disabilities review protocol, version 2.0. The evidence presented in this report is based on available research. Findings and conclusions may change as new research becomes available. Four WWC intervention reports in the Early Childhood Education topic area review *phonological awareness training* alone or in combination with other practices, as well as two curricula that focus on phonological awareness: *Daisy Quest* and *Sound Foundations*.

[3] For criteria used in the determination of the rating of effectiveness and extent of evidence, see the WWC Rating Criteria on p. 41. These improvement index numbers show the average and range of student-level improvement indices for all findings across the studies.

[4] Readers who are unfamiliar with the terminology related to *phonological awareness training* and the development of reading may find it helpful to consult the glossary of terms available from the National Literacy Information and Communication System (http://lincs.ed.gov/research/researchdef.html) and the definitions of outcome measures in Appendix B.

[5] The other intervention groups had high differential attrition when compared to the comparison group and were not equivalent to the comparison group at baseline. This report includes the comparison of the three *phonological awareness training* conditions to one another in Appendix D.

[6] There were a total of 30 children randomly assigned to intervention or comparison groups; 18 were from the United States and 12 were from New Zealand (and were therefore not included in this review). Random assignment in the study was conducted using a matched pairs design, which occurred on a rolling basis. In one case in the United States sample, the random assignment process spanned two cohorts, because there were an odd number of children in the first cohort of the study. In this instance, one child in the first cohort was randomly assigned to a group, and when a match was identified in the next cohort, that matched child was assigned to the opposite condition. The WWC determined that this process did not constitute random assignment in accordance with the matched pair design, and as such, only the data from the remaining 16 children in the eight uncompromised pairs were included in this review. Specifically, the issue flagged by the WWC was that the child in the second cohort was selected into a pair and thus was assigned to a condition based on their demographic similarity to the child in the first cohort, and not based on a random process.

[7] One outcome from Sweat (2003)—final consonant clusters, third person singular—was excluded because of high attrition and lack of established baseline equivalence.

[8] Information provided by the study author at the WWC's request.

[9] The other intervention groups were excluded because of high differential attrition when compared to the comparison group and lack of baseline equivalence. This report includes the comparison of the three *phonological awareness training* conditions to one another in Appendix D.

[10] The observed scores on the Bankson-Bernthal Test of Phonology at baseline demonstrated that the sample was eligible for the Early Childhood Education Interventions for Children with Disabilities review.

[11] The information that the two groups of children included in this intervention report came from four of the five sites was obtained through an author query.

[12] Comparisons of all four intervention groups against the comparison group did not meet evidence standards because of a lack of baseline equivalence. Although the comparisons of the four intervention groups against one another meet WWC standards, it was determined that the most meaningful and interpretable contrast for the purposes of this report was to compare phonological instruction against morphosyntax instruction. This contrast could be accomplished by comparing Group A and Group B at 12 weeks and is the only contrast included as providing evidence of the effect of *phonological awareness training* in Appendix C. The other five contrasts that met WWC evidence standards are included in Appendix D for transparency.

[13] The observed scores on the Goldman-Fristoe Test of Articulation and Structured Photographic Expressive Language Test at baseline demonstrated that the sample was eligible for the Early Childhood Education Interventions for Children with Disabilities review.

[14] All of the eligible outcomes measured in the four studies that meet WWC evidence standards have been included, even though some outcomes might appear to be overaligned to the interventions being delivered. With interventions that are practices targeted at young populations (as is the case in this report), researchers will commonly measure outcomes that are directly being taught during

the intervention (e.g., when teaching young children to count to 10, assessing their ability to count to 10 can be considered a reasonable outcome). In this report, a consistent approach of including all eligible outcomes was applied, given the type of intervention being examined and the age of the population of interest.

Recommended Citation

U.S. Department of Education, Institute of Education Sciences, What Works Clearinghouse. (2012, June). *Early Childhood Education Interventions for Children with Disabilities intervention report: Phonological awareness training.* Retrieved from http://whatworks.ed.gov.

WWC Rating Criteria

Criteria used to determine the rating of a study

Study rating	Criteria
Meets WWC evidence standards without reservations	A study that provides strong evidence for an intervention's effectiveness, such as a well-implemented RCT.
Meets WWC evidence standards with reservations	A study that provides weaker evidence for an intervention's effectiveness, such as a QED or an RCT with high attrition that has established equivalence of the analytic samples.

Criteria used to determine the rating of effectiveness for an intervention

Rating of effectiveness	Criteria
Positive effects	Two or more studies show statistically significant positive effects, at least one of which met WWC evidence standards for a strong design, AND No studies show statistically significant or substantively important negative effects.
Potentially positive effects	At least one study shows a statistically significant or substantively important positive effect, AND No studies show a statistically significant or substantively important negative effect AND fewer or the same number of studies show indeterminate effects than show statistically significant or substantively important positive effects.
Mixed effects	At least one study shows a statistically significant or substantively important positive effect AND at least one study shows a statistically significant or substantively important negative effect, but no more such studies than the number showing a statistically significant or substantively important positive effect, OR At least one study shows a statistically significant or substantively important effect AND more studies show an indeterminate effect than show a statistically significant or substantively important effect.
Potentially negative effects	One study shows a statistically significant or substantively important negative effect and no studies show a statistically significant or substantively important positive effect, OR Two or more studies show statistically significant or substantively important negative effects, at least one study shows a statistically significant or substantively important positive effect, and more studies show statistically significant or substantively important negative effects than show statistically significant or substantively important positive effects.
Negative effects	Two or more studies show statistically significant negative effects, at least one of which met WWC evidence standards for a strong design, AND No studies show statistically significant or substantively important positive effects.
No discernible effects	None of the studies shows a statistically significant or substantively important effect, either positive or negative.

Criteria used to determine the extent of evidence for an intervention

Extent of evidence	Criteria
Medium to large	The domain includes more than one study, AND The domain includes more than one school, AND The domain findings are based on a total sample size of at least 350 students, OR, assuming 25 students in a class, a total of at least 14 classrooms across studies.
Small	The domain includes only one study, OR The domain includes only one school, OR The domain findings are based on a total sample size of fewer than 350 students, AND, assuming 25 students in a class, a total of fewer than 14 classrooms across studies.

Glossary of Terms

Attrition Attrition occurs when an outcome variable is not available for all participants initially assigned to the intervention and comparison groups. The WWC considers the total attrition rate and the difference in attrition rates across groups within a study.

Clustering adjustment If intervention assignment is made at a cluster level and the analysis is conducted at the student level, the WWC will adjust the statistical significance to account for this mismatch, if necessary.

Confounding factor A confounding factor is a component of a study that is completely aligned with one of the study conditions, making it impossible to separate how much of the observed effect was due to the intervention and how much was due to the factor.

Design The design of a study is the method by which intervention and comparison groups were assigned.

Domain A domain is a group of closely related outcomes.

Effect size The effect size is a measure of the magnitude of an effect. The WWC uses a standardized measure to facilitate comparisons across studies and outcomes.

Eligibility A study is eligible for review and inclusion in this report if it falls within the scope of the review protocol and uses either an experimental or matched comparison group design.

Equivalence A demonstration that the analysis sample groups are similar on observed characteristics defined in the review area protocol.

Extent of evidence An indication of how much evidence supports the findings. The criteria for the extent of evidence levels are given in the WWC Rating Criteria on p. 41.

Improvement index Along a percentile distribution of students, the improvement index represents the gain or loss of the average student due to the intervention. As the average student starts at the 50th percentile, the measure ranges from –50 to +50.

Multiple comparison adjustment When a study includes multiple outcomes or comparison groups, the WWC will adjust the statistical significance to account for the multiple comparisons, if necessary.

Quasi-experimental design (QED) A quasi-experimental design (QED) is a research design in which subjects are assigned to intervention and comparison groups through a process that is not random.

Randomized controlled trial (RCT) A randomized controlled trial (RCT) is an experiment in which investigators randomly assign eligible participants into intervention and comparison groups.

Rating of effectiveness The WWC rates the effects of an intervention in each domain based on the quality of the research design and the magnitude, statistical significance, and consistency in findings. The criteria for the ratings of effectiveness are given in the WWC Rating Criteria on p. 41.

Single-case design A research approach in which an outcome variable is measured repeatedly within and across different conditions that are defined by the presence or absence of an intervention.

Standard deviation The standard deviation of a measure shows how much variation exists across observations in the sample. A low standard deviation indicates that the observations in the sample tend to be very close to the mean; a high standard deviation indicates that the observations in the sample tend to be spread out over a large range of values.

Statistical significance Statistical significance is the probability that the difference between groups is a result of chance rather than a real difference between the groups. The WWC labels a finding statistically significant if the likelihood that the difference is due to chance is less than 5% ($p < 0.05$).

Substantively important A substantively important finding is one that has an effect size of 0.25 or greater, regardless of statistical significance.

Please see the WWC Procedures and Standards Handbook (version 2.1) for additional details.