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REMEDICATION OF PHONOLOGICAL DISORDERS
IN PRESCHOOL AGE CHILDREN:
EVIDENCE FOR THE CYCLES APPROACH

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Structured Abstract for Remediation of Phonological Disorders in Preschool Age Children: Evidence for the Cycles Approach

Clinical Questions:

- (1) Does the Cycles Approach effectively reduce the frequency of occurrence of phonological processes?
- (2) Does the Cycles Approach efficiently remediate phonological disorders?

Method: EBP Intervention Review

Study Sources: Cumulative Index to Nursing and Allied Health Literature [CINAHL], Education Resources Information Center [ERIC], Linguistics and Language Behavior Abstracts [LLBA], MEDLINE, PsycINFO, Google Scholar, and journals published by the American Speech-Language-Hearing Association [ASHA].

Search Terms:

Participant Terms: phonology

Intervention Terms: cycles, Cycles Approach

Number of Included Studies: 6

Number of Participants: Total n for all 6 studies = 90

Primary Results:

- (1) Treated children demonstrated improved consonant production in conversational contexts.
- (2) Treated children with less severe phonological and language impairments improved in both domains.
- (3) Earlier intervention resulted in greater outcome improvement.

Conclusions: Evidence found in this systematic review for the effectiveness and efficiency of the Cycles Approach is limited. The best evidence available suggests that this approach is effective with children who exhibit severe phonological disorders both in isolation and in combination with other language disorders. Clinicians must be aware of individual study limitations and refer to their own clinical expertise as well as client preferences when considering the implementation of the Cycles Approach.

Remediation of Phonological Disorders in Preschool Age Children: Evidence for the Cycles Approach

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Scenario

Cindy recently enrolled her 3-year-old son, Peter, in a preschool language program through the communication sciences and disorders department at the local university. Peter was diagnosed with an expressive language impairment characterized primarily by a phonological disorder. He exhibits a number of phonological processes, including final consonant deletion, fronting, stopping, syllable deletion, and consonant cluster simplification. Peter's intelligibility is greatly reduced because of his speech sound errors. Cindy is concerned because Peter's impairment limits his ability to communicate his needs, wants, and ideas to his family and friends. Frequent misunderstandings often cause Peter to feel frustrated and isolated. Two weeks before the beginning of the school semester, Cindy met with Jean, the school speech-language pathologist, to express her concerns. Jean noted that the severity of Peter's phonological disorder may make him a good candidate for a comprehensive speech-sound remediation program, such as the Cycles Approach. She told Cindy that she would investigate the literature on the Cycles Approach before the semester begins to determine if this intervention method is appropriate for Peter. Jean's goal is to answer two questions through her literature search: (1) Does the Cycles Approach effectively reduce the frequency of occurrence of phonological processes? (2) Does the Cycles Approach efficiently remediate phonological disorders?

Introduction

Phonological and articulation disorders are the most common type of speech/language impairment and account for 32% of all communication disorder diagnoses (Slater, 1992). These difficulties are common particularly among preschoolers. Approximately 10% of these children exhibit speech sound errors (National Institute on Deafness and Other Communication Disorders, 1994). Phonological

disorders may exist independently or concurrently with other types of language or cognitive impairments.

Typically developing children between ages 1.5 and 4 years old demonstrate phonological processes. These processes are characterized by systematic relations between child and adult forms of a target phoneme and involve whole classes of sounds (e.g., stops, fricatives, liquids) or syllable types (e.g., CVC, CVCV). Phonological processes may include deletion of a sound (e.g., final consonant deletion), substitution of one sound for another (e.g., fronting), or assimilation of one sound with another (e.g., consonant harmony). For example, the phonological process of stopping involves the substitution of the members of stop sound class (e.g., /p/, /b/, /t/, /d/) for members of the fricative sound class (e.g., /f/, /v/, /s/, /z/). Phonological processes are considered to be atypical when they detrimentally affect intelligibility (e.g., less than 25% by 3 years of age), when they exist for a protracted period of time (e.g., past 4 years of age), or when they are idiosyncratic in nature (e.g., initial consonant deletion, backing, frication). The observed speech difficulties are not attributed to impaired speech motor function, but to reduced abilities to produce sound classes and syllable structure. Phonological processes that do not resolve independently are frequently targeted in language intervention. The Cycles Approach (Hodson & Paden, 1983, 1991) is an intervention method used with severe phonological disorders.

Cycles Approach

The Cycles Approach (Hodson & Paden, 1983, 1991) addresses a child's use of phonological processes by cyclically targeting affected sound classes. A different process is targeted every one to two weeks and two to four processes are targeted within a cycle. Processes that remain problematic are addressed in later cycles by recycling patterns and targets until the client becomes intelligible. Each individual session includes both a perception and a production component and a home program is sometimes implemented.

One of the most notable features of this approach involves introducing new targets before old targets have been mastered. This strategy is purported to increase efficiency without decreasing effectiveness, because the transition from emergent sound use to mastery has often been found to occur without direct intervention. In addition, the Cycles Approach is based upon the assumption that elimination of a few specific sound errors will cause a change in the underlying phonological system and, therefore, be generalized to all phonemes affected by that process (Tyler, Edwards, & Saxman, 1987).

Many clinicians whose clients exhibit severe phonological disorders and limited intelligibility use the Cycles Approach. Though the method and purported benefits of this intervention make theoretical sense, empirical data are needed to confirm these claims before such an approach is implemented in clinical practice.

Method

Inclusion Criteria

To be included in this Brief, each study had to fulfill the following requirements: (1) an experimental, quasi-experimental, or descriptive/non-experimental group design must be used (i.e., no case studies), (2) the target population must include preschool age children (2.5 to 6.0 years) diagnosed with phonological disorder, and (3) the Cycles or modified Cycles Approach must be used as the intervention. Though descriptive group studies are considered a low level of evidence due to their inability to demonstrate a causal relationship, they constitute the majority of currently available research on the Cycles Approach. It was necessary to include such studies in this Brief to provide an adequate overview on the current research base.

Search Strategy

Six databases were searched—the Cumulative Index to Nursing and Allied Health Literature [CINAHL]; Education Resources Information Center [ERIC]; Linguistics and Language Behavior Abstracts [LLBA]; MEDLINE; and PsycINFO, as well as three journals affiliated with the American Speech-Language-Hearing Association (ASHA) (*American Journal of Speech-Language Pathology*; *Journal of Speech, Language, and Hearing Research*; *Language, Speech, and Hearing Services in the Schools*). Google Scholar was used as a supplementary

search strategy. The following keywords were used individually and in combination in the search: *Cycles Approach*, *cycles*, and *phonology*. All studies published prior to December 2009 were included. Reference lists from the articles found through this search were also reviewed to locate related studies. Of the 62 potential studies found, six met the inclusion criteria and are summarized in Table 1. This search also identified one relevant narrative review, one relevant systematic review, four descriptive case studies, and one retrospective report. For professionals who may not have access to databases such as LLBA or PsycINFO, it is important to note that four of the six qualified articles were located in ASHA journals and the remaining two were identified via Google Scholar. Google Scholar is open to the public and the ASHA journals are available online for all ASHA members.

Data Extraction

Each of the six included articles was reviewed and study characteristics (author, year, intervention method, participant number, participant ages, research design, study results, interrater reliability, and treatment integrity) were identified.

Data Analysis and Interpretation

Of the six included studies, two provided data for group contrasts, three provided data for one-group pre-post contrasts, and one provided single-subject data. Effect sizes could not be calculated from the single-subject study data; however, effect sizes were calculated for the group studies. For those studies involving group contrasts, Cohen's *d* was calculated by dividing the mean difference between the groups by the pooled standard deviation. For those studies providing pre-post contrasts, the *standardized mean gain score* was calculated by dividing the nonstandardized mean gain score (difference between pre- and post-assessment values) by the pooled standard deviation. Because all of the studies involved small samples (i.e., less than 30 participants), Hedges' *g* was calculated in each case to correct for small sample bias (Littell, Corcoran, & Pillai, 2008). Effect size measures for *d* and *g* range from -3.00 to $+3.00$. Interpretation of effect sizes was based on Cohen's (1977, 1988) standards: an ES below .20 is considered a small effect, an ES of .20 to .50 is a medium effect, an ES of .50 to .80 is important and anything above .80 is considered a large effect (Lipsey & Wilson, 2001).

Guidelines for Study Evaluation

The Certainty of Evidence Framework (Simeonsson & Bailey, 1991) was used to appraise the studies based on *research design*, *interrater reliability*, and *treatment integrity*. Interrater reliability is a measure of agreement between two independent judges who are observing and recording target behaviors. Typically, IR values above 80% are considered adequate. Treatment integrity is a measure of how closely the interventionist(s) adhered to the treatment guidelines and procedures. An independent judge observes and notes this consistency. TI values above 80% are considered adequate.

Studies were ranked as *conclusive*, *preponderant*, *suggestive*, or *inconclusive*. If a study is ranked as *conclusive*, this indicates that the outcomes were undoubtedly caused by the intervention. Such studies must have sound designs and at least adequate interrater reliability and treatment integrity. A ranking of *preponderant* indicates that the outcomes were likely to be the result of the intervention. These studies have minor design flaws and at least adequate interrater reliability and treatment integrity. Studies ranked as *suggestive* had either flawed designs or strong designs with inadequate interrater reliability and treatment integrity. As a result, the outcomes were only plausibly a result of the intervention. *Inconclusive* studies referred to those in which the outcomes could not be attributed to the intervention because the design was fatally flawed.

After the ranking process was completed, the studies were ordered in a table from most to least convincing evidence (see Table 1). Within each category, studies were sequenced alphabetically by author. Although *inconclusive* studies are not typically incorporated in such summaries, the lack of available high quality evidence necessitated their inclusion in this Brief. However, clinicians need to view the results derived from these studies with caution because threats to internal and external validity are not controlled. Typically, such research is less appropriate for informing clinical practice, yet provides an insight into current applications of the Cycles Approach.

Results

Six relevant group studies were analyzed to determine the effectiveness and efficiency of the Cycles Approach as an intervention for phonological remediation.

Participant Characteristics

A total of 90 children with phonological disorders were participants in the included studies. Participant ages ranged from 2:9 to 5:7. All participants exhibited moderate to profound phonological disorders. Participants from two of the studies exhibited receptive and/or expressive language impairments in addition to their phonological disorders.

Research Design

Three of the included studies were descriptive in nature. These studies were non-experimental because control groups were not used (Montgomery & Bonderman, 1989; Rvachew, Rafaat, & Martin, 1999; Tyler, Edwards, & Saxman, 1987). The remaining three studies were experimental group designs. One experimental study was a randomized control trial (Almost & Rosenbaum, 1998) and the other two were pre- and post-test control group designs (Tyler & Watterson, 1991; Gillon, 2005).

Treatment Integrity

Treatment Integrity (TI) refers to the consistency of intervention implementation, that is, how reliably the treatment is applied. TI measures should be taken across 20–40% of all treatment sessions. In the studies reviewed for this Brief, TI reflected how consistently the experimenters executed the steps of the Cycles Approach. High TI is an indication of high internal validity and must be considered when determining the reliability of evidence provided by a study. Only one study reported TI (Gillon, 2005), however, this measure was only obtained across 12% of sessions and a reliability coefficient was not reported. As a result, no studies could be ranked as *conclusive* or *preponderant*. Lack of TI is a serious flaw to internal validity and respective studies cannot rank higher than *suggestive*.

Interrater Reliability

Interrater Reliability (IR) refers to the consistency with which two observers record the target behavior, or dependent variable. IR should be measured across 20–33% of experimental sessions. In the studies reviewed for this Brief, IR reflected how well observers agreed in measurements of phonological accuracy and expressive language ability. High IR increases the validity of study results. Three of the six studies reported IR. For two of these studies, IR was excellent, that is, higher than .70 (kappa range) or 98% (Almost & Rosenbaum, 1998; Rvachew, Rafaat, & Martin, 1999). IR for the remaining study was adequate, that is, greater than 75% (Tyler & Watterson, 1991).

Study Appraisal

The quality of the studies varied widely. The authors ranked two studies as *suggestive*, indicating that the Cycles Approach might be an effective form of intervention for phonological remediation (Almost & Rosenbaum, 1998; Tyler & Watterson, 1991). The authors ranked the remaining four studies as *inconclusive* due to weak designs, lack of IR, and/or lack of TI (Gillon, 2005; Montgomery & Bonderman, 1989; Rvachew, Rafaat, & Martin, 1999; Tyler, Edwards, & Saxman, 1987). As a result, the conclusions drawn from such studies must be considered with caution.

Treatment Effectiveness

Suggestive studies used two measures of speech/language performance to determine participant improvements. These measures included percentage of consonants correct (PCC) and mean length of utterance (MLU). Effect sizes for these measures are included in Table 1. PCC is a measure of correct consonant production in conversational speech, whereas, MLU is a morpheme-based measure of conversational utterance length. Both *suggestive* studies found that PCC and MLU improved following Cycles intervention, however, statistically significant changes for PCC were found in only one study (Almost & Rosenbaum, 1998). Large effect sizes for PCC in these two studies indicate that the Cycles Approach is highly effective for treating phonological disorders in preschool-age children.

Inconclusive studies used measures of phonological process percentage of occurrence and sound probe scores to determine participant improvements. These studies

found decreased frequency of phonological process occurrence and/or improved sound probe scores following Cycles intervention. One of these studies also showed that a larger number of processes and sounds could be targeted in a shorter amount of time when the Cycles Approach was used instead of a Minimal Pairs Approach (Tyler, Edwards, & Saxman, 1987). Effect sizes for these studies, where they could be calculated, were also large. However, such findings must be interpreted with caution because the effect sizes may have been inflated due to small sample bias, lack of randomization, and lack of experimental control. In addition, because these calculations were based on pre- and post-test scores, the outcomes may have been the result of extraneous variables such as maturation or history effects.

Discussion

The purpose of this Brief was to analyze and appraise the available literature on the Cycles Approach to answer the two questions posed by Peter's speech-language pathologist.

Concerning the first question, "Does the Cycles Approach effectively reduce phonological processes?"—*suggestive* studies indicated that it is plausible that the Cycles Approach results in improved consonant production in conversational contexts (Tyler & Watterson, 1991; Almost & Rosenbaum, 1998), that children with less severe phonological and language impairments improve in both domains when the Cycles Approach is used (Tyler & Watterson, 1991), and that earlier implementation of the Cycles Approach results in improved outcomes (Almost & Rosenbaum, 1998). *Inconclusive* studies suggest that the Cycles Approach reduces phonological processes and improves production of non-target phonemes through generalization (Tyler, Edwards, & Saxman, 1987), that this intervention technique may be effectively administered in a group treatment setting such as a preschool program (Montgomery & Bonderman, 1989) as long as the children are stimutable for target sounds (Rvachew, Rafaat, & Martin, 1999), and that a combined Cycles Approach-phonological awareness program may also result in improved speech production (Gillon, 2005). The findings of these inconclusive studies, however, are not appropriate for clinical decision making due to their low methodological quality and lack of experimental control. It cannot be said with any level of certainty that the observed effects were the result of Cycles Approach intervention.

The second question addressed in this Brief was, “Does the Cycles Approach efficiently remediate phonological disorders?” Only one study addressed the topic of efficiency (Tyler, Edwards, & Saxman, 1987), showing that the Cycles Approach is able to remediate a greater number of speech sound errors in a shorter period of time by targeting sound patterns instead of individual phonemes. However, this study was ranked as *inconclusive*; therefore, the efficiency of the Cycles Approach remains an unanswered question. Further studies are needed to substantiate the claim that the Cycles Approach is, in fact, more efficient than other phonological remediation programs.

Unfortunately, the available literature on the Cycles Approach has not reached the critical mass or methodological rigor necessary for a sound evidence-based approach to clinical decision-making. Most of the studies reviewed had weak research designs or were merely descriptive in nature. In addition, the lack or inadequate level of IR and TI in several articles reduced the validity of these inconclusive studies and of their results. Of the two studies that were *suggestive*, the participants of one study exhibited both language and phonological impairments (Tyler & Watterson, 1991), whereas Peter’s impairment is limited to the phonological domain. As a result, the applicability of this particular study is reduced. Clinicians must be aware of individual study limitations when interpreting results and refer to their own clinical expertise and client preferences as they consider implementing an approach based on the Cycles Approach.

Try and Test

During the first day of the preschool semester, Jean met again with Cindy to explain the findings of her literature search and make suggestions regarding intervention approaches for Peter. Jean reported that though the articles she found were very supportive of the Cycles Approach, the low quality of most of the studies made their results less reliable. However, Jean could rely on her own clinical experience and the interest of Peter’s mother to guide her decision-making. Jean told Cindy that her colleagues had had much success with the Cycles Approach, so, she would be willing to implement this approach for two cycles and carefully monitor Peter’s progress. If, after this two-cycle treatment period, Peter did not show noticeable improvements, Jean would meet Cindy for another consultation to consider further options for the remediation of Peter’s phonological difficulties.

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Table 1. Cycle Approach Studies in Order of Most to Least Convincing Evidence

Study	Participants	Design	Results	Hedges' <i>g</i>	Appraisal
Almost & Rosenbaum (1998): Modified cycles	30 children (2:9–5:1); severe phonological disorders, receptive	randomized control trial; immediate vs. delayed treatment	greater gains in PCC and MLU were found for the immediate treatment	PCC: 1.42 MLU: data not available	“suggestive”: strong design, good IR (kappa range: .71–.94); lack of TI
Tyler & Watterson (1991): Cycles approach	12 children (3:7–5:7); phonological disorder, language impairment	modified pre- and post-test control group design: cycles approach vs. script approach	improvements in PCC were found for the cycles group, but not the script group	PCC: 1.51 MLU: .89	“suggestive”: strong design; adequate IR (75–97%); lack of TI
Gillon (2005): Cycles approach + phonological awareness & letter-name/sound knowledge training	12 children (3:0–3:11); moderate-severe speech delay, normal language 19 children (mean age 3:6); normal speech/language	longitudinal pre- and post-control group design	improvements in phoneme production and phonological awareness were found for subjects with speech impairment	PCC: 2.08	“inconclusive”: weak design for determining speech sound outcomes; lack of IR; insufficient TI (12% of sessions), no coefficient
Rvachew, Rafaat, & Martin (1999): Modified cycles approach	10 children (mean age 4:6) 13 children (mean age 4:7); moderate-severe phonological disorder, normal language	descriptive: Study 1: group treatment; Study 2: individual + group treatment	improved production of non-stimulable sounds occurred after individual and group therapy, but not after group therapy alone	Study 1: Group therapy only: .66 Study 2: Group + Individual therapy: 1.55	“inconclusive”: no experimental design; limited generalizability; good IR (98%); lack of TI
Tyler, Edwards, & Saxman (1987): Cycles approach	4 children (Subject A, 5:1, Subject B, 3:8, Subject C, 4:1, Subject D, 3:1); moderate-severe phonological disorder, normal language	descriptive: cycles approach vs. minimal pairs approach	cycles group showed improvement across more phonological processes and phonemes than minimal pairs group	only individual data provided, unable to calculate effect size	“inconclusive”: no experimental design, limited generalizability; lack of IR/TI
Montgomery & Bonderman (1989): Cycles approach	9 children (3:1–4:10); severe-profound phonological disorder, normal language	descriptive: cycles approach only	improvements in phoneme production and lower severity ratings were found for all subjects after group therapy	2.50	“inconclusive”: no experimental design, limited generalizability; lack of IR/TI