PEARSON NEW INTERNATIONAL EDITION

Articulatory and Phonological Impairment
A Clinical Focus

Jacqueline Bauman-Waengler

Fourth Edition

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CLINICAL APPLICATION

Diadochokinetic Rates

The following data on diadochokinetic rates are summarized from Fletcher (1972, 1978), Kent, Kent, and Rosenbek (1987), and St. Louis and Ruscello (2000):

Age	Repetition Rates/Second	Stimulus
6	4.2 per second	[pʌ]
	4.1 per second	[tʌ]
	3.6 per second	[kʌ]
	1 per second	[pʌ]-[tʌ]-[kʌ]
7	4.7 per second	[pʌ]
	4.1 per second	[tʌ]
	3.8 per second	[kʌ]
	1 per second	[pʌ]-[tʌ]-[kʌ]
8+	5–6 per second	[pʌ]
	5–6 per second	[tʌ]
	5–6 per second	[kʌ]
	2 per second	[pʌ]-[tʌ]-[kʌ]

Although these rates have been found for children as young as 5 years old, the task is not suggested for younger children. In addition, Kent and associates (1987) state that there is a lot of variability in the performance of children, and that across the life span normative data are limited. Therefore, the use of such tasks and their interpretation should be carried out with caution. In addition, Weismer (1997) questions the role of using these types of procedures in the evaluation of speech disorders. He concludes that these rates may not furnish important diagnostic data: these tasks do not simulate speech production and that the rapid repetition of syllables are not consistent with speaking rates or with articulatory movement patterns found in conversational speech.

If the client cannot move individual structures on command but movements are noted during involuntary tasks—for example, the client cannot stick out the tongue when asked to do so but can stick out the tongue to lick a postage stamp—this could indicate an apraxic condition. Further testing becomes necessary.

The major goal of this portion of the assessment is to determine whether the functional integrity of the articulators appears adequate. Isolated functional deviancies do not necessarily translate into an inability to articulate certain speech sounds. They only suggest motor problems. Such functional difficulties should be evaluated in light of the client's articulatory performance, articulatory limitations, and intelligibility. Several functional tasks for lips, mandible, tongue, and velum are indicated in Appendix 1.

SELECTION OF ADDITIONAL ASSESSMENT MEASURES

Approximately 80% of the clinical population with "delayed speech" have associated language problems (Keating, Turrell, & Ozanne, 2001; Shriberg, 1991; Shriberg, Kwiatkowski, Best, Hengst, & Terselic-Weber, 1986; Shriberg, Kwiatkowski, & Rasmussen, 1990; Toppelberg, Shapiro, & Theodore, 2000). Therefore, language testing is recommended for every child who has an articulation and/or a phonological disorder. In addition, a hearing screening is essential. Other measures may include the testing of specific auditory discrimination skills and an appraisal of the cognitive abilities of the client. Selection of additional tests will largely depend on an evaluation of the background information, medical and/or school records, and the clinical impression of the individual client.

Hearing Screening

A hearing screening is a portion of every assessment procedure. According to the revised set of "Guidelines for Identification

Audiometry" (American Speech-Language-Hearing Association [ASHA], 1985) and the "Guidelines for Audiologic Screening" (ASHA, 1997), the following procedures should be a portion of the audiologic screening:

1. Taking a history, which includes noting recent episodes of ear pain (otalgia) and/or ear discharge (otorrhea)
2. Visual inspection to determine the presence of structural defects, and ear-canal and eardrum abnormalities
3. Identification audiometry
4. Acoustic immittance measurements

Referral criteria for each are included in Table 2.

Especially with children, the clinician should have knowledge of any developmental history that could affect the child's hearing status. This would include a history of episodes of otitis media, "earaches," or the placement of tubes. Shriberg and Kwiatkowski (1982a) verified that one third of children enrolled in speech or language intervention had histories of recurrent middle-ear disease. Although controversy exists surrounding the exact role that chronic otitis media plays in the acquisition of phonology, it may at least

TABLE 2 | Referral Criteria for Audiologic Screening

History Information		
Recent history of earaches, ear pain (otalgia)	→	Refer
Recent history of ear discharge (otorrhea)	→	Refer
Visual Inspection of the Ear		
Structural defect of the ear, head, or neck	→	Refer
Ear-canal abnormalities, including blood or effusion, occlusion, inflammation, excessive cerumen, tumor, and/or foreign material	→	Refer
Eardrum abnormalities, including abnormal color, bulging eardrum, fluid line or bubbles, perforation, retraction	→	Refer
Identification Audiometry		
Procedure: Air conduction screening at 20 dB HL at 1,000, 2,000, and 4,000 Hz*		
Failure to respond at one frequency in either ear	→	Refer
Tympanometry		
Procedure: Static admittance, equivalent ear-canal volume, and tympanometric width are used in the screening protocol.		
Flat tympanogram and equivalent ear-canal volume (V_{ec}) outside normal range	→	Refer
Low static admittance (Peak Y) on two successive occurrences in a 4–6 week interval	→	Refer
Abnormally wide tympanometric width (TW) on two successive occurrences in a 4–6 week interval	→	Refer

*According to ASHA (1985, 1997), these criteria may require alteration for various clinical settings and populations.
Source: Summarized from *Guidelines for Screening for Hearing Impairments and Middle Ear Disorders,* 1990. Copyright 1990 by the American Speech-Language-Hearing Association.

interact with other risk factors in some children. This interaction could easily lead to a greater risk of delayed or impaired communication skills.

Language Testing

Due to the high percentage of language problems in children with speech disorders, language screening belongs to the evaluation process. This can be done using formal, standardized assessment measures or informal evaluations. For example, the previously recorded speech sample could be analyzed to determine if morphosyntactic and semantic skills are age-appropriate. As with any screening tool, if the client does not pass the procedure, further testing becomes necessary.

Several language screening measures are available for children of all ages. Box 2 gives a few examples of standardized and nonstandardized language *screening* measures for preschool and school-age children.

Specific Auditory Perceptual Testing

For many years, the appraisal of auditory perceptual skills, specifically speech sound discrimination testing, was a standard procedure for all clients with speech sound difficulties. The reasoning was that faulty speech sound perception often caused, or was linked to,

Clinical Exercises

You are testing diadochokinetic rates with a 7-year-old child. Can you think of two or three words or short phrases that you could use that would incorporate [pʌ], [tʌ], and [kʌ]?

Make a list of three comprehensive language tests (not screening measures) that could be used for preschool children and three that could be used for school-age children.

BOX 2 Selected Language Screening Measures for Preschool and School-Age Children

Birth to 3 Years Screening Measures

Brigance, A. (2004). *Brigance inventory of early development—II.* N. Billerica, MA: Curriculum Associates.

Fankenburg, W., Archer, P., Bresnick, B., Dodds, J., Edelman, N., Maschka, P., & Shapiro, H. (1992). *Denver II.* Denver, CO: Denver Developmental Materials Publishing Co.

Glover, M., Preminger, J., & Sanford, A. (2002). *The early learning accomplishment profile for developmentally young children birth to 36 months (E-LAP).* Lewisville, NC: Kaplan Press.

LeBuffe, P., & Naglieri, J. (2003). *Devereux early childhood assessment.* Lewisville, NC: Kaplan Early Learning Company.

Linder, T. (1993). *Transdisciplinary play-based assessment: A functional approach to working with young children.* Baltimore, MD: Paul H. Brookes.

Newborg, J., Stock, J., Wnek, L., Guibaldi, J., & Suinicki, J. (1984). *Battelle developmental inventory (screening scale).* Allen, TX: DLM Teaching Resources.

Preschool, School-Age Screening Measures

Blank, M., Rose, S., & Berlin, L. (1978). *Preschool language assessment instrument* (2nd ed.). Austin, TX: PRO-ED.

Gauthier, S., & Madison, C. (1998). *Kindergarten language screening test (KIST-2)* (2nd ed.). Austin, TX: PRO-ED.

Hresko, W., Reid, D., & Hammill, D. (1999). *Test of early language development (TELD-3)* (3rd ed.). Austin, TX: PRO-ED.

Morgan, D., & Guilford, A. (1989). *Adolescent language screening test (ALST)* (3rd ed.). Austin, TX: PRO-ED.

Semel, E., Wiig, E., & Secord, W. (1995). *CELF-3 screening test.* New York: The Psychological Corporation.

Speech-Ease Associates. (1985). *Speech-Ease screening inventory (K–1).* Austin, TX: PRO-ED.

the production problems. This was promoted by earlier works such as Van Riper's (1939b) *Speech Correction,* in which discrimination training was seen as a necessary portion of every therapy sequence.

Investigations into the relationship between auditory discrimination abilities and the production of speech sounds have extended over half a century (e.g., Anderson, 1941; Aungst & Frick, 1964; Cohen & Diehl, 1963; Hall, 1938; Kronvall & Diehl, 1954; Lapko & Bankson, 1975; Locke, 1980a, 1980b; Mase, 1946; Monnin & Huntington, 1974; Prins, 1963; Travis & Rasmus, 1931; Williams & McReynolds, 1975; Winitz, 1969; Winitz, Sanders, & Kort, 1981). The results of these and many other studies were inconclusive: Some investigators found a positive relationship between auditory discrimination and articulation skills, whereas others did not. Several reasons for the variation of these results have been suggested (Schwartz & Goldman, 1974; Sherman & Geith, 1967; Weiner, 1967; Winitz, 1984). These different outcomes, however, did not support the cause–effect relationship earlier hypothesized. As a result of these findings, auditory discrimination testing seemed to lose much of its value as a standard assessment procedure.

Currently, speech sound discrimination testing is typically done only with those clients who demonstrate a collapse of two or more phonemic contrasts into a single sound (Bernthal, Bankson, & Flipsen, 2009). If a child substitutes [w] for [r] and [l], this would exemplify the collapse of three phonemic contrasts into a single sound: /w/, /r/, and /l/ would all be represented by the phoneme /w/. Auditory discrimination testing is a means of ascertaining whether clients who do not use phonemic contrasts might also not perceive the difference between these contrasts.

Within the last few years, auditory discrimination testing has departed from the testing of general discrimination skills. General tests of auditory discrimination would include measures such as the Auditory Discrimination Test (Wepman, 1973) and the Goldman-Fristoe-Woodcock Diagnostic Auditory Discrimination Test (Goldman, Fristoe, & Woodcock, 1970). Although these tests are designed to measure general auditory deficiencies, they do not give enough information about the discrimination skills of specific phonemic collapses noted in individual clients. Both Locke (1980b) and Winitz (1984) advocate the use of specific auditory discrimination testing that (1) is tailored to the individual client, (2) considers the client's speech sound difficulties or the collapse of the particular phonemic contrasts, and (3) includes the productionally problematic phonetic environment in words and in more meaningful sentence contexts.

Discrimination Testing and the Phonological Performance Analysis (Winitz, 1984). Winitz offers additional suggestions that could be incorporated into the assessment of auditory discrimination skills of clients:

1. *The test items should be relevant and client oriented.* General auditory discrimination tests are not a good measure of the client's difficulties. If a child produces [r] incorrectly, for example, tasks should concentrate on the child's discrimination of [r] and not of [l] or [t]. However, if the child substitutes [w] for [r] then the task should reflect differentiating between these two sounds.

2. *The specific aberrant productions of the client should be targeted.* The client's production should be contrasted to the norm production of the sound in question. If a child lateralizes [s], the child's abilities to discriminate between a lateral [s] and a regular [s] should be examined. Therefore, the clinician must be able to replicate any of the client's distortions.

3. *The phonetic context in which the incorrect productions occur must be considered.* The clinician must know whether the client's production occurs in the word-initial, -medial, or -final position; in singletons or in consonant clusters; or with specific vowels, for example. If a child evidences deletion of [z] at the end of a word, the discrimination testing should emphasize the presence versus the absence of [z] in this position—for example, *toe* versus *toes*. Similarly, a child who produces an unrounded [ʃ] preceding front vowels should be tested with words with front vowels—for example, *ship, sheep,* and *sheet*.

Winitz (1984) also proposes a phonological performance analysis to supplement the aforementioned auditory discrimination tasks. The purpose of such an analysis is to determine whether children perceive the distinction between contrastive sounds that they misarticulate. Although the previous suggestions are guidelines for appraising all clients with speech sound difficulties, the phonological performance analysis is appropriate for those who demonstrate the collapse of two (or more) phonemic contrasts. Minimal pairs containing the respective phoneme contrasts are embedded in sets of three identical sentences with a somewhat connected topic. Each set of sentences has an appropriate illustrative picture. After reading one set of sentences, the clinician tells the child to select the picture that best represents the meaning of the sentences. At a later point in the assessment process, the child is read the second set of sentences and again asked to pick the appropriate picture. Although the phonological performance analysis attempts to test minimal pairs in connected sentences rather than in isolated word productions, the development of such a battery for each child not only would be time consuming but also would probably tax a clinician's artistic and creative skills.

Cognitive Appraisal

Speech-language pathologists are not qualified to perform formal IQ testing. However, the results of a cognitive appraisal may be important when developing further assessment and treatment goals. IQ testing might then be initiated by referring the client to appropriate professionals. Often, such test results may be obtained through medical, school, or client records.

Caution should be exercised, though, when interpreting the results of IQ measures of children demonstrating phonetic-phonemic disorders. First, a large percentage of children with speech disorders also demonstrate language difficulties. Some cognitive assessment tools use tasks very similar to those used to assess language. Therefore, IQ scores may be affected by the child's language incompetencies. This is particularly a problem with full-scale IQ scores (Nelson, 1998). For this reason, some authors have suggested using nonverbal cognitive measures (Paul, 2007), although tests designed to evaluate nonverbal cognitive skills may appraise only a limited aspect of cognition (Johnston, 1982; Kamhi, Minor, & Mauer, 1990). Second, intelligibility may play a role in the assessment of children with moderate to severe phonemic difficulties, particularly if verbal IQ measures are used. Nonverbal measures would be helpful with the unintelligible child; however, as previously noted, these tests appear restricted. Third, cognitive measures, similar to other standardized tests, do not adequately reflect the abilities of children from culturally and linguistically diverse backgrounds. Although the sample used to norm a particular test typically contains a percentage of children

from culturally and linguistically diverse backgrounds (usually the same percentage as these minorities are represented within the U.S. population), this percentage is so small that the inherent test bias for these populations is not eliminated. The presence of language and/or phonetic-phonemic impairments may further compound the interpretation of IQ scores of children from culturally or linguistically diverse backgrounds.

Although the results of a cognitive appraisal may give helpful guidelines for planning subsequent assessment and remediation strategies, the interpretation of the results is not without its problems. Clinicians should be aware of the type of cognitive assessment instrument used to appraise the individual (e.g., verbal versus nonverbal) and the limitations of each measure. *Extreme care should be exercised when interpreting the scores of children from linguistically and culturally diverse backgrounds.*

CLINICAL APPLICATION

How Much Time Does a Comprehensive Appraisal Require?

A comprehensive phonetic-phonemic appraisal seems to involve a considerable amount of time. However, gathering data could be distributed over several therapy sessions. The following sequence is possible if a clinician is limited to 20 minutes of data collection per setting.

Time #1	Impression of intelligibility.
	Hearing screening.
	Speech-motor screening.
Time #2	Articulation test + stimulability measures.
Interim planning	Analyze articulation test and plan spontaneous speech sample.
Time #3	Spontaneous speech sample in at least two different settings.
	Could include sample with family, siblings, classmates.
Time #4	Supplemental testing, if necessary.
	This could include additional word lists to supplement articulation test, specific auditory discrimination testing, language screening, and so on.

SPECIAL CONSIDERATIONS

The Child with Emerging Phonology

The period of **emerging phonology** is the time span during childhood in which conventional words begin to appear as a means of communication. Although this level of development usually occurs when children are toddlers, it may also occur in older children with more severe deficits in language learning. Within the assessment process, special consideration must be given to the child with an emerging phonological system. Both the diagnostic procedures themselves and the analysis of the results will be different for this population.

Characteristics of Children with Emerging Phonological Systems. Children with emerging phonology are referred for speech-language services for several reasons. First, some may have been born with known risk factors. Identifiable developmental disorders include Down syndrome and other genetic disorders, known hearing impairments, and cerebral palsy. Second, some children will have early acquired disorders secondary to diseases or trauma such as encephalitis, closed head injury, or abuse. Third, children will be brought by parents who are concerned about the child's development: Parents might have observed differences in the expressive communication abilities and/or intelligibility of their child compared to other children of a