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A COMPARISON OF THE SSW AND LANGUAGE TEST RESULTS

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The purpose of this paper is to determine the relationship between the SSW and a battery of auditory-language tests in a group of children suspected of auditory processing problems. Thirty-one children between the ages of 6.2 and 10.4 were referred by their classroom teachers. All children were administered a pure tone and an acoustic immittance battery, the SSW test, selected subtests of the Clinical Evaluation of Language Functions, the Goldman–Fristoe–Woodcock Auditory Skills Battery, an elicited language sample, and the Observational Profile of Classroom Communication. No significant correlations were found between the SSW right competing and left competing conditions and the auditory-language test battery. The findings suggest that these two test approaches measure different aspects of auditory processing abilities in children, and both are required to adequately describe auditory processing abilities at all levels.

INTRODUCTION

The importance of auditory processing and the effects that problems in this area have on learning and communication development are cited throughout the literature (Keith, 1985; Lasky and Katz 1983; Sloan, 1985; Willeford and Burleigh, 1985). However, there are unresolved issues related to terminology, identification, and assessment (Keith, 1981, 1982, 1985; Lasky and Katz, 1983). Although the literature suggests that the terms "auditory processing" and "auditory-language processing" have different diagnostic implications (Dempsy, 1983; Keith, 1981, 1982, 1984; Protti, Young, and Byrne, 1980; Young 1985), these terms are not consistently used as diagnostic entities in communicating test results (Young,

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1985). For example, speech–language pathologists assess children with a battery of tests using loaded auditory-language stimuli while audiologists use noncognitive auditory stimuli. Both claim to identify children as having auditory processing problems. In view of these concerns, it is important to address whether professionals are talking about the same types of problems when referring to children who have either auditory or auditory-language processing problems. This paper examines the relationship between auditory processing and auditory-language processing in elementary school aged children by determining whether those children who do poorly on an auditory processing test are the same as those who do poorly on auditory-language tests.

Butler (1983) describes language processing as a psychological process within an information processing model. This model refers to "the abstraction of meaning from an acoustic signal and the retrieval of that meaning." One distinguishing characteristic of children who have auditory-language processing problems is an inconsistent response profile to auditory stimuli. Speech–language pathologists commonly use diagnostic tests that measure linguistic competencies (Young and Protti-Patterson 1984) using stimuli that are reliant on semantic, syntax, and metalinguistics skills. Some of the tests propose to measure selective attention, auditory analysis, synthesis, closure, discrimination, sound blending, nonlinguistic and linguistic sequencing, short-term memory, and long-term memory for linguistic symbols (Rampp, 1980; Keith, 1984). These results provide the diagnostician clinical data in information processing (Matkin and Hook, 1983).

Audiologists commonly administer auditory processing tests to investigate the auditory central nervous system and to localize disorders of the auditory pathways. Their tests are based on the premise that linguistic signals and neural pathways are redundant (Lasky, 1983; Keith, 1982). These tests reduce the redundancies by degrading, filtering, and distorting the linguistic signal. Auditory processing tests are sometimes referred to as assessing neuromaturational levels since performance improves with age. They also evaluate functional listening abilities including temporal sequencing, interhemispheric interaction, localization, figure–ground, memory, blending, discrimination, closure, attention, association, and aspects of cognition (Keith, 1982, 1984; Musiek and Geurkink, 1980; Young and Protti-Patterson, 1984). They are designed to provide information that permits the structuring of the child's learning environment and other remediation strategies.

Whether the results from an audiological and an auditory-language battery identify the "same" children and result in significant relationships among their tests results is questionable (Condon, 1984; Matkin and Hook, 1983). However, previous research suggests that some audiological tests in an auditory processing battery correlate more positively with a language

processing battery than do others (Harris, Keith, and Novak, 1983; Keith and Novak, 1984; Keith, Rudy, Donahue, and Katbamna, 1989). The research findings discussed by Young (1983) also indicate a connection between language disorders and auditory processing disorders.

Matkin and Hook (1983) found one significant correlation among 52 possible comparisons between a central auditory test battery and an auditory-language battery. They concluded that audiologists and speech–language clinicians are investigating different functions. However, Keith and Novak (1984) reported that the SSW and a test of speech discrimination in noise were significantly correlated to the total scores of the Token Test for Children (DiSimone, 1978), the Test for Auditory Comprehension of Language (Carrow, 1973), and each subtest of the Del Rio Language Screening Test (Toranto, Leverman, Hanna, Rozenwieg, and Maldonede, 1978) except for the Oral Commands Subtest. These findings suggest that the different tests will alter the outcomes.

Findings from a study to compare the SCAN results with two language tests were reported by Keith et al. (1989). In that study, the Composite Standard Score and Competing Word subtest of SCAN results were significantly correlated with the results of PPVT ($r = 0.38$ and 0.39, $p < 0.03$). No significant correlations among SCAN and CELF scores were found when correlations for the Auditory Processing Battery and the Production Battery of the CELF were calculated.

Young (1983) examined performance patterns of 75 normal, speech and language disordered and pragmatically disordered children who were referred for suspected auditory processing dysfunction. A total of 41 had abnormal results on the SSW. Twenty-three (70%) of these children were speech and language disordered, 13 (54%) had normal speech and language, and 5 (28%) were pragmatically disordered. Young's findings were similar to those reported by Keith and Novak (1984), which suggested a relationship between language disorders and auditory processing disorders.

The purpose of the present study was to determine the relationship between the SSW and a battery of auditory-language processing tests for children suspected of auditory processing problems.

METHODS

Subjects

Thirty-one first, second, and third grade students (18 males, 13 females) who were referred by their classroom teachers for suspected auditory processing problems and who also were experiencing learning difficulties in school served as subjects. The sample included 10 first, 12 second, and 9 third graders ranging in age from 6.2 to 10.4 years ($M = 7.9$ years).

None of the children had other known handicapping conditions and none had previously received special remedial services.

Procedures

All children passed pure tone hearing screenings administered at octave frequencies 500–4000 Hz at 20 dB HTL (ANSI, 1969). Acoustic immittance tests indicated that all children had smooth notch-shaped tympanograms with middle ear pressure between +25 and −150 mm H_2O. Speech recognition testing in quiet was completed for each ear under earphones using lists of the NU-6. All children scored 92% or better.

All children referred were administered the Staggered Spondaic Word Test (SSW) (Katz, 1962, 1963, 1968, 1977) and were also tested on an auditory-language battery. Auditory tests were administered by a certified audiologist in an IAC sound suite using a Grason Stadler GSI-10 audiometer with TDH-50P supra-aural earphones. The SSW was presented at 50 dB SL re SRT utilizing a commercial recording (Precision Acoustics) of the SSW test list. Percent error scores were derived from the raw SSW right competing (RC) and left competing (LC) conditions.

A language battery that stressed processing of auditory information was administered to all children during two, 1-hour sessions in the school the subject attended. The following subtests from the Clinical Evaluation of Language Functions (Semel and Wiig, 1980) were included: Linguistic Concepts, Relationships and Ambiguities, Oral Directions, Spoken Paragraphs, Word Association, and Model Sentences. Other standardized tests included the Goldman–Fristoe–Woodcock (GFW) Memory for Sequence Test, the GFW Sound Mimicry Test, the GFW Sound–Symbol Association Test (Goldman, Fristoe, and Woodcock, 1970). An elicited language sample and an Observational Profile of Classroom Communication (Sanger, Keith, and Maher, 1987) were also part of the auditory-language battery. Following the testing, parent conferences were conducted with one or both parents of each child to obtain background history related to etiological factors and the subject's behavior in the home environment.

Although it was not a primary purpose of this study, the subjects were divided into two groups based on their SSW test results and the outcome of the auditory-language test battery. Subjects in the auditory-language group failed both the SSW and the auditory-language battery. Specifically, failure to perform at the 16th percentile on either the SSW right competing or left competing condition and failure to pass the auditory-language test battery comprised the auditory processing group. Failure on the auditory-language based tests was defined as follows: (1) Any of the subtests within the Clinical Evaluation of Language Functions below age-expected grade level criteria; (2) performance at or below the 40th percentile on the GFW

Sound Symbol Association Test for the GFW Sound Mimicry Test; (3) an error score of 20% or more of the total words on the nonstandardized language sample; (4) an error score of more than half of the total 31 items (16 or more) on the Observational Profile of Classroom Communication.

The second language group included those subjects who performed above the 16th percentile on the SSW right competing and left competing condition, but failed to meet the established criteria on three or more of the auditory-language tests described in the preceding paragraph. The 16th percentile was arbitrarily selected for separation groups since it reflects 1 SD below the mean.

RESULTS

Twenty-eight of the 31 students (90%) referred by their classroom teachers were positively identified as having auditory-language or language processing difficulties according to criteria established in this study. Of the 28 children identified, 36%, were in first grade ($n = 7$). Fifty-four percent ($n = 15$) were males, and 46% ($n = 13$) were females. Parent interviews revealed that 9 children had histories of more than two episodes of otitis media during the first two years of life, 4 were known to have complicated birth histories, and reportedly 2 children had allergies. Thirteen of the identified children had no known complicating birth or health history.

Pearson product–moment correlations were computed among the SSW right competing (RC) and left competing (LC) conditions and the auditory-language battery for the 31 subjects referred to the study. The SSW scores were based on percentage of error scores, which were converted to percentile scores. Tables 1 and 2 show that low correlations were obtained and they were nonsignificant ($P < .05$).

Regarding the distribution of children who did poorly on the SSW test and the auditory-language tests, fourteen (45%) children who failed the auditory-language processing battery also failed the SSW. Of the remaining 17 subjects, however, 14 (45%) failed the auditory-language processing battery but passed the SSW. No subjects failed the SSW and

Table 1. Correlation Coefficients Between the Percentile Scores of SSW RC and LC Subtests of the Goldman–Fristoe–Woodcock Auditory Skills for Children Referred for Auditory Processing Problems ($n = 31$)

SSW test	Memory for sequence	Sound–symbol association	Sound mimicry	Sounds in quiet	Sounds in noise
RC	.35	.10	.31	−.06	.14
LC	.22	−.05	.17	−.07	.12

Table 2. Correlation Coefficients Between the Percentile Scores of the SSW RC and LC and Raw Scores of Six Subtests of the Clinical Evaluation of Language Functions (CELF) for Children Referred for Auditory Processing Problems (n = 31).

SSW test	Linguistic concepts	Relationships and ambiguities	Oral directions	Spoken paragraphs	Word associations	Model sentences
RC	.03	−.04	.15	.31	.28	.31
LC	−.10	.01	.03	.09	.12	.27

passed the language measures. Three children (10%) passed both batteries of tests.

A behavioral profile was developed from the checklist (Sanger, Freed, and Decker, 1985) used by teachers to refer children suspected of auditory processing problems (see Appendix). The following represents the most frequently occurring behaviors (occurring one or more times per day) in more than 40% of the subjects: inattentiveness, difficulty following a sequence of instructions, reading or spelling problems, and problems in blending sounds. Teachers observed expressive language problems in only 11% of the total (n = 28) children tested.

DISCUSSION

The purpose of this study was to determine the relationship between the SSW and a battery of auditory-language tests in a group of children suspected of auditory processing problems.

The nonsignificant correlations between the SSW and the tests in the auditory-language battery could be interpreted in several ways. Perhaps audiologists and speech–language clinicians test different aspects of the same problem, as suggested by Keith and Novak (1984; Keith et al., 1989). Language tests are administered with different stimuli and require higher-level language skills and often require cognitive processes for making a response. Audiological tests tend to be less reliant on language skills. It is important then to incorporate both top-down and bottom-up theoretical philosophies in planning and administering an evaluation (Duchan and Katz, 1983; Keith, 1984). An alternative explanation for the nonsignificant correlations could be related to the relatively small number of subjects on our study (n = 31). Perhaps if more subjects had been included in this study results may have revealed statistical significance.

Although Public Law 94-142 was implemented to provide appropriate services for all handicapped students, it is cause for concern that 90% (n = 28) of the 31 nonhandicapped students referred were identified as having processing problems. Five of these children were "at risk" for au-

ditory processing problems according to the criteria established in this research. Their learning and communication problems were subtle but important, particularly since these children were experiencing behavioral, social, and/or academic problems in their classrooms. Many of these children had allergies and middle ear problems reported by parents (46%) and histories of birth problems (54%). It is possible that these children have experienced fluctuating hearing losses that have gone undetected because of the redundant nature of elementary teaching, a point emphasized by Young (1985).

While it is not certain whether audiologists and speech–language pathologists test the same functions and identify the same children, there is accumulating evidence that central auditory tests and auditory-language tests are not highly correlated. Most likely they measure two different aspects of a problem. On a continuum auditory-language measures rely on language and cognitive skills. Central auditory tests are less reliant on language skills than auditory-language tests. Therefore, professionals should include both types of measures in order to completely evaluate a child's auditory processing abilities at all levels.

APPENDIX: A Checklist of Classroom Observations for Children "At Risk" for Auditory Processing Problems

Developed by: Dixie D. Sanger, Barkley Center, UN-L
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Name of Student: School:
Birthdate: Age: Grade: Teacher:
Phone: Speech–Language Clinician:
Frequently: Occurs one or more times a day
Occasionally: Occurs one or more times a week

	Frequently	Occasionally	Never observed
1. Inattentiveness, particularly when significant background noise is present (i.e., a marching band, music in an adjoining room).			
2. Intermittent and inconsistent responsiveness.			
3. Inappropriate conversations or answers to questions.			

	Frequently	Occasionally	Never observed
4. Articulation problems consisting of substitutions, distortions, or omissions of sounds in words.			
5. Reading or spelling problems including discrimination of various vowel forms, incorrect sound-to-letter associations, etc.			
6. Confusion of words with similar sounds (e.g., "shoe" for "zoo," "busy" for "dizzy").			
7. Deletion of small words from sentences (e.g., "I have apple").			
8. Language problems evidenced in usage of inappropriate "wh" questions, pronouns, word order, possessives, deletion of small words, etc.			
9. Difficulty understanding material on a recording, radio, or television when static is present.			
10. Difficulty understanding someone who is talking fast.			
11. More difficulty understanding the teacher when she moves around the room than when she is stationary.			
12. Difficulty in blending sounds in phonics activities (e.g., blending separate sounds to make a complete word).			
13. Problems in recognizing whether or not an event occurred (i.e., that a story was read the previous day, that the letter "L" was discussed, a particular name).			

	Frequently	Occasionally	Never observed
14. Problems in recalling a particular characteristic in a story, a spelling word previously discussed, the name of a poem, etc.			
15. Problems in recalling events of the previous day or previous week in the correct order.			
16. Problems in recalling the oral spelling of a simple word.			
17. Problems in recalling one's phone number, five letters of the alphabet, spelling of his name, the days of the week, counting to ten, etc.			
18. Problems with oral arithmetic in which one has to give an answer to an addition or subtraction combination he hears.			
19. Problems in following a sequence of instructions without having the instructions repeated.			
20. Problems with colds, earaches, ear infections, etc.			
21. Problems consisting of irritability or hostility toward students or toward teachers.			
22. Problems attending in class and/or learning subject matter related to eating habits, lack of sleep, health problems, etc.			
23. Conscious refusal to learn, quick discouragement to learn, extreme distractibility, and restlessness.			

Remarks (Include on a separate piece of paper if necessary):

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