

SSW NEWSLETTER  
INDEX TO VOLUME 3

<u>Volume 3</u>	<u>Number 1</u>	<u>Good News</u>	<u>February, 1981</u>	<u>J. Katz, Editor</u>
<u>Page</u>	<u>No.</u>			
1	1	Performance of LD and LH Children on the SSW - J. Lukas & O. Eshenheimer		
2	2	Central Auditory Dysfunction in Echolalic Autistic Individuals - A.M. Wetherby & R.L. Koegel		
3 & 5	3	Use & Misuse of the SSW Test - VI: Deep Lesions of the Brain - J. Katz		
4,5&6	4	The National Sample for Children: A Piece of the Pie - J. Katz		

<u>Volume 3</u>	<u>Number 2</u>	<u>Pure Lucker</u>	<u>May, 1981</u>	<u>J. Lucker, Editor</u>
<u>Page</u>	<u>No.</u>			
7,8,9	5	Interpreting SSW Test Results of Learning Disabled Children - J. Lucker		
10,11,12	6	Application of CES with LD Children - J. Lucker		

<u>Volume 3</u>	<u>Number 3</u>		<u>August, 1981</u>	<u>J. Katz, Editor</u>
<u>Page</u>	<u>No.</u>			
13&16	7	When SSW and CT Scans Don't Agree - D. McCarthy		
14	8	CES A Valuable "Companion" to the SSW - D. McCarthy		
15&16	9	Is There A Posterior Reversal Strip and What Are Reversal-Ear-Effects - M. Linderman and J. Katz		
17	10	Staggered Dichotic Alignment Studies - F. Rudmin		
17	11	Little Known SSW Facts - J. Katz		

<u>Volume 3</u>	<u>Number 4</u>	<u>National Sample</u>	<u>November, 1981</u>	<u>J. Katz, Editor</u>
<u>Page</u>	<u>No.</u>			
18-23	12	Tentative C-SSW Norms for Children (7 Through 11 Years): National Sample and Three Other Studies - J. Katz, D. Johnson & E. White		



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GUEST EDITOR -- JAY R. LUCKER, Scarsdale & Ossining, N.Y.

INTERPRETING SSW TEST RESULTS OF  
LEARNING DISABLED CHILDREN

Jay R. Lucker, Ed.D.  
Scarsdale & Ossining, N.Y.

Audiologists utilizing the SSW test with L.D. children are often faced with the problem of interpreting the test results beyond saying that the child falls within or beyond the established norms. After obtaining 103 SSW test results of L.D. (including language impaired) children, I examined the data and found a number of distinct patterns with other information regarding the children. The following is a description of the patterns and their diagnostic implications.

The first patterns emerge from the response biases (RBs). The Type A pattern has been associated with reading, writing and spelling problems and its diagnostic significance has been discussed (Lucker, 1979 & 1980). When the Type A occurs, the Order and Ear RBs are confounded and should be assumed to be invalid. Therefore, Ear and Order Effects are discussed only when the Type A was not obtained.

In regard to the Ear and Order Effects, a number of researchers have discussed some diagnostic implications. Lukas and Eschenheimer (1981) related the Ear L/H to left cerebral dominance (without explaining why since both ears contribute to the listening task for the REF and LEF conditions). In my sample of 103 L.D. children, only 8 (8%) had significant (i.e., according to White's, 1977, criteria) Ear Effects. Of these 8

children, 7 had Ear L/H and all seven had language processing problems. I feel that the diagnostic significance of Ear L/H is poor auditory processing in the dominant (left) hemisphere related to auditory-linguistic overloading. That is, the child is able to process information from either ear so long as two pieces of information do not arrive for processing simultaneously. In this latter case, the child is overloaded and loses or distorts some of the information in the condition of simultaneous arrival. In the REF situation, the four pieces of information arrive to the language processing centers sequentially. However, during the LEF routing, I feel the LC and RC messages arrive simultaneously (using Katz's model for the SSW presented at his workshops and in the SSW manual). For the Ear L/H children, this simultaneous arrival impairs accurate auditory-linguistic processing yielding more errors in the second ear (LEF) condition. According to this interpretation of Ear L/H, the audiologist could state that the child with this RB may have impaired auditory-linguistic processing especially if a lot of information is presented. Under this latter condition, an overloading could be expected and the child would lose the message, become frustrated, tune-out, become inattentive or exhibit other negative listening behaviors. Remedial techniques should emphasize improving proficiency of auditory-linguistic processing.

Since I have found only one right handed child with Ear H/L it is not possible to provide and interpretation

of this RB at this time as it appears in children. Katz (see SSW manual) localizes Ear H/L for adults involving the region in and around the AR center. Perhaps Ear L/H and H/L both involve language disorders at different levels or for different linguistic processes.

Order Effects have been related to memory problems (Lukas, 1980; Lukas and Eschenheimer, 1981). Lukas (1980) interpreted Order H/L as a recency effect. That is, the child loses the initial pieces of information while retaining the most recent. I found 12 (12%) of my 103 L.D. children having significant (according to White's 1977, criteria) Order Effects with 7 being L/H and only 5 yielding the H/L recency effect. These latter children did have significant memory deficits. However, the former 7 did not all have memory problems. They did have language processing problems. Typically, these children revealed good memory for digits and sentences, but poor memory was found for less redundant material such as nonsense words. It appears that Order L/H is indicative of a child who has difficulty analyzing acoustic-linguistic information (i.e., phonemic processing). These children would appear to require all of their energies to process the information as it arrives. They then "shut down" their processing centers until the first pieces of information have been handled. For the SSW, once these children are ready to receive new information there is none since only four words are employed. These Order L/H children seem to get the beginnings and endings of messages, but miss the middle. They seem to have good comprehension for the gestalt of the messages but miss the specifics and small details. Short, non-redundant messages would be the most difficult for these children to handle. Remediation would appear to best be focused upon developing strategies for more rapid, accurate processing, utilizing associative thinking to speed processing and improve ability to analyze the specifics of messages.

The next RB is reversals which were found in 63 (61%) of my sample. Of these 63 children, 22 (33%) of my entire sample

had less than 5 reversals, 12 (19%) had 5-9 reversals, 21 (33%) had 10-20 reversals, and 8 (13%) had more than 20 reversals. Applying White's criteria (1977) for reversals, 32 (31%) of my entire sample had a significantly large number of reversals although all of the 103 L.D. children had normal hearing and middle ear functioning at the time of testing. Katz's (see SSW manual) model places reversals in the reversal strip which includes the frontal lobe. This lobe of the brain is involved in high cognitive functions such as organization of information and actions. I found that typically children with a significantly large number of reversals (often 10 or more regardless of age) were described as disorganized, unable to follow directions sequentially unless individual attention is given and often unable to follow through on assignments without assistance. SSW reversals appear to correlate highly with organization problems. Remediation for these children involves teaching strategies for organization, understanding directions and following through on tasks independently.

In addition to RBs, the SSW-gram provides a lot of diagnostic information if TEC analysis is ignored. I have found 4 SSW-gram patterns which did relate to other test data and descriptions of the children's functioning. In describing these patterns I compared the results to both the adult norms and the children's norms appearing in the SSW manual.

Pattern 1 was found in the majority of cases. It is a single peak in the LC regardless of patient handedness. Sixty-five (63%) of my 103 LD children yielded Pattern 1. I divided this pattern into two groups with Pattern 1a an LC peak exceeding adult norms but within children's norms, and Pattern 1b exceeding both adult and children's norms for LC. For these patterns all other conditions were within children's norms although LC peaked. Of the 65 children with single LC peaks, 15 (23%) were Pattern 1a while 50 (77%) were Pattern 1b. All children with these patterns demonstrated auditory related problems which is why they were referred for central auditory processing testing. Because all 65 children revealed some auditory problems, I feel that Pattern 1 obtained, regardless of being within or

beyond children's norms, is indicative of a weakness in the auditory processing centers of the dominant (left) hemisphere. Those children with Pattern 1a may be revealing a maturational lag in development of auditory processing abilities. In contrast, Pattern 1b children may have true auditory processing problems. All of these Pattern 1 children seem to be able to give you the messages they receive without providing an interpretation of the message below the surface structure. These children appear to have language difficulties and may require language remediation to improve linguistic proficiency in order to build up the ability to interpret messages below the surface structures.

The second major pattern was a double peak in the RC and LC conditions. Lukas (1980) describes children with double peaks as does Katz at his workshops. In my sample, 16 (16%) had double peaks with the LC peak always poorer than the RC peak regardless of handedness. Only one other child revealed a double peak Pattern 2 but with RC slightly poorer than LC for this right handed child. These 17 double peak, Pattern 2 children are the most impaired in auditory processing, are easily overloaded and many have significant emotional disturbances, including the child with the poorer RC peak. Pattern 2 would appear to be indicative of a severe auditory processing problem as well as maturational lags in cognitive functioning to overcome the auditory processing problems. Pattern 2 children require an entire remedial program to improve auditory processing. It should also be remembered that most of my Pattern 2 children have emotional and behavior problems which may be related to the auditory processing problems.

The third major pattern was found in 22 (21%) children in my sample. This Pattern 3 revealed normal SSW-grams for these L.D. children. Since 17 (77%) of these children yielded some significant RBs, only 5 or 5% of the entire sample revealed no problems, including significant RBs, on the SSW. Therefore, for my sample, the SSW test provided diagnostic information for 95% of the children. The other 5 children were either false negatives or do not have auditory-linguistic processing problems.

Reviewing the records did not support the latter conclusion. Some of the five children did show language problems on the speech/language evaluation.

The final pattern was found in only one (1%) child. He revealed a single peak, but for the RC condition which exceeded his age norms while all other conditions were within age norms for this right handed child. This unusual finding could not be explained. To further confuse the issue, a recent re-evaluation one and one-half years later revealed a SSW test Pattern 1b. This recent SSW is in opposition to the initial. I cannot explain the Pattern 4 unless the earphones were reversed.

The various patterns described as well as the RBs for the SSW test should provide the audiologist with: 1) an interpretation of the central auditory test battery which will provide an understanding of the auditory processing abilities; 2) likely classroom problems of the children; 3) information related to educational performance; and, 4) direction for remediation.

Lucker, J.R. Diagnostic significance of the type A pattern. SSW Newsletter, 1, 4-5 (Nov. 1979).

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## APPLICATION OF CES WITH LD CHILDREN

JAY R. LUCKER, ED.D.

Scarsdale &amp; Ossining, N. Y.

Katz developed the CES test for use in diagnosing auditory processing abilities of adults and patients with corpus callosum lesions. Will the CES test find application with LD children as has been the case with the SSW test? Johnson and Sherman (1980) presented preliminary data for the CES test in normal achieving children ages 6 to 12 years revealing a significant improvement with age and better performance for LE items. Although Johnson and Sherman discussed the CES test in regard to LD children, no researcher has determined whether the CES test has diagnostic implications for LD children.

I have presented the SSW and CES tests to 20 known LD children ages 8-4 to 11-10, with a mean age of 10-5 and a median age of 10-8 for the group. The sample consisted of 10 boys and 10 girls. The SSW and CES tests were presented in counterbalance order. For the CES test both a pointing and a verbal response was employed with all subjects in a counterbalanced order. The SSW and CES tests were presented at an intensity level of 70 dB SPL (Approximately 50 dB HL). All subjects had both normal hearing and middle ear functioning.

The CES test % error results revealed no significant ear differences for the pointing response mode (RE  $\bar{x}$ =3,  $sd$ =4.7; LE  $\bar{x}$ =3,  $sd$ =4.7;  $t$ =0.170,  $p$ >0.20). However, there was a significant difference for the verbal response mode favoring the left ear (RE  $\bar{x}$ =4,  $sd$ =4.5; LE  $\bar{x}$ =2,  $sd$ =3.4;  $t$ =2.628,  $p$ <0.02). The differences between response modes was not significant for the right (Pointing  $\bar{x}$ =3,  $sd$ =4.7; Verbal  $\bar{x}$ =4,  $sd$ =4.5;  $t$ =0.890,  $p$ >0.20) and left (Pointing  $\bar{x}$ =3,  $sd$ =4.7; Verbal  $\bar{x}$ =2,  $sd$ =3.4;  $t$ =1.097,  $p$ >0.20) ears.

These results do not support the findings of a left ear advantage for LD children when the CES test was utilized in the pointing response mode. However, these results may still support an hypothesis of integration problems in LDs. I feel that there is more to the CES test than merely listening, analyzing the sounds and pointing

to a picture representing the sound. The additional factor involves integrative analysis. The CES test provides a rather long preparatory set during the demo items. During these items the listener is hypothesized to have taught himself/herself how to respond to the task. The only factor left during the actual test is auditory analysis of the items presented. I hypothesize two problems with LD children. On the one hand, they have auditory analysis problems. This factor would cause every message to be inaccurately processed through the auditory channel at times. Therefore, during the pointing task, poor right hemisphere auditory analysis could explain the equally poor results for the two ears for the subjects as a group. The second factor involves integration. During the pointing response mode the subjects are essentially told to "turn off" left hemisphere processing and concentrate upon right hemisphere processing. Therefore, there is no need for the listener to integrate hemispheric function. However, during the verbal response mode the listener must utilize both hemispheres for processing and integrate which processing occurs at the appropriate time. The left ear message goes first to the right hemisphere for auditory analysis then to the left hemisphere for verbal analysis (the appropriate sequence). In contrast, the right ear message goes to the left hemisphere where integration should have told the listener to ignore the message, cross to the right hemisphere for processing and then come back to the left hemisphere for verbal processing. However, it is hypothesized that the LD child has integration problems and may begin the verbal and nonverbal processing simultaneously. Since the left ear message receives nonverbal analysis before verbal coding the message is less distorted than the right ear message which begins verbal processing, crosses for nonverbal processing and then recrosses for verbal coding and response. This hypothesis of auditory analysis and integration problems in LD children could explain the findings obtained during my investigation. This hypothesis would also suggest that CES might be poor for both ears since both analysis and integration are impaired. It is interesting to note that almost half of my subjects did reveal

equal performance for the CES tasks (9 or 45% for the pointing task; 11 or 55% for the verbal task). The other patterns were better left ear performance (8 or 30% for the pointing task; 8 or 40% for the verbal task) and better right ear performance (5 or 25% for the pointing task; 1 or 5% for the verbal task).

I feel that the CES test does have application for understanding integration and ability to process information for LD children. Additional research is needed to provide further understanding of CES test results and performance of LD children on other tasks.

Johnson, D.W. & Sherman, R.E. The New SSW test (List EE) and the CES test. Audiology and Hearing Education, 5-8 (Spring 1980).

#### SAMPLE CASES

Jay R. Lucker ED.D.

CASE 1: Male, 8 years old, third grader. COH designation: Severe speech/language impaired with significant related learning problems. Child reveals 2-3 year delay in receptive language and 3 years or greater delay in expressive language. Possible soft signs for neurological impairment noted on neurological work-up. Reading level is early first grade with great difficulties learning phonics. Difficulties following directions, distractable, doesn't focus, doesn't always seem to understand.

CASE 2: Male, 9 years old repeating third grade. COH designation: pending further evaluation. Difficulties in phonics, spelling, other language arts. Can retell a story presented verbally, but responses for inference questions are poor as are any responses requiring interpretation beyond the obvious. Speech and language evaluation reveals 1-2 year delay in receptive and expressive language, mainly for higher cognitive tasks such as auditory association, similarities, visual association. Syntax, vocabulary, and general verbal expression are age appropriate

CASE 3: Male, 10 years old, fourth grader. COH designation: Specific learning disability. Very distractable, can't put it all together, very high IQ with large discrepancy between performance (better) and verbal areas. Often misinterprets questions asked of him and can't follow verbal directions without adult supervision. Teacher or other adult often has to break down each task for child when presented verbally. When directions, information, tasks are presented visually, no problems are noted. Reading is between fifth and sixth grades although responses to verbal questions about material read is difficult. Language evaluation revealed above age level in vocabulary, expressive language, associative language. However, receptive language, especially following directions, sentence memory, understanding verbal stories, is 2 or more years below age level.

#### SSW TEST RESULTS

Try matching cases 1-3 to these results:

CASE A: 8 CN: (REF) 0 0 16 5 (LEF) 1 14 3 2

SSW REVERSALS: 0

WDS: RE: 96% LE: 100%

CASE B: 8 CN: (REF) 0 6 9 2 (LEF) 0 10 10 3

SSW REVERSALS: 0

WDS: RE: 100% LE: 100%

CASE C: 8 CN: (REF) 1 4 3 0 (LEF) 0 8 3 2

SSW REVERSALS: 2

WDS: RE: 100% LE: 96%

Jack Katz, Editor  
State University of New York - Buffalo  
Communicative Disorders and Sciences  
4226 Ridge Lea Rd.  
Amherst, NY 14226  
716-831-3395

SSW NEWSLETTER

#### ANSWERS TO SAMPLE CASES

CASE 1 = CASE B: SSW reveals Lucker Type 2 pattern consistent with auditory overloading and severe auditory processing problem. No significant RBs.

CASE 2 = CASE C: SSW reveals Lucker Type 1a pattern consistent with maturational lag in auditory-linguistic processing. RBs reveal Type A pattern consistent with sound-symbol association problems which may be a causal factor in academic problems.

CASE 3 = CASE A: SSW reveals Lucker Type 1b pattern consistent with an auditory processing deficit which, in this case, has not interfered significantly with most language and cognitive abilities and development. RBs reveal Order L/H consistent with the recency effect of poor memory.