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AFTER YOU SCORE THE SSW...

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When Katz (1968) first discussed the interpretation and significance of the results yielded by the SSW test, he descibed the methods still in use today for interpreting test data. After the audiologist scores the SSW, he or she utilizes the TEC and response bias methods to provide the interpretation of the test results. However, these methods are most applicable when providing diagnostic information regarding the site-of-lesion of the central nervous system disorder-- whether auditory reception or NAR (Katz, 1968).
Utilization of TEC or response bias data for implicating a site-of-lesion in LD children appears to limit the use of the SSW test as well as imply assumptions which may not be valid (that is, a specific site-of-lesion for LD children performing poorly on the SSW). Analyses using these methods developed for application with adults are limited to concluding that LD children perform equal to, poorer than or better than normal achievers. However, educators, LD specialists, teachers, speech-language pathologists, parents and audiologists want to know how SSW performance relates to the child's academic and language problems as well as how these results lead to the development of remedial programing for the child. In order to answer these questions a different view of the SSW test results must be taken. Having worked for many years with the SSW test and with LD children both evaluating and remediating their problems, I have developed a method of evaluating SSW test responses and results (Lucker, 1979; 1980; 1981a & b).

The following is a discussion of the model by which I interpret the data after I score the SSW...

The basic model for the SSW reveals that there are two tracks by which auditory information goes from the ear to the brain and the contralateral tracks are "stronger". One hemisphere (usually left) is dominant for language reception and the information presented on the SSW competes for language processing (two different messages to each ear as well as simultaneous presentation). During the SSW test the NC messages have two tracks by which to reach the language processor. However, during dichotic competition the ipsilateral tracks are inhibited by the stronger contralateral tracks, and the RC/LC messages have only one track each by which to reach the brain. This is interpreted as resulting in a reduction in the redundancy of the competing items which yields poorer performance on these items for a non-intact central auditory nervous system (CANS). This interpretation is felt to be limited to a neurophysiological view of the SSW test.

I feel that this non-competing/competing factor on the SSW test also taxes the cognitive-linguistic processing systems. That is, during the non-competing items the person has to focus and attend to only one ear and one message. However, during the competing items the listener must switch focus of attention between ears and messages without loosing or confusing the intact information contained in each message. Therefore, the competing task reduces both neurophysiological redundancy as well as cognitive-linguistic-acoustic redundancy. Loss of attention and poor focusing could cause a loss of information processed. This would then require greater proficiency of linguistic processing to fill in the missing information, integrate which two monosyllabic words go together appropriately and which word was said first. Problems in the cognitive-linguistic processes of focusing, attending, sequencing, "tagging" or labeling, decoding and organizing could account for problems on the competing items on the SSW test as much as a lesion in the right hemisphere. In both cases one could obtain a single peak or Lucker Type I pattern on the SSW.

In the above case it would be hypothesized that the listener was focusing best upon the right ear items since they lead to the language hemisphere via the dominant (contralateral) pathway. (It should be noted that this is only valid for left hemisphere-language dominance which is the typical organization of the brain for most people.) However, if decoding and tagging of the items (felt to be primarily a linguistic skill) is very impaired, accuracy of processing right ear items would be hampered especially if part of the language processing mechanisms are called into play for decoding and tagging left ear items during simultaneous (competing) presentation. This could yield a double peak or Lucker Type 2 pattern. In this case a severe language problem would be interpreted the cause, not a lesion of the left hemisphere.

Performance on the SSW test also involves timing and sequencing since the items switch between ears as well as the order of which ear is first. In addition, RE items are felt to arrive at the language processor (left hemisphere for our discussion) before LE items. This built in timing/sequencing factor would cause RE items preceding LE items (REF) to be more easily processed than LEF items. Therefore during LEF, not only is RC and LC competing, but the LNC is felt to compete with the RC for language processing. The normal brain probably delays the processing of the RC item by tagging its acoustic and linguistic sequence. The LD child with poor language "tagging" and poor abilities to utilize delaying would fall down on the LEF over the REF and yield an ear L/H not because of a CNS lesion.

Sequencing and timing factors may also be interpreted as relating to corpus callosum problems yet may merely be symptoms of poor processing intergration (that is, inability to put together the various components of the processing tasks into one meaningful whole efficiently). The brain must integrate the processes in each hemisphere as well as language-acoustic processes with memory, visual processes, organizational factors and motor (output) processes. Therefore, integration on the SSW requires a coordination of highly organized processes utilized to maximum efficiency, not repeating unnecessary processes and having a backup system ready when needed. Merely looking at the integration required on the SSW as a corpus callosum problem in LD children is overlooking the importance of the processes involved.

The above discussion has demonstrated that breakdown on the SSW test for LD children may demonstrate specific auditory-linguistic-cognitive processes which are in need of remediation and not merely stating that LD children perform poorer than normal achievers or have problems in the right hemisphere of the brain or the corpus callosum. Application of my interpretation of SSW results allows for an understanding of the processes which are impaired, and therefore directly identifies areas in need of remediation.

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AUTHOR'S NOTES

* This paper is based upon a presentation made by the author at the SSW Study Group, October 17, 1982, Toronto, Ontario, Canada.

** Originally, Lucker described four SSW Gram patterns as Types 1,2,3,4. He has revised the types as Type 1 (single LC peak beyond norms), Type 2 (both RC & LC beyond norms), Type N (all within norms), Type R (RC peaks beyond norms while LC is within norms).

C-SSW NORMS: THE LEARNING DISABLED 12 to 60 YEARS OF AGE

by Jack Katz, Ph.D.

The Problem

In the past we had little choice but to use the standard C-SSW category table (Katz, 1968) for analyzing individuals 12 years or older. This was true whether we were testing a person suspected of having a brain tumor or an auditory processing problem associated with a learning disability. I have not had reason to question the use of the category table for cases with suspected brain lesions -- these norms were specifically designed to identify such problems. Occasionally, I wondered why the norms for 11 year olds were more stringent than those for adults. For example, the National Sample calls for scores of 4, 4, 10, 4 for the RNC, RC, LC and LNC Conditions, respectively for 11 year olds (Katz, Johnson and White, 1981). By comparison the adult norms demand only 15 or better for each of the Conditions.

The Reasons

Why the discrepancy? There seems to be two major reasons why we have asked more of 11 year olds (or even 9 year olds for three of the Conditions) than we do for adults. First, the children's norms are statistically based (1 SD above the mean for normal children). Such statistical approaches are used in other tests such as for evaluating IQ scores and ABR performance. The adult SSW categories, on the other hand, are set up to maximize the distinction between both normals and those with peripheral hearing loss from NAR cases and then NARs from AR cases. The cutoffs are set up to yield the largest number of "correct hits" for the category (eg, identifying central cases) and the fewest "false positives" (identifying normals or peripheral hearing loss cases as having CANS problems). Many audiologic tests are based on this category system and not on statistics per se. Audiologic procedures such as tone decay tests as well as tympanograms and acoustic reflexes follow this model. Thus, the bases and approaches for the two C-SSW standards are quite different and the control populations differ considerably.

Secondly, the category approach for adults and the statistical approach for young children differ philosophically for another reason. The two standards differ in our willingness to be wrong. The possibility of falsely identifying a location in a brain tumor case or suggesting that a normal individual has an AR problem is far more serious than to misrepresent a person with marginal auditory processing skills as someone having an auditory perceptual (AP) dysfunction.

In my experience it is very rare to find a perfectly normal listener (11 through 59 years of age etc.) who demonstrates even a mild C-SSW score based on the category table. However, it should not be surprising if 16 out of 100 normal children who are given the SSW test would obtain scores 1 SD below the mean for their age group. Most clinicians are willing to accept the +1 SD criterion for AP difficulty for the following reasons: 1) it is not likely that many perfectly normal listeners will be referred for central auditory processing tests (therefore there will be few false positives), 2) if those with normal auditory processes are referred and fail the tests, it may well be a relatively small mistake (eg, confusing a person with marginal skills with one who has a significant problem), 3) should such a confusion take place the recommendations and information are not likely to cause serious harm to the individual even if misdiagnosis is not caught (in fact it might be quite beneficial as we have found many marginal cases to benefit from the same theraputic approaches as those with significant deficits), and 4) very importantly, it would be more serious to miss an individual who truely needed help with an AP problem than to include one who might not need it. To "clear" a person of an auditory deficit when one is present can be damaging indeed, or, at least, delay proper treatment. Thus a more laxed criterion (eg, +1 SD) could be more appropriate in dealing with LD children than a more demanding criterion (eg, +2 SD or more) if too many AP cases will be missed.

A third less important point relates to the question of "disorder-vs-difference". Educationally, one might look at AP problems as different from the performance of other children simply because it is lower down on the continuum and statistically 16% of "normal" children will fall below the 1 SD point. Others look upon AP problems as true "disorder" such as that produced by skull trauma or disease. In this sense the children represent another population (not the healthy, undamaged one). This arguement is beyond the scope of the present article except to say that while AP may represent a disorder, a difference or both, that those with brain tumors and strokes are far off the continuum of normal and represent a pathological group. Thus a category system would not be inappropriate for the brain damage group (AR or NAR disorder) and that a statistical system would not be inappropriate for identifying those out on the continuum (eg, AP difference).

A Clinical Decision for the Learning Disabled

Based on the foregoing discussion, it seems to me that it would be most appropriate to establish a statistical norm to evaluate those individuals over 11 years of age who are suspected of having an AP problem (presumably associated with LD or communication difficulties).

Brunt (1978) and others have pointed out that normal adult groups have similar mean SSW scores and small SDs. Others have shown that children 11 or 12 years of age do not differ from adults on the test (Myrick, 1965; Turner, 1966). Since the SDs associated with a broad age range of adults is much smaller than the variation even in 1 year of childhood (eg, 9 year olds), it is reasonable to assume that we can be more critical in spotting deviations in adults. Both +1 and +2 SD cutoffs may be considered. A +2 SD criterion failure would have a probability of 1 in 100 that the individual was drawn from the normal population.

A statistical SSW standard for individuals 12 through 59 years would follow the present (tentative) standards for children 7-11 years based on the National Sample-I. This would appear to be the proper standard to use for LD cases (following appropriate validation) while the category table should still be followed for detecting brain disorders.

Establishing a Tentative Norm

A body of data was needed to establish a statistical norm that would be appropriate for individuals 12-59 years of age. Data were obtained from normal subjects who were tested as part of SSW class projects over a period of years. Because of this source, there was a preponderance of subjects in the 20-29 year age range (mean= 26.5 years). The distibution is shown in Table 1.

TABLE 1

AGE DISTRIBUTION OF SUBJECTS

AGE	NUMBER
12-19	19
20-29	63
30-39	10
40-49	2
50-59	10

All subjects demonstrated normal hearing bilaterally and had WDSs (Hirsh W-22s) of 92% or better in each ear. Standard procedures were used in administering and scoring the SSW (Brunt, 1978).

The data shown in Table 2 are similar to those that have been reported over the years for groups of normals within this age range. While all the Conditions hover around the zero-line, LC has the highest percent of error and LNC the lowest. The SD was largest for LC and smallest for LNC. The mean and SD for the RC Condition are much like those for NS-I for 11 year olds but LC is better than NS-I both for mean performance and smaller SD. Thus, it appears that the norms for those 12-59 years represent a continuation of the maturation process, though slight.

Statistical cutoff points are shown for +1 and +2 SDs. It can be seen that +1 SD permits relatively little deviation from zero. It is my feeling that even if the data are shown to be reliable in other normal groups of a similar make up that it seems too stringent for a clinical population. It is my first impression that for clinical purposes that the +2 SD cutoff would be more appropriate. It is interesting that these criteria are within 1% of those established for 11 year olds in NS-I. We have no evidence to show that these criteria can be used if the listener has a significant hearing loss (unlike the category which accounts for peripheral loss).

Cross Validation

The first step in testing the appropriateness of the new standard was to see how the criteria perform on a group of clients who were seen at our clinic for learning disabilities. Records for eleven clients seen in the past year and who were over 11 years of age were studied. The ages ranged from 12 to 37 (mean= 17.6 years). Eight of the clients had significant response bias (by adult criteria). The C-SSW results were studied to see the sensitivity of the +1 SD and +2 SD cutoffs compared with the TEC category results. The comparisons are shown in Table 3.

Since all the clients who had positive Ear or Total C-SSW scores also had positive Condition scores only the Condition scores are shown. Using the most sensitive criteria (+1 SD), 8 (73%) of the clients were identified as having abnormal SSW results, presumably reflecting auditory perceptual difficulties. Using the more lenient +2 SD cutoff, 6 (55%) of the clients were identified and using the TEC criteria, only 1 (9%) client was identified.

If one were to use both the +1 SD criteria and response bias then 10 of the 11 (91%) clients would have been identified as failures on the test (presumably having AP problems). With +2 SD and response bias, 8 out of 11 (73%) would have failed the SSW. The TEC category is far too lenient as it does not identify any cases beyond those already identified by the response bias.

Further Verification

In order to provide further verification that these standards are appropriate and do not falsely identify too many normal subjects 12 years and older, further cross validation is needed. The data of Lukas and Eschenheimer (1980) and other studies would be most helpful for this purpose. If you have normal or LD data that can be used for comparison, please send something in to the SSW Reports.

Summary

A statistical standard is proposed for use with individuals over 11 years of age who are suspected of having auditory processing disorders. A tentative norm based on 104 normal subjects 12 through 59 years of age is proposed. The +2 SD failure criteria appear to be appropriately cautious for clinical purposes.

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?SKULL TRAUMA?

Who is working with skull trauma cases and auditory processing deficits?

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TABLE 2

C-SSW RESULTS BASED ON 104 SUBJECTS

	RNC	RC	LC	LNC	RE	LE	TOTAL
MEAN	-1.00	.08	1.41	-1.10	-.40	.12	-.20
SD	2.59	2.40	4.02	2.17	2.27	2.68	1.85
Cutoff of Normal (beyond which scores are considered abnormal)							
1 SD	2	2	5	1	2	3	2
2 SD	4	5	9	3	4	5	4

Means, SDs and +1 and +2 SD cutoffs for normal performance are shown for the 4 Conditions, the 2 Ears and the Total C-SSW.

TABLE 3

FAILURES AMONG 11 LD SUBJECTS BASED ON THREE CRITERIA

Criterion	# Identified	Number of Failures/ Condition			
		RNC	RC	LC	LNC
TEC	1	-	-	1	-
+2 SD	6	3	4	3	1
+1 SD	8	3	5	4	1

The number of clients identified by (the category table) TEC, +2 SD and +1 SD criteria as well as the number of failures on each of the 4 Conditions based on the three criteria.