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REPORTS

TWO IMPORTANT ADDITIONS TO SSW
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TWO IMPORTANT ADDITIONS TO THE SSW TEST

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ABSTRACT: Two new methods are discussed for improving the SSW diagnostic analysis in cases seen for Central Auditory Processing evaluations. The first method is the use of number of errors instead of the percent of error. The second approach utilizes a statistical scoring of Ear and Order Effects instead of the typical cutoff points.

INTRODUCTION: The SSW test has remained an important measure of central auditory function for almost 35 years. It is probably the oldest central test in wide spread use today.

The basic scoring of the SSW was fully established by 1965. It includes the scoring and calculations of the four Conditions, as well as the scoring and calculations of Response Bias (Ear and Order Effects, Type A patterns and Reversals).

Over the years, minor modifications have been made and new features have been added. For example, we no longer divide up Reversals into different types (e.g., partial, questionable, true), but we do consider Common Reversals, Reversal-Ear-Effect and Engineer's Reversals.

The greatest changes in the SSW scoring have been introduced over the past 10 years. The use of Qualifiers has been an important improvement in supporting the diagnosis that comes from the central test battery. Because they are behavioral characteristics, both parents and teachers can identify with the test results more readily than if we tell them "there is an Order Effect high/low". Qualifiers also help us to relate the person's problems to the four CAP categories that we generally use.

This report deals with two additions that appear to have considerable promise for improving ones ability to properly diagnose a Central Auditory Processing (CAP) problem, and to simplify the calculations.

For the first 10 years of the SSW, it was used almost exclusively as a test of central auditory disorder, to identify and locate lesions in the CNS. The scoring procedures were developed for that purpose and not to evaluate auditory processing problems. Of course, at that time we knew very little of what CAP was about or what would be the best way to

assess it. Therefore, we simply borrowed what we knew was valuable in evaluating central lesions. For the most part the results have been very good. The suggestions here are refinements and not corrections in the SSW analysis.

If you are content with your present scoring and results, we have no strong evidence, at the present time, that the new methods are any better. In fact, to be sure, we do not have strong evidence that these methods are as good. However, logic and experience tells us that these new methods are most appropriate for evaluations of CAP (but not for site-of-lesion).

SCORING NUMBER OF ERRORS (NOE): We will spare you a long explanation of why using the number of errors instead of percent of error would be advantageous. We will not go into detail that this may be an intermediary step to have the SSW results represented in standard scores and the advantages of that. However, we must point out that use of number of errors (NOE) replaces the Raw and Corrected scores and eliminates (a) the multiplication (by 2.5) and (b) the correction for word recognition.

The scoring and summing procedures of the SSW up to the 8CN and combined totals are exactly the same as before. However, when the four combined totals are brought forward to the first page of the score sheet and placed in the proper boxes for "Raw SSW Scores", no additional calculations are needed. Rather each of the four numbers is compared with the normal limits shown in Table 1. Table 1 shows the means, S.D.s and normal limits for the various SSW indicators, using the Number of Errors (NOE) based on the normative sample.

Normative Sample. The normative sample for these NOE scores is the Combined National Sample - 1985. Three-hundred and nine (309) control subjects who had usable data make up the normal sample. The age norms for the SSW are available for single groups 5 to 11 years of age, an adult group 12 through 59 years and a 60-year-old group ranging from 60 through 69 years.

Factors. The various SSW indicators, that we have used over the years (i.e., the four Conditions and Response Biases) are included. In addition, two new factors should be mentioned.

The total number of errors may be of assistance to the audiologist who notices that two or more of the four Conditions fall just within normal limits and therefore do not properly identify a CAPD. In the TEC analysis we get this overall information from the Total score, but do not have a comparable measure when testing patients for CAP dysfunction (CAPD). Now we do. This measure can be used to describe overall performance, rather than being used for a refined assessment of the person's problems.

The other factor is word discrimination score (WDS) for each ear. In the past C-SSW scores helped us take the person's WDS into account. WDS was most profitable in the site-of-lesion work but, unfortunately a confounding influence when testing some children with CAPD. We have found that some children perform poorly on the WDS for a variety of reasons despite perfectly normal hearing. This could be due to:

SSW NORMS: NUMBER OF ERRORS (NOE) and WDS PERCENT CORRECT - JUNE 1994

AGE	RNC	RC	LC	LNC	TOT	REV	ORD	EAR	WDSR	WDSL
5 m*	1	7	8	2	18	0	0	-1	98	99
sd	1	3	4	3	8	1	5	3	5	3
nl	2	10	12	5	26	1	-5 +5	-4 +2	(93)	(96)
							LH HL	LH HL	nl 88	93
6 m	2	6	11	2	21	2	1	-2	97	96
sd	2	4	4	3	9	2	8	4	4	4
nl	4	10	15	5	30	4	-7 +9	-6 +2	(93)	(92)
							LH HL	LH HL	nl 89	88
7 m	2	5	9	2	17	2	2	-2	97	97
sd	2	3	4	2	7	3	5	4	4	4
nl	4	8	13	4	24	5	-3 +7	-6 +2	(93)	(93)
							LH HL	LH HL	nl 89	89
8 m	1	4	5	1	10	2	0	-1	98	97
sd	1	3	4	2	6	4	4	4	3	4
nl	2	7	9	3	16	6	-4 +4	-5 +3	(95)	(93)
							LH HL	LH HL	nl 92	89
9 m	1	2	4	1	7	2	1	-2	98	98
sd	1	2	2	1	5	3	3	3	3	3
nl	2	4	6	2	12	5	-2 +4	-5 +1	(95)	(95)
							LH HL	LH HL	nl 92	92
10 m	0	2	3	1	6	1	0	-1	98	98
sd	1	2	2	1	4	2	3	3	3	2
nl	1	4	5	2	10	3	-3 +3	-4 +2	(95)	(96)
							LH HL	LH HL	nl 92	94
11 m	0	1	3	1	5	1	0	-1	98	97
sd	1	1	2	1	3	2	2	3	3	3
nl	1	2	5	2	8	3	-2 +2	-4 +2	(95)	(94)
							LH HL	LH HL	nl 92	91
Adult										
m	0	1	1	0	2	0	0	-1	98	98
sd	0	1	1	0	2	1	2	1	3	3
nl	0	2	2	0	4	1	-2 +2	-2 0	(95)	(95)
							LH HL	LH HL	nl 92	92
60-69										
m	1	2	3	1	7	2	1	-1	95	95
sd	1	2	3	1	4	3	3	3	4	5
nl	2	4	6	2	11	5	-2 +4	-4 +2	(91)	(90)
							LH HL	LH HL	nl 87	85

NOE norms for scoring SSW/WDS, based on C-NS-85 data. Order (1st Spondee - 2nd Spondee) and Ear (REF - LEF) Effect difference norms are set ±1sd. Significant HL (high-low) and LH (low-high) values are beyond these limits. The nl for WDS are set at -2sd below the mean. [m* = mean, sd = standard deviation, nl = limit of normal range, which is set at +1sd for first 6 columns] jk 12/7/94

1. fear, distractability or attentional problems
2. severe decoding difficulty at cerebral level
3. brainstem level disorder

In each case above, except perhaps for #1 above, it is not beneficial to correct the SSW score for WDS, because we are subtracting out a central factor on a test of CAP. In some cases this makes a significant difference in our findings by eliminating or reducing the percent of error and subsequently making the problem appear less severe. We have all seen overcorrected scores (that we know to ignore) in CAP cases, but the NOE approach circumvents this problem.

STATISTICAL LIMITS FOR EAR AND ORDER EFFECTS:

I was quite content to believe that Ear and Order Effects were assessed in a procedure that was as good as could be designed. I had worked with a statistician years ago and asked him to find the best cutoff points for Ear and Order in evaluating CNS lesion cases. He indicated that the ±5% that I used was as good a cutoff as he could calculate.

Of course, I did not imagine that there could be a better, or different approach to assess Ear and Order. I did not consider a variation even for assessment of CAPD. Early this year I had a visitor from Chile. His name is Hernan Soto-Ramos. He came to work on the norms for the Spanish Language Version of the SSW test.

Professor Soto-Ramos suggested that we calculate a statistical norm for Ear and Order, just as we had for each of the other features (perhaps even Type A, but I can't remember what we did for that measure. For the time being there will be no change in the Type A).

After arguing with him for a while I realized that he was entirely correct. We then worked on a statistical norm for the SLV-SSW and it seemed very effective. So much so, that I thought that we should all have benefit of Hernan's approach.

It is particularly well suited to the study of CAP, as we generally think of this group as a relatively normal population, except that they fall at the poor end of the continuum. If so, we could employ a statistical measure for Ear and Order Effects. By subtracting errors on one half-test from the other, positive difference scores tell us "high-low" and negative "low-high".

The calculation that is made for Ear Effect is: REF errors minus LEF errors. The calculation for Order Effect is: first spondee errors minus second spondee errors.

This calculation should improve the slight "tilt" of the SSW that is in favor of showing anterior Response Bias (Ear L/H and Order H/L) in the present system. Now because we take a statistical approach, the mean will reflect this influence on the results. Thus for Order/Ear Effects, statistically it will be equally likely that a person will deviate in the direction of a short-term auditory memory deficit as a deviation showing poor decoding.

In summary, it seems that the two additions, that are suggested here, will make the SSW a better test. We shall discuss hit-miss ratios and also the use of standard scores in coming issues of SSW REPORTS.

The remainder of this issue will be devoted to a review of the scoring procedures and a comparison of the C-SSW and NOE analyses. Thus far we found the NOE to be, at least, as sensitive as the C-SSW.

HOW TO CALCULATE NOE: An eight-year-old is tested with the SSW and the results show the following 8CNs:

6 8 4 2 4 5 4 0

The combined totals are:

RNC	RC	LC	LNC
6	12	9	6

These scores are brought to the front sheet of the test form and put into the appropriate boxes for calculating R-SSW scores. At the bottom of the rectangle, for R-SSW calculations, is a little space that may be used for putting the NOE norms below each of the four columns.

For C-SSW, we would multiply each value by 2.5, correct for WDS, and then look up the C-SSW norms in the manual. You will see the NOE procedure is much simpler. 8-year-old NOE norms are:

RNC	RC	LC	LNC
2	7	9	3

Generally, we circle the significant scores so they can be easily identified. Six is greater than 2, so RNC is significant, 12 is greater than 7, so RC is significant, but 9 is at the normal limit for LC so it does not reach significance, and finally, 6 is greater than 3, so LNC is also significant.

Had we multiplied the combined totals by 2.5 we would have gotten the following R-SSW scores:

RNC	RC	LC	LNC
15	30	22	15

When we subtract out the WDS % error (RE = -10, LE = -8) we get:

RNC	RC	LC	LNC
5	(20)	18	(7)

Here we see two of the Conditions fall just within normal limits. Had the WDS been better, they would have been significant. In this case we would have gotten the decoding information anyway, but with NOE it was more complete. Let's see what we can learn about WDS from the NOE analysis.

For an 8-year-old, the normal limits for WDS are set at +2sd (although the +1sd cutoff is also shown). The limit of normal for the RE is 92% and for the LE 89%. Thus, in this case the child's WDS is significantly depressed in the RE, but within normal limits for the LE.

Whenever I see poor discrimination in the face of normal hearing, it makes me a bit uneasy. Is it because of anxiety, fatigue confusion etc. or is it part of the CAPD? If WDS is less than 90% I would certainly encourage a retest. By use of NOE the poor WDS will not throw off the SSW findings and the -2sd WDS cutoff provides a good yardstick for deciding when to be concerned. Parenthetically, some of our patients with poor WDS who do not prove normal on WDS retest, have shown abnormalities on ABR.

Let's take a look at what else NOE provides. The patient had a total SSW error score of 33. For an 8-year-old this is very poor. We see that 16 is the limit of normal so that 17 errors or more would be significant. With a sd of 6, overall this child falls 3 sd poorer than the mean for age 8.

For Ear and Order Effects we use the information from the third sheet of the SSW form. For Order we subtract the second spondee errors from the first spondee errors. This gives us 23 - 10 or a difference of +13. From Table 1 you can see that the normal range for Order (age 8) is -4 to +4. This child deviates quite a bit in the positive direction which according to the table is Order H/L (a sign of TFM or more specifically short-term memory difficulty).

For Ear Effect we subtract the LEF errors from the REF. Thus, 20 - 13 = +7. Table 1 shows the Ear norms from -5 to +3. The +7 is well beyond the normal range and therefore an Order Effect H/L (see Table 1).

CLINICAL CASES

There was no attempt to select good or bad cases for this presentation. I only looked for some random patients from the clinic files.

AGE		RNC	RC	LC	LNC	TOT
6	CSSW	(18)	(48)	37	(12)	-
	NOE	(7)	(19)	(18)	(8)	(52)
NOE	NORM	(4	10	15	5)	(30)

The CSSW showed the RNC and RC conditions to be significant. On the other hand the NOE found each of the four conditions to be beyond the limits of normal. By chance, in this first case the NOE helped us to see part of the child's problem that CSSW may have missed. It also gives us an overall feeling about the severity of the score when we look at the Total error score. She had 52 errors. Table 1 shows the nl to be 30, so it is well outside the limits of normal. The sd is 9 so we can say that the child was 3 sd poorer than the average child in the normative study.

The second case is shown below.

AGE		RNC	RC	LC	LNC	TOT
6	CSSW	-8	4	-2	-15	-
	NOE	3	8	7	2	20
NOE	NORM	(4	10	15	5)	(30)

This case is quite different. You will see that each of the 4 conditions and the Total were within normal limits. It is interesting to note that this child had abnormal WDS in each ear. The WDSs were 80 and 64% in the right and left ears respectively. The norms in the table show 89 and 88%. Thus, in each case (but especially in the LE) the child's scores were below normal.

This procedure alerts us to the fact that one of the three groups of problems (noted earlier) might account for the deviations in WDS. Because it was a 6-year-old, we retested WDS using the same list live voice. The results were 84 and 80%. These are not normal scores and need to be checked out further. Sometimes the rest of the battery reveals the reason, or a retest or ABR should be carried out, I feel.

The third case is shown below.

AGE		RNC	RC	LC	LNC	TOT
5	CSSW	(23)	43	(66)	1	-
	NOE	(7)	(11)	(14)	1	(33)
NOE	NORM	(2	10	12	5)	(26)

Of course, we gave only 20 items for this 5-year-old. You can see that the RC score was normal for CSSW but abnormal on the NOE analysis. The reason for missing the RC problem is no doubt the poorer WDS in RE (88% at limit of normal), but NOE is not restricted by this. More of the NOE work in the coming issues.