SSW REPORTS . . .

1. **Central Test Battery - CD**
2. **SSW: What to Expect on Re-Test**

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CENTRAL TEST BATTERY - CD WHAT TO EXPECT FROM IT

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For the past few years audiologists have asked to have the SSW on CD. I have been working, for a year or so with the folks from Precision Acoustics to produce a valuable battery of central tests.

We tried to produce more than just a group of central tests. Rather a test battery that provides the audiologist with a complete package for diagnosis and efficiency. In addition there are a variety of perks for the busy clinician. Here are the tests:

- **Word Recognition/Discrimination Score** (WDS) materials are included for both **Quiet and Noise** conditions (this will be discussed in greater detail).
- The same old **SSW** test (list EC) comes next, noise floor and all (but clicks and pops are minimized).
- The **Phonemic Synthesis** (PS) provides test material for school-age children.
- **Phonemic Synthesis Picture** (PS-P) is the test that follows. It is used for children 4 to 7 years of age (from preschool to first grade).
- **Competing Environmental Sounds** (CES) test is next. It is the same test that has been available for many years.
- The last test is **Phoneme Recognition Test** (PRT) that might not sound familiar to you. It is a test that I developed to evaluate the phonemic perception of patients with a cochlear implants.

General Considerations

The Central Test Battery (CTB) CD contains a group of central tests that can be administered in less than one hour and will provide a great deal of information about the patient as well as what may be done to aid the individual.

It is the same battery that many of you already use, but it is more powerful and time saving. One CD is used instead of three or more cassette tapes. Thus, there is only one calibrating tone and the audiologist can go from one test to another simply at the touch of a button.

A major benefit is that unlike tapes, the CD is a complete Speech-in-Noise test. Thus each clinician is NOT responsible for getting a group of normal children to calculate the normal limits. With cassette recordings we need to get such norms and must also renorm with each change (e.g., a new audiometer or test tape). Because tapes wear out and age deteriorates their quality, tapes represent a moving target. This is not the case with CDs that are essentially permanent.

Quality of Recording

WDS

Not only do tape recordings get beaten up, frayed with time, and lose their fidelity but the master recordings themselves lose their quality even when stored under ideal conditions. This is perhaps the most important reason for changing to a CD. I have noticed that the Hirsh W-22 recordings in the last few years have not given as good results as in previous years. This is not surprising after almost 50 years and changing from a phonograph record to a reel-to-reel recording and finally to a cassette.

When the compact disk was made the recording engineer was asked to return the quality to the recordings as much as possible. First the signal was enhanced in the 2-3k Hz region, but the high frequency consonants were still too faint in some cases so further enhancement was made.

Other Tests

Other tests also required some improvements. The SSW needed similar attention but not to the extent of the W-22s that have been around for a very long time. The CD will now be used by Precision Acoustics as their master for future cassette recordings. Thus the CD enhanced quality will preserve the regular tape recordings as well.

Improve Speech-in-Noise Test

We believe that the CD will offer a better speech-in-noise test because it is a very specific procedure, unlike most of the tests we have used in the past. It also will be unnecessary to obtain your own norms! Rather national norms can be employed.

It is well recognized that one cannot use the S-N norms from another clinic. Everything is critical in a S-N test. Some people use NU-6s, others W-22s and there are various voices used to record them. Even with the same test and speaker we generally select whatever list is handy (1A, 3A or whatever) as though they were interchangeable, but they are not. Even the noise sources used by the audiometer manufacturers may vary. Several years ago when we changed from a GSI 1701 to a GSI 10 we noted a large reduction in the noise scores. It became obvious that the new speech-spectrum noise was much more potent than the previous one. We had to change the S/N ratio to +10 dB and renorm.

In addition to these variations, as a tape ages there is potential alteration in the difficulty level of the material, especially the S-N task. All of these factors tend to make the audiologist uneasy about the S-N norms. The new CD should add greatly to the consistency and accuracy of the S-N measure and to the tester's confidence.

The CTB-CD improves the situation for the audiologist by providing a nationally normed S-N test. The CD is considered a permanent recording and therefore both the speech and noise are expected to last until after you retire (assuming that they are not damaged or get dirty).

The stability of the message is assured. Our next concern is what specific speech and noise can be used to provide a strong consistent national norm? The norm is based on specific speech and speech-spectrum noise. Instead of giving people options in choosing a test list for the quiet and noise portions of the test, specific half lists are used (list 1A for quiet and list 3A for noise) for consistency. Therefore, if there are more difficult words for a particular age group on a list this will be reflected in the norms and therefore should not interfere with an accurate assessment. Thus the variation noted in S-N tests as a result of using different lists or half lists will be avoided.

New Tests Available

Speech-in-Noise (S-N)

The S-N test is not an entirely new one but it is significantly different from previous versions typically used by audiologist to warrant mention here.

CTB-CD offers a specific set of lists to use with a specific S/N ratio (+5dB) and a specific presentation level (40dB SL) that we believe will help to reduce to wide variability noted in S-N tests. Of course the WDS that is obtained is not specific to central testing and can be used for the basic word recognition test as well.

Phonemic Synthesis Picture (PS-P)

The PS-P is an excellent test of CAP function that may be used for children 4 to 7 years of age. It is appropriate for preschool to first grade children. It overlaps with the regular PS test for the first grade. It is better than the regular PS test for early-to-middle first grade. It is not for 7 year olds in second grade or above.

This multiple-choice test has been used for the past 30 years with considerable success, but is only now being released commercially. It provides not only general information about phonemic problems but also about signs of both Decoding and Tolerance-Fading Memory problems.

Phonemic Recognition (PRT) Test

PRT is a test that was devised for evaluating patients who have cochlear implants (CIs). I view the perceptual difficulties of those who have CIs to be similar to phonemic Decoding problems, but much more severe than seen in CAP cases. PRT might be applicable for other patients with hearing losses.

PRT correlates with the standard WDSs in patients who have CIs. When we have done phonemic therapy with these people we have seen improvement in both PRT and WDSs even though little if any word training was given. Similarly, performance on Everyday Sentences improved with no training with connected speech. So I feel that PRT is an important measure to help clarify perception at the phonemic level.

PRT contains 34 phonemes that are presented twice each, to determine not only the overall level of perception but also how severe the errors are and what are the specific confusions. A computer program is in preparation to analyze the patient's performance and to provide a confusion matrix for up to 20 individual tests.

In summary, the CTB-CD appears to bring CAP testing up another notch. Oh yes, it is available from Precision Acoustics (360- 892-9367).

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THE SSW SCORE ON RETEST: HOW TO PREDICT THE RESULTS

Jack Katz, Kim L. Tillery and Reva Batheja

If you know the person's score on the first administration of the SSW you can make a calculated approximation of the second test.

Some audiologists routinely retest the SSW 6 months or a year following the initial test, others of us give retests in special cases. Often we don't know how much of the change is due to therapy, maturation, or in learning how to take the SSW test.

Unlike IQ and puretone threshold tests we do not believe that CAP tests re-

main unchanged on retest. IQ and hearing are considered stable functions, but auditory perception is a continually changing function (e.g., we get used to a person's speech pattern and understand better and better). Although we could expect those who have better perception to understand a foreign speaker better than a person who has poor phonemic perception, both should improve on retest but the better listener will still be ahead. How much learning is expected after a person has taken 40 SSW items?

Let us use a another example. A 10-year-old boy comes to the US and holds a football for the first time. When he throws it, the ball falls far from the mark and its motion is wobbly. After 40 throws practice is over. But the next day he will be much improved if he learned from his experience.

A Previous Study

Katz and Kram (1993) studied the records of 47 children who were tested and retested as part of a Ritalin study in the late 60s. There was no significant difference in the SSW performance between Ritalin and Placebo conditions. Therefore it was possible to use the data to study test-retest results. There was a strong .91 correlation for test-retest. On retest the score improved by 4 errors (about 33%).

Correlations Help

A child's height at 5 years and at 6 years is highly correlated. But of course the absolute values are quite different (taller at 6 years). Test result can be highly correlated on retest with different magnitudes.

There are two uses for correlation in our work. We can use it as a measure of validity and we can use it to predict performance on retest. To save space we will limit our discussion to prediction on retest.

Influences on Retest Score

We are interested in predicting retest scores. In addition to the learning effect there is also maturation consider. We expect children to improve in perceptual competance as they get older. Therefore, after 3 months we may see a significant improvement due to maturation as well as learning. Perhaps two to four weeks between test and retest would be ideal to study learning.

Tillery (1992) Study

Tillery (1993) data gave us an opportunity to study the effects of learning on retest. She evaluated 34 children who had both ADHD and CAPD. Half were tested first on Ritalin and then on Placebo. The other half were tested in the reversed order. There was an average 7½ week interval between tests. As in the case of the Ritalin-Placebo study reported by Katz and Kram, there was no significant difference between the 2 conditions and therefore Tillery's results were studied for test-retest differences.

The correlation between the first and second tests was a very strong .94. As in the other studies the SSW showed a high level of consistency on retest. Table 1 shows the NOE means and SDs for the two tests.

	Test	Retest
Mean	15.5	12.4
SD	11.0	12.7

Table 1 (above) shows an improvement of 3 errors on retest. This represent an 19% benefit over the initial test. This is likely the effect of learning and little, if any maturational effect. Without other data to support this or the larger differences reported by Katz and Kram, we will assume that this is the purer learning effect as the 1960s study had a longer interval between test and retest.

Table 2. Prediction of NOE Total Error Score on Retest Based on Initial Test Score. Lower and Upper Limits of Prediction Shown for 1 and 2 Standard Deviations. Based on results of Tillery, 1992.

Total NOE Test 1	Prediction of Test 2	Lower Limit 1 SD	Upper Limit 1 SD	Lower Limit 2 SD	Upper Limit 2 SD
1	0	0	2	0	6
2	0	0	3	0	7
3	0	0	4	0	8
4	0	0	5	0	9
5	1	0	6	0	10
6	2	0	7	0	11
7	3	0	8	0	12
8	4	0	9	0	13
9	5	1	10	0	14
10	6	2	11	0	16
11	7	3	12	0	17
12	9	4	13	0	18
13	10	5	14	1	19
14	11	6	15	2	20
15	12	7	16	3	21
16	13	8	17	4	22
17	14	10	18	5	23
18	15	11	19	6	24
19	16	12	21	7	25
20	17	13	22	8	26
21	18	14	23	9	27
22	19	15	24	10	28
23	21	16	25	11	29
24	22	17	26	12	30
25	23	18	27	13	31
26	24	19	28	15	32
27	25	20	29	16	33
28	26	21	30	17	34
29	27	22	31	18	35
30	28	23	32	19	37
31	29	24	33	20	38
32	30	25	34	21	39
33	31	26	35	22	40
34	33	27	36	23	41
35	34	28	37	24	42
36	35	29	38	25	43
37	36	31	39	26	44
38	37	32	40	27	45
39	38	33	42	28	46
40	39	34	43	29	47

Table 2 (continued). Predicting NOE Total Error on Retest

Total NOE Test 1	Prediction of Test 2	Lower Limit 1 SD	Upper Limit 1 SD	Lower Limit 2 SD	Upper Limit 2 SD
41	40	35	44	30	48
42	41	36	45	31	49
43	42	37	46	32	50
44	43	38	47	33	51
45	45	39	48	34	52
46	46	40	49	36	53
47	47	41	50	37	54
48	48	42	51	38	55
49	49	43	52	39	56
50	50	44	53	40	58
60	61	55	64	50	66
70	72	65	74	61	79
80	83	76	85	71	89
90	94	86	95	82	100
100	105	97	106	92	110

Predicting the Total Score on Retest

Table 2 shows the predictions for Total Error scores. Simply enter the Total Errors for the first test (col-1) and read out the prediction (col-2). The next 2 columns give the range of scores for ± 1 SD. Also shown are the 2 SD ranges (including 95% of the subjects) (Runyon & Haber, 1967).

An Example or Two

You tested Mary who is 7 years of age. She performed very poorly so you see her again in 6 months. In 6 months there will be a potential improvement due to maturation as well as learning. The mean Total NOE score for 7 years is 15.7 and 9.5 for 8 year olds, so in 6 months there could be an improvement of (on the average) 3 points in normal control subjects.

Mary's score on test-1 was 42 and a score of 30 on retest. Check Table 2 to see what you would predict with a score of 42. Above you can see that one would predict 41 as the retest just based on learning, but 68% of the time (1 SD) we could expect the score to be 36 to 45. The 30 is beyond that and beyond 2 SD as well. The change seen here is much more than we could account for by learning from test-1 so we must conclude that it is due to maturation or training.

Case 2 is Johnny who is 10 years old. He underwent Auditory Integration Training (AIT) for 10 days. You tested him before and after to see if any improvement showed up on retest. His initial Total Error score was 20 (you can see that we would predict 17 as his retest score based on learning). He gets a score 14, an improvement of 30%! Was this due to AIT or learning? Well 68% of the time we could expect a score between 13 and 22, so 14 is not too impressive.

In the future we will try other databases to get the most reasonable predictions.

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