

SSW Reports

- Buffalo Model is Beautiful
- Some Interesting Cases

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In my opinion
The Buffalo Model is Beautiful
Jack Katz

The Buffalo Model is composed of three tests: the SSW, Phonemic Synthesis and Speech in Noise procedures. Each test contributes importantly and uniquely to the diagnosis of APD as well as permitting us to make non-generic recommendations.

APD experts agree that a battery of tests is required to properly diagnose APD (and surely a battery is needed to categorize APD). No one test can be relied upon because in some cases the least sensitive test may provide the most information while our best test may contribute only marginally or not at all. No doubt we see this and other peculiarities because of the complexity of: APD, our tests, and of human beings, as well as the influence of the person's prior training which can affect APD test results.

Some Considerations for Each Test

The SSW test is a dichotic procedure and the only one in the battery that requires more than a one-word response. Because of the complex pattern of stimulation and the 4 words in each item, the listener must depend on both working auditory memory and sequencing skills so we may observe evidence of these problems as well. In addition, all speech tests require auditory Decoding to a greater or lesser extent. The more rapid or difficult the task the greater the challenge for quick and accurate Decoding. Because of the complex pattern of presentation and counter-balancing, the SSW offers many observational opportunities which, in turn, offer additional diagnostic insights. The SSW contains information about all four APD categories in the Buffalo Model.

As mentioned previously in SSW Reports and elsewhere the SSW (and no doubt other tests) has "internal dynamics". This refers to the changes in one aspect of the test as a result of behaviors/findings on other aspects. For example, as the number of SSW errors goes up, the chances of having reversals goes down. This is because items with 2 or more errors cannot be counted as reversals and the fewer words there are to repeat the easier it is to sequence. Another common example is the Type-A pattern that voids significant Ear and/or Order Effects because the peak of errors is not a result of the usual DEC or TFM errors but likely due to difficulty associated with crossing the corpus callosum to the language dominant hemisphere. The SSW is not a timed test so the person can take extra time to figure out the answers. While this reduces the number of errors on the test we compensate by counting the delays (a DEC sign). Recently a child "beat" the SSW test (i.e., normal total score) but had 35 delays! Delays are counted only when the item is completely correct. This suggests that the person needed more time to figure out the answers. Indeed this child indicated that the test was very difficult for him. Thus, internal dynamics permit the person to use their compensatory behaviors but thereby reveal the basic problem and how they deal with it. This gives us and the parents insights into the problem and why their children so often delay etc.

The Phonemic Synthesis test presents the listener with individual speech sounds which must be recognized, remembered and blended together in order to determine the correct word. This test is most heavily weighted on Decoding as it requires phonemic discrimination, phonemic memory and phonemic synthesis. These three skills are closely and uniquely associated with the auditory cortex of the temporal lobe (Luria, 1966; 1970).

In addition to the Decoding challenge the PS test taps both Tolerance-Fading Memory (TFM) and Organizational (ORG) skills. Short-term auditory memory deficits can contribute to errors on this test. While phonemic memory is associated with imprecise identification/recall of the sounds that were heard, the auditory memory problems are associated with omission of the first sound of the word. Because two or more phonemes are presented for each item, sequencing difficulty can be identified by reversals of the sound order (e.g., "goats" may be said for "ghost" or "came" for "make"). It is interesting to note that typically those who have word order confusions do not have speech-sound reversals (indeed some have both). The PS test can provide important information dealing with DEC, but also TFM and ORG.

The Speech in Noise (SN) test is the third unique procedure in the battery. As in the case of the PS test, the SN procedure focuses primarily on one skill, but not exclusively. On this test the major factor is SN ability which is associated with TFM. In this procedure each ear is evaluated separately, with and without background noise, and performance in each ear is compared with one another. As in the case of all speech tests Decoding can play a role in the person's performance; but, speech in noise skill is the primary factor.

Putting the Pieces Together

Because no test can be relied upon exclusively; we use the test battery approach to determine APD. To identify the underlying factors in a person's processing difficulty we go further by looking at aspects of the test that load on different auditory processing skills. In this way we are able to identify important characteristics of the problem which can then be addressed therapeutically by use of strategies or with compensations.

In the Buffalo Battery we have over thirty identifiable characteristics which help us to understand and treat (with considerable success) a person's underlying APD. Two factors were significant 64% of the cases: SSW NOE Total and LC (Katz & Marasciulo, Feb. 2001 SSW Reports) but median sensitivity was only 13% and Quiet Rehearsals was significant 1% of the time. Just as in the case of an auditory processing battery no one individual factor can be

counted on in any particular case. However, these factors when taken together (as you have probably seen) the Buffalo Battery is quite sensitive and accurate in diagnosing the problems and identifying the likely categories.

We generally look for patterns of errors to see which of the four categories, have two or more significant characteristics. The more characteristics that are significant for any one category the more likely that the diagnosis is correct.

Testing the Hypotheses

As discussed in the November 2006 SSW Reports, we use outside criteria to help validate our findings. Generally, the school and communication problems coincide with the specific APD categories identified by the Buffalo Battery. In some cases there is a factor (or even two) identified by either the tests or the case history/BMQ, but not both. In such cases we try to resolve which is correct. Because of the various indicators of the Buffalo Battery it generally requires very little head scratching to determine if there is APD or not. Typically, the test findings agree with the questionnaire, but because of the small number of factors in the battery that identify ORG and INT, some times the facts "on the ground" are more sensitive than the battery of tests. As noted in the last issue; questionnaires may be imprecise but here again the use of multiple questions is more likely to bring out the accurate information.

Discussion

The first version of the SSW test was recorded 45 years ago; the prototype of the PS test was recorded 50 years ago and my first speech in noise tests were developed 40 years ago. Each was developed for a different purpose and were very different types of tests. This serves us well now because together they form (in my opinion) an excellent APD battery. Each day I go to work with full confidence that the Buffalo Battery with the case history and Buffalo Model Questionnaire and some experience in working with them will provide valuable information that will help a child (and their family). They generally get insights to better understand the problems and we are able to make appropriate and effective recommendations for remediation of the problems.

Many years ago an audiologist (George Lynn) who was heavily involved with central testing said that he wanted to use the SSW test but would only do it if I could "prove" that it was effective. I suggested that he send me brain lesion cases to see if I could locate their site of lesion. My only request was that the cases be ones that were not oddballs that no one could figure out. Without benefit of case history or other information I interpreted the SSW results in the standard fashion for the 6 cases he sent. He indicated that each was correct and indeed he began using the SSW test.

While the MRI is far better a site-of-lesion tool than any APD test, even the radiologists require a through case history to know where to look and to aid in their diagnoses. So I was very pleased that I identified the 6 cases correctly. Often we can do the same even for developmental APD problems but to work without good case histories especially for APD is over the top. The bottom line is to correctly diagnose APD and check it out with the history information.

I am gratified from talking to many audiologists who use the Buffalo Battery that they too are effective diagnosticians using these tests.

Some Interesting Cases
Jack Katz

In the article above I pointed out how complex the Buffalo Battery tests are, especially the SSW. Nevertheless, or because of this, it has turned out to be a wonderful test battery for APD and a powerful method for understanding the complex underlying problems. Hopefully most of you need little convincing as I know that many have used these tests for years with good to great success.

Hopefully, to support some of my points I have chosen randomly cases that meet certain criteria. Criteria: ages between 6-18 years with no known CNS lesions, had all 3 of the AP tests, completed the AP therapy program and were diagnostically challenging/interesting. Therapy cases were used to insure that there were both test and retest data (to look for confirmation or for new information as well as to establish what tended to improve on retest). 'APD NOS' are those signs that show APD but are not otherwise spec-

ified into a single category. The questionnaires for these children had only positive responses so only ratings 5-7 (slight improvement to great) are shown (on the 4th table for each case).

Case #1

Name: Wilma **Age:** 11

Reason for Evaluation: to better understand Wilma's problems and best ways to deal with them.

Hx: Wilma's speech development was very slow, she said words at 4 years and sentences at 5. She has a visual perception problem and has had 9 months of vision therapy. Wilma was noted to be forgetful, mixes up sounds, says "huh" and "what" a lot and is 1 to 2 years behind in most academic subjects (e.g., phonics, spelling, reading comprehension and reading word accuracy). Wilma relies on vision at school.

Table 1. Significant results on test battery

1- Initial	SSW	PS	SN
DEC	RC; LNC; P; X	QT; QL; P; X; NF	.....
TFM	TTW	Q; 1 st	RE. LE
INT	Type-A	.....	.....
ORG	Rev (@NL)	Rev	.....
APD NOS	Tot; RNC	.....	.....

X=delays, P=perseveration, TTW=tongue twister, Q=quick response, 1st=omit 1st sound, NF=non-fused, QT/QL=quantitative/qualitative score

Table 2. (Left) # of positive vs. total questions; (Rt) sum of the information in Tables 2 & 1 (test)

2- Initial	BMQ	Ca Hx	Ques Σ	Test Σ
DEC	3/8	2/3	Yes	Yes
TFM	5/14	5/5	Yes	Yes
INT	2/6	-	Yes	Yes
ORG	0/3	-	No	Yes
APD NOS	-	0/2	1	Yes

¹ all were specific signs, none were general signs

Note that in this case on the SSW test there was just one reversal which is equivalent to the normal limit (NL). Under ordinary circumstances we would consider this not significant; however, Wilma had 45 errors on the SSW test (which made me suspect that *internal dynamics* were at work) because she had two or more errors on approximately half of the items. This cut in half the chances of having significant reversals. To keep her going I gave some unscheduled breaks which also tend to reduce reversals. Otherwise I suspect reversals might have been significant.

Although reversals were not supported by the BMQ, they were supported by her performance on the PS test and on both SSW & PS retests. With regard to INT, those with Type-A's very often have scores that are ≥ 3 SDs poorer than the mean on some aspects of the battery. In this case, the SSW Total & LC, and PS Quant & Qual indicators were all >3 SDs poorer than the mean.

Wilma did extremely well in therapy. It consisted of Decoding and speech in noise training. Phonemic training was most challenging for her. For example, on the Phonemic Synthesis therapy program, lesson #5 (out of 15 lessons) which is quite easy, she had only 13 out of 19 items correct. It often required 4 trials for her to complete various lessons and she did not get beyond #9 in the therapy program. Most children complete the training within an average of 13 sessions, but Wilma was nowhere near completion after 15 sessions. In retrospect, Wilma's difficulty in improving her decoding skills lends further support to an INT disorder as INT cases frequently have tenacious learning problems. Wilma did quite well on speech in noise training which was confirmed by large improvements on the speech in noise retests for each ear.

Of the 22 test battery indicators that were significant initially, all but two of them showed improvement on retest but 12 of them remained outside of normal limits.

Table 3. Significant results on retest

3-Re-Eval	SSW	PS	SN
DEC	RC; LNC;X	QT;QL; NF	.....
TFM	TTW	-	
INT	Type-A	.....	.....
ORG	Rev	Rev	.....
APD NOS	Tot; RNC	.....	.....

Wilma greatly reduced her errors on the 3 tests of the Buffalo battery (e.g., SSW: 45 to 17 fewer errors, PS: 13 to 20 correct, and SN: 60% to 84%) but clearly did not resolve her APD to a near normal level. While we would have liked all of the indicators to be normal after therapy; that would be unrealistic given the breadth and severity of her APD. A 2nd round of therapy to address DEC and dichotic listening issues was recommended for Wilma (after a mandatory 2-month "vacation" period) in order to work on the remaining issues, but the family declined.

Table 4. BMQ question ratings of improvement over therapy period: 7=great, 6=mod, 5=slight

4-Re-Eval	BMQ- Change
DEC	5, 6, 5, (6, 7, 5) ¹
TFM	6, 6, 6, 6, 5 (6, 6, 6, 7)
INT	5, 5
ORG	initially none on BMQ
APD NOS	7, 6, 5

¹ scores in parenthesis are for items not previously circled but were included because we suspected that these problems had improved.

Based on the BMQ questions which concerned the family initially, Wilma's mother indicated generally moderate (#6) improvement. It is of interest that items associated with DEC and TFM which were not initially listed as concerns (see Table 4 in parentheses) also demonstrated a great deal of improvement. This is fairly consistent with what we see with other parents who fill out questionnaires. They may not be fully aware, may not understand, or for some other reason did not circle certain items. But when improvement is seen they realize that the child is doing much better with it. Unfortunately, I didn't ask about sequencing or other characteristics that we associate with ORG on this follow up. Note that we do not directly address either INT or ORG in the first round of therapy. Quite often improvement is shown on these aspects (as well as on our tests) likely because better decoding reduces the ORG, short-term memory and INT loads. Also both speech in noise and decoding training help to improve auditory attention.

Wilma turned out to have more severe APD than typical, but this case shows the potential complexity of APD and how audiologists can suspect/look for/interpret the results more sensitively and thereby increase effectiveness.

Case #2

Name: Helen Age: 7

Reason for Evaluation: a psychologist indicated that Helen likely has auditory processing and short-term memory problems. If so, the family wanted to know how to deal with the APD.

Hx: Helen was born six weeks early, was on oxygen and required a feeding tube. She had a hole in her heart until four months of age and also had many ear infections. Helen was diagnosed as having ADHD and had intensive phonics, reading and writing help.

Table 5. Significant results on test battery

5- Initial	SSW	PS	SN
DEC	LNC, X, P	X	-
TFM	LC, SM	Q	RE, IAD
INT	-	.....	.....
ORG	Rev	-	.....
APD NOS	-	.....	.....

Children who have early intervention are most fortunate. Helen had intervention in her early school years. This surely had a positive effect on her development, but still she had persistent academic difficulties that were not sufficiently remediated. From the standpoint of evaluation, early or previous intervention sometimes makes it more difficult to see a clear picture on APD tests. In this case, Helen had several normal scores on the SSW and Phonemic Synthesis measures. Nevertheless, although we have less information to work with, typically there are enough positive findings to provide a reasonable diagnosis of APD and the likely categories.

Table 6. (Left) # of positive vs. total questions; (Rt) sum of the information in Tables 2 & 1 (test)

6- Initial	BMQ	Ca Hx	Ques Σ	Test Σ
DEC	4/8	1/3	Yes	Yes
TFM	8/14	4/5	Yes	Yes
INT	1/6	-	No	No
ORG	1/3 ¹	-	Yes	Yes
APD NOS	3/5	1/2	Yes	Yes

¹ the 1 critical factor, sequencing.

We put heavy stock on what the school and parents have to say, but believe strongly in our tests and the need to 'get it right'. There was excellent agreement between our tests and problems noted by the school and the parents.

Table 7. Significant results on retest

7-Re-Eval	SSW	PS	SN
DEC	X	-	.....
TFM	SM	-	-
INT	-	.....	.....
ORG	Rev	-	.....
APD NOS	-	.....	.....

Helen had only nine sessions of therapy. She was a fast learner, and I'm quite sure that a good part of her rapid success was due to her earlier therapies. Of the original 10 factors that were significant on the initial test, 3 remained positive on retest. As in the previous case speech in

noise was normal on retest and a more typical reduction on the other tests was shown.

Table 8. Parent/school ratings of improvement over therapy period: 7=great, 6=mod, 5=slight for questions on the Buffalo Model form.

8-Re-Eval	BMQ- Change
DEC	6, 6, 7
TFM	6, 5, 5, 7
INT	1
ORG	
APD NOS	7, 6 ²

¹ dyslexia was noted initially but on this reassessment her mother indicated "NA" next to dyslexia.

² factors e.g., O.M. are not included on retest form

The family's/school's responses and Helen's steady improvement on the therapy materials help support our retest findings and no dyslexia.

Case #3

Name: HL Age: 6

Reason for Evaluation: tested by a psychologist and found to have symptoms of APD.

Hx: O.M. as a toddler, ADHD-inattentive type, on Ritalin, ODD, learning and social issues. In preschool HL had intensive phonics and language training. Some characteristics of APD on the case history are: forgetful, sensitive to loud sounds, trouble following directions, and difficulty learning phonics.

Test behavior: became frustrated, was given several breaks between and during tests (e.g., SSW 3 breaks). HL was cooperative and liked setting up the audiometer for me. Sometimes he had no responses and just a blank look suggestive of Integration Delays.

Table 9. Significant results on test battery

9- Initial	SSW	PS	SN
DEC	LNC, X, P	QT, QL, P, NF, QR	.....
TFM	LC, OHL, Q	-	RE, LE
INT	-	.....	.....
ORG	Rev	-	.....
APD NOS	Tot	.....	.....

HL had a fairly typical number of significant findings on the test battery. Three of the four test categories were supported by the Buffalo Model Questionnaire that was filled out by the family. The one difference related to the signs of INT noted in the questionnaire but not seen in our test results.

The question of whether there was an INT problem or not was of interest, but not a critical issue that had to be solved at that time. In my practice INT and dichotic listening are addressed in the second round of therapy, if the signs are present on retest. We often find that Integration signs are eliminated following therapy. One of the factors that would discourage a Type-A pattern in this case is the 45 errors that HL had on the SSW test. Thus, we could neither confirm nor rule out INT at the initial evaluation.

Table 10. Number of positive vs. total questions; sum of the information in Tables 2 & 1 (test).

10- Initial	BMQ	Ca Hx	Ques Σ	Test Σ
DEC	3/6	0/3	Yes	Yes
TFM	8/13	2/5	Yes	Yes
INT	3/5	-	Yes	No
ORG	3/3	-	Yes	Yes
APD NOS	3/5	1/2	Yes	Yes

HL's mother noted that he, "has done rather well at school on a one-to-one basis but he demonstrates difficulty when he is back in the classroom." She thought in light of our findings that it might well be that his difficulty in class was related to his inability to filter out noise.

Table 11. Significant results on retest

11- Re-Eval	SSW	PS	SN
DEC	LNC	-	.....
TFM	LC, Q	-	-
INT	Type-A @NL	.....	.....
ORG	Rev	-	.....
APD NOS	Tot	.....	.....

Between the initial test and retest HL turned 7 that required more stringent norms. In light of our previous discussion regarding INT, it is interesting that HL was borderline for Type-A on retest. We have known for many years that the Type-A can be obscured by lots of other errors due to other issues. We see in some of those who receive therapy and improve the other APDs that on retest a Type-A is revealed. However, in this case Type-A did not exceed the normal limit. This might be a borderline case.

Table 12 shows HL's fine improvement on all 3 tests after therapy. This is strongly supported by the BMQ and his great strides on the therapy materials. HL improved on 13 of the factors that were outside NLs. The 14th showed no change.

Table 12. Parent/school ratings of improvement over therapy period: 7=great, 6=mod, 5=slight for questions on the Buffalo Model form.

12- Re-Eval	BMQ- Change
DEC	7, 7 (7, 7, 7)
TFM	6, 5, 6, 6, 7, 6, 6 (6, 7)
INT	6 (6)
ORG	(5, 5, 5)
APD NOS	6, 7, 7

Summary and Discussion

Case 1 & 3 demonstrated a variety of challenges and complexities that may be encountered in evaluating APD. It is not surprising to find 3 or even 4 types of APD in the same child. The complexity of APD, how they have adapted to it and the therapies that children get can influence performance on our tests. In addition, internal dynamics also play a part. Despite this by following the rules we have a high hit rate not only identifying APD, but even identifying the categories. Experience with the tests increases one's understanding and provides a more complete description of the problems.

One of the common influences we see was not pointed out for these 3 cases. Especially bright children can usefully trade time for errors. As you know, we only count delays when the item is correct. We also know that given extra time that poor Decoders do better and giving an intelligent child extra time improves their score. But fortunately their compensation leaves a tell-tale sign that provides categorical information about what they concealed. Using response bias makes the Buffalo Battery much more powerful.

About these cases:

- Though these were somewhat complex cases we got all, or almost all, of the information we needed to explain the issues to the family and school and to set up an effective remedial program.
- 10 of the 12 categories were in agreement between the tests and the BMQs. Retest further reduced those differences.
- Because ORG & INT have fewer indicators we are more likely to miss these categories than DEC or TFM.
- Improvement with therapy was seen on the initial academic and communicative concerns.
