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The New SCAN-C

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Comparison of the SCAN-C To the UB CAPD Battery

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In the May 1992 issue of the SSW Reports, Laurie Bedient and Nancy Stecker reported on comparisons made between the SCAN test and the University at Buffalo (UB) central auditory test battery. The SCAN test was developed by Robert Keith, Ph.D. and published in 1986 as a screening test for auditory processing disorders. At that time, the Bedient/Stecker (1992) comparisons noted that the SCAN test was less sensitive a measure of auditory processing abilities than the UB test battery with at least half of the subjects passing the SCAN yet failing the comprehensive UB battery. The original SCAN test was considered a screening test of auditory processing disorders yet took at least 20 minutes to administer. It was found in 1992 that the Filtered Words test was the least sensitive and that the Auditory Figure Ground subtest was poorly correlated with the speech-in-noise test of the UB battery. Normal performance on the SCAN did not necessarily rule out central auditory processing disorders (CAPD).

In 2000, the SCAN-C test was published as a revised version of the SCAN test, with some changes to the original test. There is an additional subtest, Competing Sentences, added and the Competing Words subtest was shortened in length. The test is now administered on a compact disc and the instructions were made easier for children to follow. Also, the norms begin at age 5 years as opposed to the previous version that had norms beginning at age 3 years. The SCAN-C test is also no longer described as a screening test. The purpose of this report is to compare the revised SCAN-C test with the UB CAPD test battery.

Method

Five children were evaluated at the University at Buffalo Speech-Language and Hearing Clinic for a central auditory processing assessment. All were male children and ranged in age from 6 to 11 years old. Hearing sensitivity and middle ear function was determined to be

within normal limits on the day of testing for each subject. Each was administered the SSW, the Phonemic Synthesis test, a speech-in-noise test, and the SCAN-C test. All tests were administered and scored according to standard procedures.

The revised SCAN-C test has four subtests. The **Filtered Words** subtest has low-passed filtered monosyllabic words presented to each ear separately. This subtest is meant to be an auditory closure task and was designed to assess the ability to process distorted speech. The **Auditory Figure Ground** subtest is composed of monosyllabic words presented in a background of a multitalker noise at a +8 dB signal-to-noise ratio. These two subtests are the same as in the original version of the test. On the **Competing Words** subtest, monosyllabic word pairs are presented in a dichotic mode. For half of the items, children are asked to repeat both words heard beginning with those heard in the right ear first. The second half of the test is the same task with the child repeating the words heard in the left ear first. This subtest was shortened and the directions were made simpler when compared to the original SCAN test. This subtest was designed to measure auditory maturity and the ability to understand speech in a competing condition. The **Competing Sentences** subtest was added as a new measure on the SCAN-C test. The child listens to two sentences presented in a dichotic manner, and is asked to repeat back only the sentence heard in the right and then left ear first. This subtest was included to assess auditory maturation, hemispheric dominance for language, and to identify damaged or disordered central auditory pathways.

The SCAN-C test is scored by comparing the correct number of responses to age norms for each subtest and for a composite score. A scaled score (SS) for each subtest and for a composite score is recorded. Also, a percentile rank and a confidence level is recorded for each. Ear advantage is calculated by comparing correct responses for right ear first versus left ear first items on the Competing Words and Competing Sentences subtests. The standard scores are classified as falling within the normal (SS 7-19), borderline (SS 4-6), or disordered (SS 1-3) range.

The UB CAPD test battery includes the administration of the SSW test, the Phonemic Synthesis Test and a speech-in-noise test (each ear alone and binaurally when possible). These tests are presented in standard form with qualitative observations recorded and interpreted equally with quantitative results. When test results fall outside norms on any procedure, careful review of all test and history information is used to determine the CAPD category (Katz, et al., 1992). A management plan is discussed with at the parents and reported to the school that fits the individual needs of that child.

Table 1. Central auditory processing test data for each subject.

Sub.	WDS-Q R	WDS-Q L	WDS-N R	WDS-N L	WDS-N Bi	SSW RNC	SSW RC	SSW LC	SSW LNC	SSW T	PS	SCAN-C FW	SCAN-C AFG	SCAN-C CW	SCAN-C CS	SCAN-C Comp.
1.	84%	88%	60%	40%	64%	5*	10*	32*	13*	60*	12*	9	12	10	13	106
2.	92%	92%	64%	32%	56%	1	9*	31*	6*	47*	17	12	5[1]	10	10	94
3.	100%	100%	64%	68%	72%	1	7*	14*	2*	24*	14*	7	8	7	8	83[1]
4	96%	96%	56%	52%	56%	3*	7*	12*	3*	25*	18*	10	8	6[1]	5[1]	81[1]
5	96%	92%	68%	40%	64%	2*	1	5*	0	8*	24	12	11	10	13	110

* Outside normal limits
1 SCAN-C borderline score

Results

Test results were studied individually since the subject number was so small. All five subjects fell outside normal limits on the SSW and speech-in-noise tests. Three had scores outside normal limits on the Phonemic Synthesis Test. Three subjects were found to have significant decoding and tolerance fading memory signs and the remaining two subjects had primarily tolerance fading memory symptoms on the UB test battery.

Of the five subjects tested, only three would have been suspected of having CAPD using the SCAN-C test alone. One subject had a borderline score (SS 5) on the Auditory Figure Ground subtest yet had a composite score (SS 94) within normal limits. Another subject had subtest scores within normal limits yet had a borderline composite score (SS 83). The third subject had borderline scores on the Competing Words (SS 6) and Competing Sentences (SS 5) subtests and a borderline composite score (SS 81). Please refer to Table 1 for test results.

When examining the consistency between the SSW and the SCAN-C test results, two of the five subjects or 40% had similar patterns on both tests. In other words, 40% of the subjects would have resulted in a similar diagnosis if the SCAN or UB test battery were administered alone. Table 2 displays the percentage of subjects with abnormal results on individual tests. Three of the five subjects (60%) would have passed the SCAN-C test yet had significant test results on the UB test battery.

Discussion

The results of this investigation indicate that the SCAN-C test does not appear to be as sensitive a predictor of CAPD compared to the UB CAPD test battery. Therefore, a within normal limits performance on the SCAN-C does not necessarily rule out a CAPD. In the SCAN-C manual, the investigator is encouraged to use additional tests when possible (page 55). This investigator has concern regarding this point since he SCAN-C test is often administered by speech-language pathologists ,psychologists and educators who cannot

administer further audiological CAPD tests. It is therefore strongly recommended that professions administering the SCAN-C test as a CAPD test recognize the need to refer to an audiologist for further assessment even with SCAN-C test results within normal limits.

As in the 1992 investigation, the Filtered Words subtest appeared to be the least sensitive. In the SCAN-C manual, a poor score on this subtest is associated with difficulty understanding people who speak rapidly, articulate poorly or have an unfamiliar dialect and is associated with receptive language deficits. Based on this description, one would assume that a poor score on this subtest would be closely related to the decoding pattern as described by Katz, et al. (1992). This was not supported by the results of this or the 1992 investigation. None of the five subjects scored outside normal limits on this subtest, yet three had strong decoding weaknesses noted on the UB test battery.

The Auditory Figure Ground subtest of the SCAN-C was also found to be rather insensitive. Even though the signal-to-noise ratio used on the SCAN-C is +8 dB and is +10 dB on the UB test battery, all but one subject scored within normal limits on this subtest while all five were outside normal limits on the UB speech-in-noise test. Also, the one subject's score fell within the borderline score range. Therefore, use of the SCAN-C test alone would result in many false negative results for this skill. The results of this investigation is similar to the 1992 results.

The Competing Words subtest was shortened from the original version of the SCAN test and the directions were simplified. As an administrator of this subtest, I found these changes an improvement. Again, the sensitivity of this subtest is questioned since four of the five subjects had normal scores yet had significant difficulty on the competing items of the SSW test.

The Competing Sentences test was a new addition to the SCAN-C test battery. It was this examiner's observation that most subjects had difficulty with this task, especially when the subjects are asked to repeat back the sentences heard in the left ear. The norms allow many errors and until age nine, subjects can have more than half the items wrong yet still score within normal limits.

Table 2. Percentage of total subjects displaying abnormal CAP test results.

Data	SSW	PS	S/N	SCAN Subtest	SCAN Comp.
Stecker (1992)	100	40	100	75	25
Bedient (1992)	78	33	100	48	28
Stecker (2000)	100	60	100	40	40

Conclusion

Since the SCAN-C is a revision of the original SCAN test and it is no longer considered a screening tool for CAPD but as a diagnostic tool, caution should be used while interpreting this test. Based on the results of this and the 1992 investigation, the SCAN-C may under diagnose CAPD in children. With many professionals other than audiologists administering this test, there is a great risk that many children will be misdiagnosed unless further testing is recommended. It is essential that these other professionals be educated in the area of CAPD and understand when further assessment by an audiologist is warranted. Since the SCAN-C takes the same amount of time to administer and seems to be less sensitive to CAPDs, the UB test battery appears to be a more efficient and valid assessment of these skills.

References

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The Value of Binaural Speech-in-Noise: A Case Study

A speech-in-noise test is administered as part of the UB CAPD test battery to assess ability to process speech in a noisy, competing environment. The speech-in-noise test used by this investigator is given under three conditions: right ear alone, left ear alone, and binaurally. A +10 dB signal-to-noise ratio is used in all three conditions with CID W22 word lists and a multitalker noise. Individual ear comparisons are made with the word discrimination scores in quiet, resulting in ear difference scores. Age norms are established to determine significance of test results. All three conditions are presented at 40 dB SL re: SRT. If there is a difference between the ears, the binaural condition is presented at the level of the less sensitive ear. A difference score is then calculated by subtracting the binaural score form the better WDS in quiet score.

Valuable information can be obtained from these comparisons. Ideally, the binaural score should be as good as, or close to, the better ear score. A strong right ear advantage often noted on this measure, even in left handed individuals. If the binaural score is closer to the poorer ear score or worse, it may be assumed that the poorer ear is interfering with the better ear performance.

It has been observed by this examiner that when the binaural score is close to the score of the poorer ear or worse, the SSW competing conditions are typically outside normal limits. Also, the contralateral acoustic reflexes are often elevated relative to the ipsilateral reflexes. These results have some interesting implications for choosing management approaches. The following case study is an example of a unique remedial approach for an individual who presented with such a pattern of results.

E.D. is a 22 year old male who has been evaluated and has received therapy at our clinic over several years. He is now employed at a local office as a clerk and reported difficulty understanding directions and concentrating since the office is quite noisy. He was reevaluated and presented with the following results:

SSW:

RNC	0
RC	1
LC	10
LNC	0
Total	11

PS: Within normal limits

WDS-Noise:

RE	68%
LE	60%
Bi	56%

Based on these test results and discussion with E.D., it was decided to try plugging the poorer ear during work hours. A custom swim mold was made for the left ear and he was instructed to wear the ear plug while at work and to report back to us in one week to discuss the effectiveness and benefit. E.D. not only seemed to benefit at work but his ability to cope at work was improved remarkably. He came back to the clinic to have two more molds made (in different colors) to have on hand at all times. His parents reported a noticeable change in his behavior and said E.D. was much less fatigued returning from work.

The use of the ear plug was a simple and effective management strategy for this individual, but he was 22 years old at the time. Caution should be exercised when considering this approach with children before the auditory system is fully mature. By placing an ear plug in one ear (usually the left ear), sound deprivation to that ear could be detrimental to a developing auditory system. Possibly pluging the poorer ear in young children for short periods of time, during especially noisy or important listening times, may be warranted. Further research in this area is needed to determine efficacy and safety.