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The SSW IN ALZHEIMER'S DISEASE

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Alzheimer's Disease (AD) is characterized by diffuse atrophic and metabolic alterations of the cerebral cortex. While AD is a global brain impairment, it has a propensity for the temporal lobe, making this disease of particular interest to the audiologist. We anticipated that central auditory nervous system (CANS) function, particularly for dichotic tests, would be abnormal in AD patients, and that the degree of abnormality might be related to the severity of dementia. In the past few years, we have conducted three separate studies using the SSW with AD patients, to explore this relationship.

The first of these studies (Grimes, Grady, Foster, Sunderland and Patronas, Neurology, 35,3,352-58,1985) described the SSW performance of AD patients compared with that of normal aged subjects. For the AD patients, taped SSW instructions were bypassed in favor of more simple face-to-face directions. The carrier phrase "are you ready?" had to be deleted for many of these subjects because they persevered in answering the question, masking part of the stimulus item. Finally, liberal use was made of increasing the interitem interval, and encouraging responses, as well as offering positive reinforcement for the AD subjects.

Table 1 presents SSW performance in the AD patients and controls. The SSW values utilized in statistical comparisons were the right competing (RC) and left competing (LC) scores, expressed as percent correct, without correction for speech recognition error. Group mean differences were highly significant. Using a score of 85% as a normal cutoff (the 10th percentile score for the normal controls), 81% of RC and LC scores in AD patients were abnormal, with only 5 of 38 patients having normal performance bilaterally.

Group	N		RC	LC
Normal	25	M	93.7%	90.9%
		SD	5.8	7.1
Alzheimer	38	M	61.3%	56.8%
		SD	27.2	26.8

Table 1. Mean SSW performance in Alzheimer and Control groups. Differences between groups was significant ($p < .0001$).

To further define the nature of the abnormality in SSW performance observed in AD patients, cerebral atrophy as assessed by CT scan was compared with dichotic performance. Table 2 shows the mean SSW scores of subjects in 4 atrophy-rating groups in 4 brain regions. Atrophy groups 0-3 represent a range from no significant atrophy to severely exaggerated atrophy; the brain regions were anterior and posterior temporal lobe, right and left. As shown in Table 2, each group with greater amounts of atrophy of the temporal lobe (ratings 2-3) had significantly poorer

	Atrophy rating			
Brain region	0	1	2	3
Anterior temporal				
R		70% (28)	53%* (23)	
L		84 (14)	56* (25)	37 (14)
Posterior temporal				
R	86 (20)	48+ (24)	56+ (23)	
L	93 (5)	59+ (21)	46+ (24)	

*Different from Group 1, $p<0.05$.
+Different from Group 0, $p<0.05$.

Table 2. Mean dichotic scores (and SD) of Alzheimer patients, grouped by atrophy ratings (0-3 or not significant to severe), for four brain regions.

performance on the SSW than the least involved group. Importantly, all statistical comparisons of SSW performance for atrophy in the parietal and frontal lobes were non-significant. This suggests the temporal lobe specificity of the SSW test in this population.

Finally, SSW performance was compared with regional cerebral glucose metabolism as estimated by positron emission topography (PET) scans. In these comparisons, only temporal lobe metabolism was found to bear a significant relationship to performance on the SSW. Significant correlations emerged supporting the relationship of the right SSW score to measures of left temporal lobe glucose metabolism. These findings demonstrated that the classical model of dichotic listening (Sparks, Goodglass and Nickel, Cortex, 6, 249-60, 1970) can be applied to the metabolic as well as structural status of the left temporal lobe.

Having demonstrated this relationship of SSW performance with degree of dementia, Grimes, Grady, Foster, et al.,investigated (1984a,b. Papers presented at the annual convention of the American Speech-Language-Hearing Association,San Francisco, CA) two additional questions regarding results in AD cases: 1) whether changes in SSW performance over time accurately reflected progression of the disease as evidenced by other measures, and 2) whether a CANS test other than the SSW would similarly reflect the status of temporal lobe pathology.

To address the first question, 21 AD patients were studied on initial and repeat evaluations at a mean intertest interval of 10 months (range 5-23 months). Subjects were re-evaluated on the SSW, and on a battery of neuropsychologic and neuroradiologic measures. In Table 3, the mean right and left ear SSW scores are shown on the initial and retest evaluation. While there is a trend toward decreased performance over time, these means are not significantly different ($p>.05$) because of the large standard deviations. Differences between initial and reevaluation SSW scores were studied for the individual patients. Table 4 presents the distribution of individual difference for

	Test 1 Right	Test 2 Right
M	64.5%	51.9%
SD	(23.9)	(34.7)
range	20-97	0-95
	Test 1 Left	**Test 2 Left**
M	62.3%	57.3%
SD	(21.1)	(30.6)
range	30-97.5	0-90

Table 3. Change in SSW score from initial to re-evaluation, by ear.

	Significant change for the worse	Significant change for the better	No significant change
Criterion for Significance			
≥ 10%	10	5	6
≥ 20%	6	2	13

Table 4. Occurrence of significant changes on retest SSW using two criteria. (based on difference score of ear showing greater change).

	FSIQ	Mattis DS	WMS - Stories	WMS - Figures
Diff. score R-SSW	0.63**	0.53*	0.00	0.12
Diff. score L-SSW	0.74**	0.66**	0.39	0.58*

* Significant beyond the 0.05 level
** Significant beyond the 0.01 level

Table 5. Correlations between right and left interval difference scores for the SSW, and interval difference scores for four neuropsychological tests.

ear showing greater change using two criteria for significance: lax (≥ 10%) and stringent (≥ 20%). The concern here is what constitutes a significant change on the SSW, or what can be attributed merely to retest variability. Using the less stringent criterion, 10 patients showed poorer SSW performance on SSW-retest, but 5 patients in this group of 21 would be identified as improving on the SSW. This is not only counterintuitive, but is not supported by there diagnostic measures. The more stringent criterion of 20% reduces this number of "improvements" to 2, and predictably decreases the number of subjects showing significantly poorer SSW performance as well. This issue, which was addressed by Beck, Mueller and Sedge (SSW Reports, 1985) deserves continuing consideration in determining significant differences. The choice of criterion for significant difference must be governed by clinical requirements for test sensitivity and specificity (see Mueller in next SSW Reports).

In another approach to evaluate whether observed test-retest differences on the SSW were significant, we correlated SSW difference scores with other cognitive and neuroradiographic measures. These mesures were CT and PET scans, full-scale WAIS IQ, Mattis Dementia Scale, and Weschler Memory Scale (subtests for stories and

figures). These correlations are shown in Table 5, with significant ones starred. These correlations support the contention that in group data, change in SSW scores over time is a reliable indicator of change in dementia as measured by conventional psychological tests. On individual data comparisons, however, there were at least two cases in which the SSW results were in direct contradiction with other cognitive measures.

Comparisons of changes in SSW performance with changes in CT and PET scans over the same interval also were made. While a general trend of decreased SSW performance with decreased metabolism on PET was noted, this can only be termed a trend due to a limited number of subjects studied. It should be noted that comparisons of CT atrophy change and SSW change over time were not meaningful because there was a lack of significant change in atrophy from the first to the second scan.

It is important to remember that AD is quite variable in its severity, and the use of group statistics can obscure or enhance the apparent sensitivity of the SSW to disease progression. It was clear, however, that in some measures of dementia, the SSW provided an accurate reflection of the direction and degree of change of dementia in AD as shown by other indicators. It may well be that with greater intertest intervals, more consistent and significant findings might emerge.

A third paper on the use of the SSW in AD centered on the comparative value of the SSW and 2 monotic CANS measures. The question here was whether it was specifically the dichotic nature of the SSW which was responsible for the observed relationships with dementia, or whether the use of any presumably cortically-sensitive auditory measure would result in similar findings.

Thirty-four AD subjects were studied, as well as a matched normal control group. In addition to the SSW, patients and controls received the 1000 Hz low-pass filtered NU #6 (LPFS) and the 60% time-compressed NU #6 (TCS) (Auditec of St. Louis recordings).

Table 6 shows the results for the normal control and AD groups on these three measures. Cutoff scores, based on the level above which 90 percent of the normal subjects scored were 87.5% (SSW), 74% (LPFS) and 24% (TCS). The low mean scores, shown in Table 6, and large standard deviations and ranges evidence the depressed, but variable performance on these measures by the AD group. When an abnormality in either case is considered a hit, sensitivity for the SSW in AD was 91%, versus 47% for LPFS and 19% for TCS.

Test scores on these 3 measures were also compared with evidence of temporal lobe atrophy on CT scans. ANOVAs were significant for the right and left SSW scores with CT atrophy ratings in the anterior temporal lobes. There were no significant relationships with brain atrophy in any region and either the TCS or LPFS speech recognition tests for either ear.

	Right	Left
SSW (87.5%)		
M	64.4%	63.2%
SD	25.9	24.0
range	17.5-95	12.5-92.5
TCS (24%)		
M	42.8%	41.9%
SD	20.7	16.9
range	6-82	6-76
LPFS (74%)		
M	74.5%	73.9%
SD	16.6	13.2
range	26-96	48-96

Table 6. Performance on 3 CANS mesures in 34 AD subjects (normal cut-off scores in parentheses).

These data offer support for the notion that it is the dichotic SSW, and not simply any CANS measure that results in significant realtionships with the degree of dementia in AD. Whether another dichotic measure would be similarly sensitive is being studied. The reasons for the differences between the SSW and monotic tests are undoubtedly related to several factors, two of the most prominent of which are peripheral hearing loss (with the SSW more resistant to effects of high-frequency presbycusic hearing loss than monotic-degraded speech), and memory, with the greater length of the SSW resulting in increased demands on the CANS for processing.

Our experience over the past four years in using the SSW to study the AD patient has been successful. Assessment of auditory function in AD using the SSW provides substantial data on the presence and degree of temporal lobe dysfunction. The SSW is clearly better than at least two monotic CANS tests for this purpose. There is potential also that the SSW may, over a sufficient interval, offer corroborative evidence with regard to progression of disease.

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HIT RATE USING THE C-NS-85 NORMS WITH LD AND CAP REFERRALS

Jack Katz

No test is 100% successful in identifying problems. The SSW is a test. Therefore, the SSW is not 100% successful. To prove my point would require relatively little effort or study. Having more or less proved my first point, my second question is, if not 100% identifications, what percentage of those referred for learning disabilities (LD) or central auditory processing (CAP) problems can be anticipated to show positive signs on the SSW?

The current standard (C-NS-1985) is being scrutinized to affirm its value in the study of CAP dysfunction. The standard was established with the help of numerous audiologists across the US and Canada who evaluated 287 normal children and adults. The standard has face validity as the results are coherent with reasonable means and standard deviation for all of the Conditions for all of the age groups.

SAMPLE

Fifteen audiologists in the US and Canada were asked to contribute 5 - 12 cases each. The sample was to be unselected, in that neither the best nor worst were desired. Rather, the most recent consecutive clients/patients/subjects were requested. This helps to insure that there was no bias in selecting the cases. Thus far,seven audiologists sent 80 cases. The Ss had essentially normal hearing bilaterally and were referred because of LD and/or CAP problems. The permissible age range was 5 - 59 years. While those referred for LD might be a slightly different group than those referred strictly for CAP, it was not possible to separate them out. Indeed, it is likely that the vast majority were referred because of concern for both problems.

Of the 80 subjects (Ss), 22 (28%) were females and 58% (72%) males. This is in the range of 67 to 75% males that is commonly reported for LD children. The age range was 5 - 23 with a median of 8 years.

RESULTS

Seventy of the 80 Ss were identified by the SSW test. Thus, the hit rate for this national sample when compared to the C-NS-1985 norms was 88%. This is a relatively high yield. Data from a research study with LD children that I ran back in the early 1970's showed the same hit rate (88%) when using the C-NS-1985 norms. In that study, 5 of the 6 children who passed the SSW failed a test of Phonemic Synthesis, a speech-in-noise test or both.

SSW REPORTS
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The hit rate noted above makes the SSW a time effective, cost effective test. This 15 minute procedure identified nearly 90% of the individuals suspected of having problems. In addition, the SSW provides insight into the nature of the CAP problem and what types of school/communication problems might be associated with the auditory difficulties.

Forty-six (58%) of the Ss had both C-SSW abnormalities and significant response biases. Twenty (25%) had only positive C-SSW Conditions and 6 (8%) had only significant response biases. Thus, the use of response bias information not only provides unique information about the individual's listening disorder but also increases the hit rate by 10%.

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