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PERFORMANCE OF LD AND LH CHILDREN ON THE SSW

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Some interesting results regarding the SSW emerged in a study designed to evaluate the overall performance of learning disabled (LD) children and language handicapped (LH) children on the SSW and Willeford's CAP.

SUBJECTS: Forty-two students, 14LH, 14LD, and 14 normal with mean ages of 14.1, 13.5, and 14.1 years, respectively, were tested. All subjects had peripheral hearing sensitivity within normal limits and WDS of at least 88%.

RESULTS: Table 1 shows the percentage of subjects within each group identified as having abnormal results on the SSW. As can be seen, the TEC category and the Type A pattern were the least sensitive measures of the SSW, correctly identifying only 21% of the LD subjects and 43-50% of the LH subjects. However, looking at the other response biases, namely Ear Effect and Order Effect, significantly increased the sensitivity of the SSW. Overall, only 2 subjects (14%) in the normal group had any abnormal SSW result (5 reversals for 1 subject and a Type A Pattern for the other subject). Whereas, 79% of the subjects in the LD group and 86% of the subjects in the LH group were identified as having abnormal results. The LH subjects tended to obtain abnormal results in more than one area, while the LD subjects' results were more often depressed in only one area.

It is interesting to note that none of the subjects in the normal group had significant Ear or Order Effects compared to over one-half of the LH subjects.

Table 1. Percent of subjects within each group identified as having abnormal results on the SSW.

	TEC Categ.	ANY Response Bias (excluding Type A pattern)	Type A Pattern	Abnormal Results (in any area)
N	0%	7%	7%	14%
LD	21%	64%	21%	79%
LH	50%	86%	43%	86%

The predominant type of Ear Effect for all groups (normal group included), regardless of significance, was L/H. This is consistent with a right ear-left hemisphere dominance theory. The predominant type of Order Effect for LD and LH subjects only, regardless of significance, was H/L suggesting a possible memory problem. The normal group showed no predominant type of Order Effect suggesting almost a chance occurence of either H/L or L/H, rather than pointing toward a consistent memory problem.

CONCLUSIONS: The SSW, with complete interpretation, proved to be a sensitive measure, clearly delineating the three groups. We recommend that the SSW be used as a screening tool to identify LD children and that further refinement of this test's interpretation (to include specific auditory skill assessment) be investigated. We further recommend that this study be replicated in a younger population to substantiate the trends we observed in these older children.

CENTRAL AUDITORY DYSFUNCTION IN ECHOLALIC AUTISTIC INDIVIDUALS

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The syndrome of autism is presumed to be caused by a CNS dysfunction, although there has been little direct evidence and the exact nature of the dysfunction is as yet unknown (Ritvo & Freeman, 1978). Speculation of an underlying neuropathology of the left hemisphere has been formulated to explain receptive and expressive language deficiency in autistic children, in marked contrast to proficiency in various nonverbal and musical abilities. Inconsistent and inappropriate responses to auditory stimuli and delayed language development often lead to an early suspicion of hearing loss prior to a diagnosis of autism. However, autistic children generally do not show primary perceptual deficits. Therefore, an assessment of central auditory function seems warranted to aid in delineating a possible cause of their inconsistent responding. In this preliminary investigation the SSW/CES test battery was used as an experimental tool to assess central auditory function in a small group of autistic individuals.

SUBJECTS: Six autistic subjects ranging in age from 8 to 24 years participated in this study. Subjects 1 to 4 were echolalic, i.e., some of their utterances were immediate repetitions of all or part of what was said to them. Subjects 5 and 6 were previously diagnosed autistic and both participated in an extensive parent-training treatment program in our laboratory at an early age. Both Subjects 5 and 6 presently showed essentially normal language skills for their age. All subjects were able to repeat intelligibly at least 4 syllables.

PRE-TRAINING AND TESTING PROCEDURES: Because the autistic subjects were unable to follow the relatively lengthy pre-recorded instructions for the SSW and CES tests, it was necessary to provide pre-training procedures in place of the instructions. These procedures were designed to accomplish the same end results as the pre-recorded instructions (i.e., to instruct the subjects to repeat groups of words, or point to two pictures of sounds heard). Principles of shaping and stimulus fading were used to help the transfer from responding to live voice to responding to the pre-recorded stimuli. Training was terminated when the subject responded correctly to 5 consecutive trials of the training items presented binaurally over headphones (see Wetherby, Koegel & Mendel, in press).

Because of the variability in autistic children's behavior, the SSW test was administered two times with an interval of 3-4 months to check test-retest reliability. For Subject 4, the SSW test was administered at 2-3 month intervals, during a year of language treatment.

RESULTS AND DISCUSSION: All subjects showed normal SRT (range 0-10 dB) and WDS (range 96-100) for each ear. The results of the SSW and CES tests are summarized below for all subjects. For Subject 4 the test results obtained during the first 6 months (EARLY) and last 6 months (LATE) of treatment are presented.

Although all of the subjects had normal hearing for speech, there were reliable indications (from test to retest) of central auditory dysfunction involving the language-dominant hemisphere and/or corpus callosum/anterior commissure, for those subjects displaying echolalia. Essentially normal SSW/CES results for those subjects who were previously diagnosed autistic, but were no longer echolalic. The subject who received a year of intensive language treatment showed improvement on the SSW test, which appeared to be consistent with his language improvement. His improvement on the CES test may reflect cerebral maturation or be the result of advancement on language related aspects of this task.
(Cont. p.5, Col.2)

S	AGE		SSW TEST		SSW RETEST		CES	
			RE	LE	RE	LE	RE	LE
1	24		34	42	29	38	60	10
2	18		30	4	28	4	5	0
3	14		12	28	6	24	0	0
4	8	EARLY:	48	11	28	8	10	15
		LATE:	21	5	12	4	5	5
5	8		8	15	5	9	0	0
6	13		2	4	2	2	0	0

USE & MISUSE OF THE SSW TEST VI: DEEP LESIONS OF THE BRAIN

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It was indeed fortunate that the first brain lesion cases who were tested with the SSW had primarily cortical rather than sub-cortical lesions. The disorders while caused by various etiological factors dealt for the most part with involvement of grey matter as opposed to the white matter. The white matter conducts impulses from the brainstem and the deep nuclear portion of the brain to the reception centers of the cerebral cortex. The white (myelinated) fibers also carry information to association and integration centers throughout the brain and across to the opposite hemisphere, as well.

With regard to brain function, we are much less clear about the deep structures and white matter than we are about the superficial grey matter (the cell bodies). One can study the regions of the cerebral cortex with comparative ease, but the fibers projecting to the various centers, those connecting adjacent and distant centers as well as those crossing the corpus callosum (and other commisural pathways) often travel together or close by for short distances before they change their course and head off in a different direction. Unlike the cortical regions such as Broca's and the visual reception area which are reasonably homogenous, you often cannot anticipate which connecting fibers might be taken by a particular tumor or stroke. Another consideration is that while there is no doubt a great deal of redundancy in the cerebral cortex the functions tend to be rather closely tied in a circumscribed region, as opposed to the white matter that I presume can arrive from different directions. Another complication with deep lesions is that when they involve the thalamus they can interfere with many centers that project to a wide region of the brain since almost everything going up to the cortex and back from it must synapse in the thalamus.

Very little has been written in the audiology about the deep structures of the brain, either the nuclear portion or the white matter. In the past few years Musiek and his colleagues have demonstrated the effects of "split brain" surgery on the SSW test and other procedures (1979,1980). Recently, Katz, Avellanosa, and Aguilar-Markulis described the performance of 9 corpus callosum cases on the SSW and CES tests (see the preview in the last issue). Other than these sources we have little available information as what to expect from lesions to deep portions of the brain. In the past we have run into the problem of having vague confirmation about deep lesions, if at all. The CT scan will certainly help us in the future.

I dug into my files and located 9 cases with lesions of either the thalamus, basil ganglia or both. These 2 regions are deep within the inferior portion of the brain. The thalamus is associated with auditory functions but the basil ganglia are not (to my knowledge). However, a tumor or stroke primarily involving one region could easily influence the other.

Several people have communicated with me about deep lesions. Ben Koperski and I each saw a patient with Wilson's disease (copper deposits in the basil ganglia). In both cases there were no errors on the SSW and no reversals (unfortunately CES was not given). These 2 patients performed as expected since the BG are not thought to have auditory functions. But Kathy Merle had an extremely interesting case. The precise localization of the lesion is not presently available nor whether the patient is R or L-handed. The patient had a stroke at least involving R-basil ganglion. She had a "reversed crossed SSW/CES pattern" (i.e., poorer SSW in RE and poorer CES in LE instead of vice versa) and a Type A-RC. It is not clear what could (Cont. p.5, Col. 3)

	R-SSW R	R-SSW L	CES R	CES L	TYPE A	REV	DISORDER
1.	N	N	DNT		-	-	Wilson's
2.	N	N	DNT		-	-	Wilson's
3.	P			P	RC	1	Basil Ganglia (BG)
4.		P	P		LC	-	Internal Capsule (IC)
5.		P	P		LC	9	?IC/Cerebellum
6.		P		P	-	-	IC, BG
7.		P		P	LC	1	IC, BG
8.	P		P		-	3	Thalamus (Th)
9.	P		P		-	-	Th, BG

TABLE 1. Nine cases with thalamic and basil ganglia lesions (N=no errors; P=poorer ear; RC/LC=RC or LC conditions).

THE NATIONAL SAMPLE FOR CHILDREN: A PIECE OF THE PIE

The National SSW Sample is a collaborative study in which clinicians from the US and Canada have obtained data on normal children in order to develop standards of performance. Each clinician has submitted data on 1-5 children from age 5 years through 12 on the EC list of of the SSW test. The children were to be free of significant neurological problems (e.g. skull trauma), ear disorders (frequent/ severe otitis media) and learning disabilities. Subjects were to be native "American" speakers. All examiners had in common that they attended a recent SSW workshop and employed standard procedures for administration and scoring.

The value of such a study is that it takes into account the possible variations in administration, scoring, equipment, recording fidelity and regional dialects. Presumably, if one clinician had too strict a criterion for acceptance into the study, another one was perhaps a bit too laxed. The standard deviations would become quite large if there was a great variation in the criteria that were used.

The weakness in such a study is that it could reveal a great deal about the test performance in general but be a less than ideal comparison for any clinic or region in particular. If there was systematic bias in sending in only the cases that performed well on the test there would be a tendency to develop too strict a criterion. If however, some of the clinicians included subjects who has normal hearing but recently recovered from a bout of the flu or otitis media, then perhaps this would tend to make the resulting norm too easy.

The best way to maximize the advantages and minimize the disadvantages is to seek data from many clinicians and to base the norms on medians rather than means. The use of medians as the measure of central tendency decreases the influence of extreme scores.

Performance on the SSW Condition, Ear and Total scores will be presented in forthcoming issues. Our first piece of pie will relate to Ear and Order Effects. This information is based on data for 131 children from 40 clinicians in 17 states or provinces (collected before Dec.1980).

The richest source of unique information in the SSW test is in the response biases. They provide insight into the person's auditory processing abilities/disabilities. This should have importance for both adults in whom we are seeking localizing information and children in whom we are seeking the reasons for their learning difficulties.

Up until this time we have been somewhat unsure of how to evaluate Ear and Order Effects in children. Schoenfeld (1973) had noted that less stringent criteria were needed for reversals when dealing with children. White (1977) provided guidelines for assessing Ear and Order Effects in children 6 to 10 years of age. Kushner, Johnson and Stevens (1977) and Pinherio (1977) had noted the tendency for children to have poorer performance on LEF items than REF items and on the first spondee more that the second. White compared the performance for her normal and learning disabled group and proposed less stringent criteria for Ear and Order Effects. When applying these criteria to data gathered by Johnson, Lindgren, Sherman and Enfield (1978) I found them to be very effective. My one concern was whether the criteria were too laxed, permitting a significant percentage of the impaired population to pass.

The National Sample data are shown in Table 1. The number of subjects at each age level and the difference between the REF and LEF errors for the Ear Effect and the first vs. the second spondee for Order Effect are shown. By using the adult criterion of 5 or more as being the significant difference we would have to classify 22 (17%) of the Ear Effects as abnormal and 20 (15%) of the Order Effects. While this would no doubt demonstrate the highest percentage of impaired children it creates too many false positives among supposedly normal children. We then chose a difference of 0 to 7 as being normal. Thus differences of 8 or more errors between halves of the test would be significant. The number of failures were reduced considerably. For the Ear Effect it went down to 5 (4%) of the 131 S's and for Order Effect 6 (5%). A third cutoff was set at a 10 error difference with 1 (.7%) failure for Ear and 4 (3%) failures for Order. None of the normal children exceeded 15 points for Ear or Order Effect.

It is too early to decide
(Cont. p. 5, Col. 1)

(NAT'L SAMPLE Cont. from p.4)

precisely which cutoff level to use for E and O criteria. The criterion of a 10 error difference seems like a reasonable level. It is the same level that White used early in her research.

In order to see whether this criterion is appropriate it would be well to employ these norms in analyzing previously collected data (White, Kushner et.al., Johnson et.al., Madell). Clinicians in the field might compare their cases with these findings to determine the utility of a difference of 10 for children 6-10 years of age. In the National Sample there were no 11 or 12 year olds who fell outside of the adult limits for E or O Effects.

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White, E.J., "Children's Performance on the SSW Test and Willeford Battery," In Keith, R.(Ed.), Central Auditory Dysfunction. New York: Grune & Stratton, 1977.

(for Table 1, see p 6)

(AUTISM,ECHOLALIA & SSW Cont. from p.2)

The errors made by these subjects were probably not a result of a general inability to take a test of this nature, nor due to a short term memory deficit, since all of the subjects repeated two spondees in a binaural mode during pre-training. Poor test performance seems more likely to be due to cerebral immaturity (probably impaired development) or cerebral dysfunction of the auditory processing areas.

The locus of dysfunction, indicated by SSW peak analysis and response bias, was consistent with the language deficits for each subject.

Subjects 2 and 3 showed primarily anterior involvement, while Subjects 1 and 4 (EARLY) showed involvement of the posterior temporal lobe. This is particularly interesting because the predominant characteristic of both Subject 2 and 3's language behavior is a paucity of spontaneous speech, which is consistent with the nonfluent nature of an adult aphasic with an anterior lesion. In contrast, Subjects 1 and 4 showed a more severe language comprehension problem and a higher frequency of echolalia and meaningless verbal responses, which is consistent with the fluent nature of an aphasic with a posterior lesion.

The SSW test battery appears to be sensitive to cerebral dysfunction in these echolalic autistic children. Our preliminary findings support the accumulating evidence of a neurogenic etiology of autism. Future research should be directed at validating the use of this test battery on a larger population of autistic subjects. Application of the SSW test to differentiating subgroups of echolalic autistic children (i.e., anterior vs. posterior dysfunction) may lead to more effective language intervention procedures.

REFERENCES

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(USE/MISUSE Cont. from p.3)

have caused such unusual results (perhaps she was L-handed?)

The other 6 cases had thalamic lesions (typically involving the posterior limb of the internal capsule thru which the auditory radiations run). Half of them had Type A-LC, 2 had the SSW/CES crossed pattern(not reversed), 2 had LE peaks for both tests, 2 had RE peaks on both tests and 2 had significant reversals (see Table 1).

SUMMARY: Nine cases with lesions of the thalamus and/or basil ganglia were tested. Type A was the most common characteristic (a point noted by Dennis Arnst previously). All of the thalamic cases and 1 of the 3 basil ganglia cases had abnormal SSW and CES results. Two cases with Wilson's disease (limited to the BG) had no SSW abnormality.

CONCLUSIONS: (1) Deep brain lesions can produce abnormal SSW & CES results-especially when the thalamus or internal capsule is involved. (2)There is no consistent pattern of response although the Type A was found in half of the cases. (3) Much more data and careful localization of lesions is needed before the expected results will be known.

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EAR EFFECT, ORDER EFFECT and TYPES A/B: NATIONAL SAMPLE

	EAR DIFFERENCES			ORDER DIFFERENCES		
	L/H	H/L	=	L/H	H/L	=
PART-A						
Not Sig.	54	24	19	39	41	19
Sig.(≥5)	15(11%)	7(5%)	-	8(6%)	12(9%)	-
Type A/B Invalid.	10	2	-	3	9	-
PART-B						
Sig.(≥8)	4(3%)	1(.7%)		1(.7%)	5(4%)	
PART-C						
Sig.(≥11)	1(.7%)	-		-	4(3%)	

Table 1. Shows the results for 131 normal children ages 5-12. Both Ear and Order Differences are shown above. There were also 19 children with Type A and 2 with Type B that were not shown. Part-A shows the tendency for L/H or H/L (as well as the number of children who had equal errors on the two halves). Significance was set at the adult norm (equal to or greater than 5). Also shown are the number of children who had Ear/Order Effects invalidated because of significant Type A/B patterns. Parts B and C show the number of significant Ear/Order Effects when less stringent criteria are used (8 and 11, respectively).