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DICHOTIC LISTENING AND NEUROPSYCHOLOGIC PERFORMANCE OF STUTTERING CHILDREN

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Studies contrasting certral auditory function of stutterers with non-stutterers have found stutterers, as a group, demonstrate generally inferior performances. Toscher and Rupp (1978) observed their sample of stutterers to perform poorer on the ICM (Ipsilateral Competing Message) subtest of the SSI (Synthetic Sentence Identification) test battery. The discrepancy in performances between stutterers and non-stutterers widened as the MCR (Message-to-Competition Ratio) became less favorable. The researchers suggested that their findings might be "attributed to differences in neural function, neurophysiological organization, or the overall central auditory functions which are necessary to normal auditory processing and perception."

Hall and Jerger (1978) assessed overall patterns on a battery of central auditory function tests administered to stutterers. When contrasted with non-stutterers, the stutterers were found to be inferior on portions of the battery: acoustic reflex amplitude function, SSI-ICM and SSW (Staggered Spondaic Word) test.

The authors concluded " that, as a group, the stutterers did present evidence of a (subtle) central auditory deficiency." They noted further that "subgroups of stutterers may be distinguished based on unique patterns of test performance."

Both studies reported inconsistencies on various tests as well as greater variability for the stuttering groups. Inconsistencies among stutterers' performances and conflicting results in other experiments with stutterers suggest that subsets of this population may exist (St. Onge, 1963). Because of the disparities on the aforementioned central auditory tests a closer examination might reveal subgroups of stutterers. Should subgroups be distinguished, the impact of auditory deficits might be related to other measures of cerebral function to determine if subgroup delineation may be strengthened.

<u>METHOD</u>. Subjects were 24 male and 2 female children who stutter, ranging in age from 10 years 2 months to 18 years 10 months. Pure-tone thresholds and word discrimination scores were obtained for each subject. The SSW was administered and scored as prescribed in the test manual. Scores were interpreted as normal/abnormal in accordance with current guidelines (Katz, Johnson and White, 1981).

The Michigan Neuropsychological Battery was then administered to assess higher (cognitive) and lower (sensory and motor) cortical function in addition to possible indication of organic deficits.

The group of stutterers scoring abnormally on the dichotic listening test was then contrasted on each measure of the Neuropsychological Battery with the group scoring normally. A <u>t</u>-test was used to determine the significance of group differences.

<u>RESULTS</u>. Eight subjects (30.8%) were found to have abnormal scores on the SSW. Statistically significant difference (p .05) were found on 20 of the 30 measures on the Neuropsychological Battery (see Table 1).

Neuropsychological Measure	Abnormal SSW Group	Normal SSW Group	t	Significance
Verbal I.Q.	82.5	104.6	-3.71	.001
Information*	6.9	10.3	-2.83	.009
Comprehension*	7.4	11.6	-3.55	.002
Arithmetic*	5.6	10.1	-3.74	.001
Similarities*	7.6	11.6	-3.17	.004
Vocabulary*	6.9	9.9	-2.50	.020
Digit Span*	6.4	10.3	-2.68	.013
Performance I.Q.	87.8	103.7	-2.48	.021
Digit Symbol*	7.5	9.1	-1.12	.274
Picture Completion*	8.8	11.6	-2.28	.032
Block Design*	8.6	10.6	-1.52	.141
Picture Arrangement*	9.8	10.2	- .63	.535
Object Assembly*	7.9	11.2	-2.48	.020
Full Scale I.Q.	85.1	104.7	-3.46	.002
Peabody Picture Vocabulary Test**	-29.1	11.2	-3.49	.002
Hooper Visual Organization Test	24.3	26.5	-2.10	.046
Ravens Progressive Matrices	24.8	35.9	-2.45	.022
Benton Visual Retention Test	6.6	7.5	- .88	.395
Benton (errors)	7.1	4.2	1.93	.066
Benton Design Copy	9.4	9.5	- .33	.742
Benton (errors)	1.6	.7	1.20	.239
Purdue Pegboard				
30" Right	11.3	14.1	-2.74	.012
60" Right	22.6	27.6	-2.78	.011
30" Left	12.1	14.3	-2.83	.009
60" Left	23.4	27.2	-2.54	.018
30" Both	9.4	10.6	-1.18	.250
60" Both	18.1	20.8	-1.48	.153
Smith Symbol Digit Modalities Test				
Written	35.3	42.9	-1.54	.137
Oral	42.5	45.7	- .46	.647
Memory for Unrelated Sentences	20.9	26.6	-2.37	.030
Neuropsychological Signs	4.5	2.5	3.18	.004

*Scaled Score

**Months above/below chronological age

Table 1 Group Comparisons on Neuropsychological Test Battery Measures

DISCUSSION. Several distinctions emerged between the two groups. While the most apparent differences were found on the verbal subtests, significant disparities on performance subtests were also noted. The impact of deficient auditory processing skills on verbal intelligence (language) development and the stutterers' self-audition of speech are not new hypotheses in the study of speech pathologies. However differences in performance subtest scores and manual/motor tasks such as the Purdue Pegboard, suggest a disparity at lower levels of functioning in this subgroup of stutterers as well. Further analysis revealed that as a group, the auditorily deficient stutterers manifested significantly more neuropsychological signs, affecting organic impairment.

While similarities were noted for the abnormal SSW group, no single SSW pattern characterized each of the group members. Left ear performance was depressed. In subjects who evidenced binaural impairment, the left ear was more severely depressed. Each experimental subject evidenced response bias, which is generally associated with disturbance of central process functions. These disturbances may have been reflected in the neuropsychological test battery scores in all but one subject.

When the two competing conditions were examined in all stutterers, 24 of the 26 (92.3%) evidenced a higher percentage of error in the left ear (REA). The magnitude of the ear difference was nearly five times greater for abnormal SSW subjects.

It was concluded that a subset of stutterers exists with difficulty processing auditory information. The difficulty appeared to be related to relative differences in ear performance. Stutterers with auditory processing difficulty demonstrated a marked performance difference between ears, favoring the right ear. The magnitude of ear difference however, was not related to the severity of stuttering.

Abnormal SSW stutterers averaged 4.5 signs on the neuropsychological test battery. All but one evidenced three or more signs, indicative of cerebral dysfunction, presumably of organic etiology. It thus appears that these auditory processing difficulties may be organically based.

There additionally were other stutterers manifesting more signs of organicity whose audition seemed to be unaffected (or affected at a more subtle level than tested by this procedure). Eight of the 18 (44%) normal SSW stutterers exhibited three or more signs.

Studies have demonstrated subtle auditory impairments among stutterers (Hall and Jerger, 1978; Toscher and Rupp, 1978; Liebetrau and Daly, 1981). Other studies have shown that certain mechanisms inhere in the constitution of the stutterer affect performance on such tasks as voice onset time, reaction time, etc. (Adams and Hayden, 1976; Adler and Starkweather, 1979). Data from the present study support these contentions and raise the possibility that there may be an organic component to their etiology. The results of the present study may be interpreted as underscoring the role of audition in speech production, suggesting that in some stutterers, audition might be a significant contributant to their stutter ing as first suggested by Tomatis (1954), Yates (1963), Lee (1951), and Mysak (196(An alternate explanation, which is suppor ed by these researchers, might be that there exists cerebral dysfunction of an organic etiology in many stutterers, whic often affects the auditory mechanism, and the processing of acoustic informati

An alternate explanation, which is suppor by these researchers, might be that there exists cerebral dysfunction of an organic etiology in many stutterers, which often affects the auditory mechanism and the processing of acoustic information. We have then three groups of stutterers: a) those who appear to have some degree of cerebral dysfunction with concomitant auditory impairment, b) those demonstrating cerebral dysfunction without auditory impairment, and c) those with neither measureable cerebral dysfunction nor auditory impairment.

Presently, stutterers receive treatment a if they represent a homogeneous group. No other communicative disorder is treate as a unitary disorder without distinguish ing subgroups or considering etiologies o the disorder. If subgroups of stutterers exist as our data suggest, perhaps intervention programs based upon the nature of group differences would enable more effec tive and longer lasting therapeutic resul stinguishing subgroups may also clarify search studies which have found ambiguous nonsignificant results or results which ve been swayed by a small percentage of bjects. The notion of different types stutterers might also serve to explain gh variability of task performance ores. The challenge before us is to termine the bases of the distinguishing gns and their implications in the iology of stuttering and how this knowdge can aid in remediation.

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THERE ARE REVERSALS AND THEN THERE ARE REVERSALS

by

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Do you remember the old days when life was simple? Oh yes, we had some strange things to deal with then too (e.g., true, probable and questionable reversals). But at least when you found a reversal, it was a reversal. How naive. When things start to make sense and everything fits neatly in place--just wait! I'll bet the simplest things in life are our concepts of life. Why should reversals be any different? We have been talking about three different types of reversals, of late. Let me review.

A reversal is an item in which there is no more than one error and the response cannot be read correctly from left to right. The most common reversal is the second spondee first and the first one last. We call that a 3412 reversal. But, of course any other sequences except 1234 would constitute a reversal.

Reversals have been noted in adults with brain lesions. A large majority of them involve the reversal strip--columns 5, 6 & 7 (rows C - H) on the brain grid as well as some people with conductive losses and even in cases with unilateral cochlear involvement, etc. Reversals have been noted also in a large percentage of learning disabled children. In this case we cannot assume any localization of dysfunction.

A second type of reversal was noted by Bob Lukas and termed a Reversal-Ear Effect. This refers to a test finding in which a large percentage of the reversals were either REF items or LEF items. In a recent issue Michael Lindenman and I posed a question whether Reversal-Ear Effects could be associated with a posterior site and/or represented a strategy to deal with the SSW items. We need more information. Perhaps you can help?

The third type of reversal that I have noted over the years and have humorously refered to as "the engineer's reversal". It is a 1324 pattern. "Perfectly normal engineers" often respond to SSW items in this manner. On some items they substitute the competing word of the second spondee and follow it with the competing word from the first spondee. I have always assumed that it was due to their training, certain perceptual traits or personality characteristics that make engineers (and a few others) respond quite naturally in this way. This would follow if it appears that word #3 precedes #2. Most of us would ignore the brief temporal variation and stick with the spondee. Floyd Rudmin (Feb. '82) in his study of lead/lag of SSW items shows in 19 items that #3 precedes #2 (by 31 to 255 msec). In 13 cases it was by 50 msec or more. Rather than permitting the linguistic linkage to bind the spondees, the engineers' responses suggested that their decisions were often dictated by the temporal sequence.

I recently met an audiologist who told me that she had made a mess of the SSW test when it was administered to her. She said that she had made these strange reversals. On a hunch I asked her why she had dropped out of engineering school. She said that she hadn't really dropped out because she decided against engineering before she got to the university (although her father was an engineer). She is the first vote for engineers being born and not made (or at least engineer's reversals). I asked her what instructions I could have given to have her repeat the words in the "proper order" 1234 instead of 1324. I had already rejected the first three: 1. Say the first word first, the second word second and so on--No, that's what she had done. 2. Say them as naturally as possible / just the way you hear them--No, same problem. 3. Say them in compound words--Of course, they know "fishnet, greenhouse" and "daylight" as well as any of us and could put the item right artificially(but most people who have legitimate reversals probably can too). The only one she gave any hope for was the following one. 4. Just relax and don't work so hard at the items. Ease up, it wasn't meant to be listened to with such a critical ear, etc., etc.

One pathological group that has shown a high percentage of 1324 reversals is the autistic. Amy Miller Wetherby found that many of her autistic subjects responded in this manner. Autistic children often times have remarkable precision in immitating musical instruments, commercials, etc. Perhaps the individuals who made 1324 responses had much better temporal sense than linguistic. (It also requires a slightly better memory to remember 4 monosyllabic words than 2 spondees).

Dave Johnson and I have puzzled over some findings that he had obtained. He had instructed normal children on the SSW in addition to the regular instructions to "Say the first word first, the second word second, the third word third and so on." The reversals he found in his younger subjects were not surprising but we were baffled by the large number of 1324 reversals in some of his eleven year olds. Perhaps they were in part listening to the competing words and trying to determine which one came first ,second etc.

In order to shed light on this, a small study with normal college students was carried out to see what they would do (Katz & Fineberg, 1981). It is my guess that the items in which the third word actually precedes the second one by the longest time will be the one that the subject will tend to repeat 1324.

So now you might want to look closely when you have a patient with reversals. If they reverse on both REF and LEF items and the second spondee is generally given first then this seems to be a simple, garden variety reversal pattern. But if they are heavily REF (or LEF) such as 7 to 1 or 17 to 3, then you might be dealing with a Reversal- Ear Effect. Consider this as potentially different from a regular reversal.

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It could be a strategy that the person uses to get the item right or it could be possibly a more posterior site.

Lastly (for right now) if you should see 1324 reversals in an adult ask him his profession. The 1324 probably goes along with the entire "Engineer's syndrome". That is, they raise their hands quickly and accurately all the way down to threshold on the pure tone testing and on the Bekesy audiometry they have tiny excursions about threshold even where their hearing is normal. The behavior is not <u>always</u> and <u>only</u> seen in engineers, of course.

If you see these reversals in a language impaired child or one who is learning disabled, I'm not sure what to say except that this is probably not the same as a regular reversal. Maybe he's destined to be an engineer (hopefully not destined to be autistic). What professions do you suppose autistic children go into when they grow up?

Perhaps in the future we should note what type of reversal was found. After all there are reversals and then there are also <u>reversals</u>.