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ABSTRACT

Visual and auditory paired-associate learning tasks were presented to 125 fourth grade children (45 learning disabled, 39 border line learning disabled, and 41 nonlearning disabled). The visual task produced a greater number of correct responses than did the auditory task. There were no differences among groups on either task. Scores on the Illinois Test of Psycholinguistics were analyzed both between and within learning classifications and were correlated with scores from both paired associate tasks. It was hypothesized that the nonlearning disabled children rely on an auditory mode of processing information, while the learning disabled children rely either on a visual or a mixed auditory-visual mode. (Author/DB)

A COMPARISON OF VISUAL AND AUDITORY CHANNELS IN LEARNING DISABLED AND CONTROL CHILDREN

BY

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The Illinois Test of Psycholinguistic Abilities (ITPA) is a widely accepted diagnostic instrument for assessing strengths and weaknesses in both the auditory and visual areas. The results obtained from this instrument, usually in conjunction with others, are often used with exceptional children in determining remediational strategies using individual strengths and weaknesses. Unfortunately, this type of strategy is not supported by empirical evidence.

When a child's preferred modality has been identified, usually by some predetermined discrepancy between various auditory and visual scores, the degree of success on instructional material presented visually or auditorily appears to be independent of the preferred modality (Smith, 1971; Waugh, 1973). It even appears questionable whether remediational strategies to improve the child's weaknesses, as indicated on the ITPA, will be effective (Hammill and Larsen, 1974).

In addition to determining preferred modality, the ITPA has also been related to reading skills. Good and poor readers have been identified with comparisons made between their scores on various ITPA subtests (e.g., Macione, 1969; Celebre, 1971; Deese, 1971). The implicit assumption of such studies is that by identifying the psycholinguistic areas which are deficient in the poor readers, one might be able to convert them into good readers by remediating the deficient areas.

In both of the above strategies (i.e., determining the preferred modality and identifying deficient psycholinguistic areas in poor readers), the investigator is either averaging subtests scores for the same individual or averaging a subtest score for several individuals. These types of strategies in the

area of learning disabilities, where heterogeneity of psycholinguistic functioning and learning styles is the rule rather than the exception, are in need of revision.

The purpose of the present study was to investigate the relationship between the scores on auditory and visual paired-associates learning tasks and scores on the ITPA subtests for both learning disabled and control children. The learning tasks were controlled so that no cues could be obtained from the modality not being presented (e.g., cues from lip reading or subtle gestures when the material was being presented auditorily).

Method

Subjects. The sample consisted of 125 fourth-grade children enrolled in six experimental classrooms from the Dallas and Irving (Texas) Independent School Districts. Each classroom was comprised of approximately one-half learning disabled and one-half nonlearning disabled children. The children were classified on the basis of a screening battery developed by personnel from the regional educational service center (Texas Education Agency, 1973). In order to further differentiate the children, Myklebust Learning Quotients (Myklebust, 1968) were computed for each child. The following classifications were used: a quotient 90 or above, nonlearning disabled (NLD); 85 - 89, borderline (B); and 84 or below, learning disabled (LD). The specific tests used in the computation of the learning quotients and additional selection criterion are described elsewhere (Adams, Kocsis, & Estes, 1974).

The NLD children (N = 41) had WISC Full Scale IQs ranging from 88 to 136 (M = 112.3, SD = 12.2), those of the B children (N = 39) ranged from 88 to 123 (M = 103.1, SD = 8.1) and those of the LDs (N = 45) ranged from 85 to 136 (M = 101.2, SD = 11.1). Analysis of variance indicated a significant difference between groups ($F = 12.81$; df 2/122; $p < .001$) with the mean IQ of the NLD group

being significantly greater than those of both the B and LD groups, with no significant difference indicated between the latter two.

Age ranges were 8-9 to 10-0 (M = 9-4, SD = 3.2 mo.), 8-6 to 10-4 (M = 9-5, SD = 4.6 mo.) and 8-11 to 10-8 (M = 9-7, SD = 4.8 mo.) for the NLD, B and LD groups, respectively. A significant difference ($F = 4.82$; df 2/122; $p < .01$) was obtained between groups with the LDs being significantly older than the NLDs, while no significant differences were noted between either the NLD and B or the B and LD groups.

Procedure. A battery of tests, including the ITPA, was administered to all children by school psychologists during the late summer and beginning weeks of the school year. The paired-associates tasks were administered by a trained research assistant at the end of the first school semester.

The stimulus items for the paired-associates tasks were common four-letter nouns with consonants as the response items. Two 8-item lists were each prepared for one auditory and two visual presentations via audio and video tapes. For one of the visual presentations, the stimulus items were line drawings of the nouns; for the other, the stimulus items were the printed words. Methods of presenting the paired-associates, time sequences and instructions similar to those of the present study are presented elsewhere (Estes & Huizinga, 1974). Table 1 presents the stimulus-response pairs for both lists I and II.

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Insert Table 1 about here

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Each child participated in 10 acquisition trials on both lists I and II. One group received a visual presentation of list I followed two weeks later by an auditory presentation of list II. A second group received a visual presentation of list II followed two weeks later by an auditory presentation

of list I. For two other groups, the lists were also counterbalanced but in reverse order of presentation.

Results

The total number of correct responses over the 10 acquisition trials constituted the scores for the paired-associates tasks, with both visual presentations being combined. The scaled scores on each of the 10 subtests were used for the ITPA.

Within both the paired-associates tasks and each of the ITPA subtests, analyses of variance were performed on the scores between learning classifications. Where significant F ratios were obtained, comparisons were made between the scores for individual pairs of learning classifications using the pooled error term from the overall analysis of variance. Within each learning classification, comparisons were made between the auditory and visual scores for the paired-associates task as well as those for the ITPA processes. The scores were compared using t-tests for the difference between correlated means. Table 2 presents the means, standard deviations and tests of significance for both the paired-associates scores and the ITPA scaled scores by learning disabilities.

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Insert Table 2 about here

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There were no significant differences between learning classifications on either the auditory or visual paired-associates tasks. Scores were higher on the visual as compared with the auditory paired-associates task within all three learning classifications.

Significant F ratios were obtained between learning classifications for seven of the ITPA subtests. Subsequent comparisons between learning classifications showed that the subtest scores for the NLD group were significantly

higher than those for the LD group with those of the B group falling between the other two. The only exception was noted for the Manual Expression subtest where the scores for the NLD group were significantly higher than those for the B group, while those for the LD group did not differ significantly from the other two groups. Comparable scores between learning classifications were found on the Verbal Expression, Visual Closure and Visual Sequential Memory subtests.

Comparisons of the auditory and visual channels within each of the ITPA processes were made for each learning classification group separately. Scores in Visual Reception were significantly higher than Auditory Reception for both the NLD and B groups but not for the LD group. Manual Expression scores were significantly higher than those of Verbal Expression in all learning classifications. For the closure process, Grammatic Closure scores were higher than those of Visual Closure for the NLD group while Visual Closure produced higher scores than Grammatic Closure for the LD group, with no reliable differences obtained for the B group. Within both the association and sequential memory processes, comparable auditory and visual scores were obtained for all three learning classifications.

Pearson product-moment coefficients of correlation were computed for the auditory and visual paired-associates scores with the scaled scores on the individual ITPA subtest for each learning classification separately. The correlation coefficients are presented in Table 3.

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Insert Table 3 about here

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For the NLD group, significant correlations were obtained between the scores on Auditory Sequential Memory with both the auditory and visual paired-associates

scores. Likewise, a significant correlation was obtained between the scores on Auditory Sequential Memory and those on the auditory paired-associates task for the B group. Significant correlations for both Auditory Reception and Auditory Association scores with those on the visual paired-associates task were also obtained for this group. For the LD group, the only significant correlation was obtained between scores on Visual Sequential Memory with those on the visual paired-associates task.

To compare the differences in magnitude between the correlations obtained on the two channels within the same process (e.g., between Auditory and Visual Reception, Grammatic and Visual Closure, etc.), t-tests for the significance of the difference between two correlation coefficients for correlated samples were computed. For the NLD group, significant differences were obtained between the correlations with Auditory and Visual Sequential Memory in both the auditory and visual paired-associates task conditions (t = 3.26 and 2.82, respectively, $p < .01$). None of the correlations between the two channels differed significantly in magnitude for the B group. The LD group had two pairs of correlations which differed significantly from one another. The correlations with Auditory and Visual Sequential Memory for the visual paired-associates condition indicated a significant difference (t = 2.12, $p < .05$) as did those with Auditory and Visual Association for the auditory paired-associates condition (t = 2.55, $p < .05$).

Discussion

The scores of the B group are typically aligned with those either of the LD or NLD group, depending upon the specific analyses. The discussion, therefore, will focus only on comparisons between the LD and NLD groups.

It was noted that the mean IQs for the LD and NLD groups differed significantly. This factor does not appear to be related to performance on the

paired-associates tasks as the scores for both groups are comparable on each task. Correlations of .72 were obtained between the WISC Full Scale IQ and the ITPA ratio PLQ for each group. Since the IQs of the NLD children were higher than those of the LD children, generally elevated scores would be expected for this group on at least some of the ITPA subtests.

A comparison of the ITPA subtest scores revealed that the NLD group performed better than the LD group on six of the subtests. Based on the fact that no significant differences were obtained between the group means, one might speculate that the remaining four subtests of Verbal Expression, Manual Expression, Visual Closure and Visual Sequential Memory are not useful in discriminating the LD from the NLD children in this sample.

When comparing differences between the auditory and visual channels within each process, the LD and NLD groups differed only on the reception and closure processes. Again, based on these findings, one might speculate that differences between the auditory and visual channels within the association, expression and sequential memory processes are not useful in differentiating the LD from the NLD children in the present sample.

Inspection of the correlation coefficients shown in Table 3 appear to present a somewhat conflicting picture compared to the between groups comparisons previously mentioned. For the NLD group significant positive correlations were obtained between scores on both the auditory and visual paired-associates tasks and Auditory Sequential Memory. There is an obvious lack of relationship between these scores for the LD group. Auditory Sequential Memory was one of the subtests on which the NLD group scored significantly higher than the LD group. Scores for Visual Sequential Memory and those on the visual paired-associates task provided a significant positive correlation for the LD group while those on the auditory task did not. For the NLD group,

both auditory and visual paired-associates scores produced non significant negative relationships with Visual Sequential Memory scores. Visual Sequential Memory was one of the subtests which did not discriminate LD from NLD children in this sample.

Differences in the magnitudes of the correlations between Auditory and Visual Sequential Memory scores with both the auditory and visual paired-associates scores were significant in the NLD group. These differences were significant only with the visual paired-associates scores for the LD group. Differences in the correlations between Auditory and Visual Association scores with the auditory paired-associates scores were also significant for the LD group. When the auditory and visual channel scores were compared within both the sequential memory and association processes, however, no significant differences were noted for either the LD or NLD groups.

There are a variety of ways to interpret the seemingly confusing and contradictory results. By assuming that there are some basic differences between learning and nonlearning disabled children in the way in which information is processed, the question is raised as to how these processes differ. It is hypothesized that nonlearning disabled children learn to rely on auditory channels as the dominant mode of processing, while the learning disabled children have not developed the auditory channel as the dominant mode and are using either the visual or a combination of visual and auditory channels for processing.

Tentative support for this hypothesis comes from observing the trend in the correlation coefficients shown in Table 3. In comparing the differences in the correlations between the auditory and visual channels for each of the five processes, 10 comparisons (five for each paired-associates task) can be made for both the NLD and LD groups. For the NLD group, six of these compari-

sons show higher correlations with the auditory than the visual channel, one shows a higher negative correlation with the visual channel and three of the comparisons show comparable relationships. For the LD group, however, five of these comparisons show higher correlations with the visual than with the auditory channel, two show higher correlations with the auditory channel and three show comparable relationships.

It should be stressed that only four of the differences between the correlations reached statistical significance and that the trend noted above is not statistically significant but resulted from a visual inspection of the data. It should also be noted that the ages of the children in this study place them near the ceiling age for the ITPA. This may account for the generally low correlations obtained with the paired-associates scores. A replication of the study with younger children is needed to verify the hypothesis on processing differences between learning and nonlearning disabled children. If this hypothesis is empirically supported by future research, it would then be necessary to determine if children can be trained to process auditorily or if instructional material should be oriented to visual processing for the learning disabled child. In the meantime, remediational strategies using the results from the ITPA should be monitored to determine their effectiveness.

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TABLE 1

Stimulus and Response Items for Paired-Associates Lists I and II

List I	List II
soap - D	nail - C
ring - B	iron - P
kite - G	flag - S
bell - K	drum - V
sock - Y	shoe - L
leaf - R	tree - H
goat - N	bear - F
fish - T	seal - J

TABLE 2

Means, Standard Deviations and Tests of Significance

for Paired-Associates and ITPA Scores by Learning Classification

	Learning Classification										
	NLD(N=41)			B(N=39)			LD(N=45)				
Test	M	SD	t	M	SD	t	M	SD	t	F+	p
Auditory Paired-Associate	41.7	16.6	4.01**	40.4	14.5	5.03**	39.5	15.9	4.13*	.21	ns
Visual Paired-Associates	51.4	18.3		53.2	14.9		50.2	17.5		.32	ns
Auditory Reception	35.2	4.9	2.64*	32.8	5.7	2.45*	31.5	8.2	.60	3.46	<.05
Visual Reception	38.6	7.7		36.5	6.1		32.8	7.7		6.94	<.005
Auditory Association	38.5	6.5	1.52	34.1	6.7	.44	32.4	8.4	1.23	7.67	<.001
Visual Association	40.4	6.9		34.7	6.0		33.7	6.3		13.06	<.001
Verbal Expression	32.6	4.6	7.07**	30.3	5.2	5.51**	32.5	5.0	5.83**	3.03	ns
Manual Expression	40.1	6.0		36.2	5.8		38.2	5.3		4.58	<.025
Grammatic Closure	40.6	5.0	2.65*	35.8	7.9	.54	31.4	9.3	2.93**	30.14	<.001
Visual Closure	36.7	8.7		35.0	7.1		36.2	7.9		.47	ns
Auditory Sequential Memory	41.1	6.1	.14	39.0	6.1	.96	36.6	5.9	1.98	5.86	<.005
Visual Sequential Memory	40.9	6.8		37.7	8.9		39.1	8.0		1.60	ns

+df 2/122 *p <.05 **p <.01

TABLE 3

Correlation Coefficients Between Paired-Associates Scores and Scaled Scores on ITPA Subtests by Learning Classification

Paired-Associates	ITPA Subtests[a]									
Auditory	AR	VR	AA	VA	VE	ME	GC	VC	AM	VM
NLD	.14	-.01	-.05	-.16	.27	.12	.03	.05	.48**	-.16
B	.07	-.12	-.04	.34	.03	.21	.15	-.02	.32*	.15
LD	.05	.03	-.05	.29	-.05	.16	.14	.03	.09	.26
Visual										
NLD	.16	-.10	.08	.11	.25	.09	.06	.06	.35*	-.23
B	.35*	.17	.37*	-.03	.09	-.05	.25	-.07	-.01	-.06
LD	-.03	.02	-.04	.08	.00	.00	.14	-.08	.00	.36*

[a]ITPA Subtest Designations

AR - Auditory Reception

VR - Visual Reception

AA - Auditory Association

VA - Visual Association

VE - Verbal Expression

ME - Manual Expression

GC - Grammatic Closure

VC - Visual Closure

AM - Auditory Sequential Memory

VM - Visual Sequential Memory

* - $p < .05$

** - $p < .01$