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INTRODUCTION

Visual perception, as distinct from visual acuity, has to do with the understanding of the visual world. It is the process of organizing or interpreting all of the minute, abstract components of the visual scene,. A person can have 20/20 visual acuity and still not be able to interpret all the details of the visual scene without distortion. He is then considered to have a possible deficit in one or more of the specific visual perceptual skills required to interpret these details accurately.

If a person is to perceive his visual world accurately, he must have the following abilities: He must be able to distinguish shapes of objects. He must be able to differentiate one shape from another when the objects are stationary and also when the objects move across his visual field. He must be able to distinguish different sizes of objects, and also utilize cues, such as perspective and occlusion of one object by another, to perceive their relative position in space. he must be able to recognize or identify an object despite the fact that parts of it cannot be seen. He must be able to differentiate a foreground figure from the background. He must be able to estimate the amount of space that surrounds and separates

individual objects and groups of objects. he must be able to perceive the changes in location of objects as they move from one position in space to another. In addition, he must be able to perceive the direction of movement and the pattern of movement. He must be able to recognize objects despite the fact that they are viewed from different angles. he must understand his own body and its orientation in space and have a sense of its boundaries.

Visual perceptual learning disabilities often present a vague picture of difficulties on several, but not all of the above skills. In fact, some of the abilities are intact, while others reveal serious deficits. These deficits may manifest themselves in learning problems in some academic areas such as reading comprehension, decoding skills, mathematics and language. For the hearing-impaired population, problems may also be found in their speech-reading abilities.

The components of visual perception are normally used in a variety of combinations to identify, define, clarify, and interpret the visual stimulus. The Test of Visual Perceptual Abilities (TVPA) is comprised of twelve subtests, each one tapping a subskill of visual perception. Within each subtest are ten target items that tap the ability to perceive different orientation, directions, patterns of movement, spatial arrangements, and visual clues. Each item was designed with cortico-neurological organization in mind. The TVPA is designed as a screening instrument for detecting visual perceptual deficits. Part I assesses perception of characteristics of

stationary objects. Part II is presented on videotape. It consists of moving and changing objects. he subject are required to identify what they have seen on the television screen by selecting one of several line drawings reproduced in the answer booklet. The overall purpose of the TVPA is to provide measures that will probe specific visual perceptual abilities. The subtests were designed to assist in the identification of children ages 8-18 with visual perceptual/ spatial learning disabilities.

It is apparent that different components of visual perception are processed independently in different cortical ares of considerable specialization. Specific cortical neurons have been identified that independently process different visual perceptual tasks--dynamic as well as static. With this brain organization in mind, the TVPA was broken down into specific subtests which test specific subskills of visual perception:

Static Part I
Subtest 1. Discrimination of shape
Subtest 2. Discrimination of size
Subtest 3. Spatial relationships of static objects
Subtest 4. Visual closure
Subtest 5. Figure-ground discrimination
Subtest 6. Perception of space between objects

Dynamic Part II
Subtest 7. Size constancy
Subtest 8. Changing spatial location of dynamic objects
Subtest 9. Spatial relationships of dynamic objects
Subtest 10. Temporal-spatial integration
Subtest 11. Perception of body boundaries
Subtest 12. Shape constancy

Purpose of the study:

The purpose of the current study is to determine if the Test of Visual Perceptual Abilities is a valid indicator of learning problems in a sample population and also how it correlates with other measures of learning disabilities.

METHOD

The sample population consists of 20 severe to profoundly hearing-impaired children ages 8:2 years to 14:6 years (98-174 months). All of the students attend Central Institute for the Deaf. The sample was divided into two groups and age-matched (see Table 1 of Appendix). The students were assigned to either the "normal learning" group or "learning problem" group based on their classroom teachers' evaluation.

These children were administered the hearing version of the TVPA in groups of between 3 and 5 children in 2 test sessions. Testing was conducted in a quiet room free of distractions with the children seated approximately five feet from a television monitor (19 inches). Instructions were given orally by the examiner prior to each subtest. The subjects were given as much time as needed to complete the static subtests in Part I. Part II was administered during the second session. The students watched the dynamic subtests on video. Each item in Part II was presented twice with a five-second interval between them. The examiner was permitted to stop the video between subtests in order to give instructions for the

following subtest. In each of the twelve subtests, two example items were provided for the examiner to work through with the students to ensure that the students understood the task at hand.

Another test of visual perceptual skill, the Beery Buktenica Developmental Visual-Motor Integration, was also administered to all twenty subject. This is a design copying task for which age norms are provided for children between the ages of 3 and 16. Age scores on this test reflect visual perceptual development and fine-motor coordination which have been found to be predictive of reading and language learning problems in children with a delay.

Scores on the two tests of visual perceptual skills (TVPA and the Beery) were compared with scores obtained by these same subjects on the most recent administration of the Performance subtests of the Wechsler Intelligence Scale for Children-Revised (WISC-R). The Performance IQ is a measure of general learning ability in hearing-impaired children, and isolated low scores on specific subtests, particularly Coding and Block Design, may reflect visual-perceptual based learning disabilities.

Hypothesis:

If the TVPA is a valid indicator of learning problems in this hearing impaired sample of children, scores on this test should correlate significantly with those on the Beery and with WISC-R subtest scores Coding and Block Design. TVPA scores should correlate less well with chronological age (since this is not

intended to be a developmental measure) and PIQ (since the TVPA is not intended to be a measure of intelligence). Furthermore, it is expected that more children classified by their teachers as presenting learning problems should obtain below criterion scores (i.e. > 3 errors) on at least one TVPA subtest.

RESULTS

The author of the TVPA grouped the subtests according to perceptual categories as follows:

SHAPE and form perception (subtests 1,3,4,12)
SIZE perception (subtests 2,7)
Visual perceptual INTEGRATION (subtests 6, 10)
Perception of DYNAMIC objects (subtests 8, 9)
Visual FIGURE-GROUND perception (subtests 5, 11)

And so, for statistical purposes, the TVPA subtests will be looked at according to those perceptual categories. In Table 2, the mean and standard deviation of percent correct responses for each TVPA category are listed.

In examining how these subtest categories relate to each other (Table 3), with a significance above 0.35 ($p \leq .05$), we find that SHAPE is significantly correlated with DYNAMICS and FIG/GRND. SIZE shows a significant correlation with all other subtests except SHAPE. INTEGRATION shows no significant correlation with any of the other subtests with the exception of SIZE, with which it is significantly negatively correlated. The total score from the TVPA

shows a significant correlation with all of its subtests, with the highest correlation being with SHAPE and FIG/GRND and the lowest with INTEGRATION.

In Table 4, the mean and standard deviation of the tests to which the TVPA scores were compared are listed. Beery Age Scores may be compared to chronological age. The mean between the Beery age score and chronological age differ significantly (by 29 months). The WISC-R Performance IQ of the group is slightly above average (at 108 with average being 85-100). All WISC-R subtest scores are within the average range (7-13). Scores on Coding and Block Design are, however, the lowest --an expected result when half of the group have been identified to have learning problems.

Comparing those scores to the TVPA subtest categories (Table 5), the WISC-R shows significant correlations to the SHAPE and FIG/GRND categories. Both Chronological Age and Beery scores have significant correlations with SHAPE, DYNAMICS, FIG/GRND. SHAPE has its highest correlation with the Beery, which is to be expected (see Discussion section). The total TVPA score is significantly correlated with all three validation measures: most highly with the Beery (.66), followed by Chronological Age (.58) and the WISC-R IQ (.43).

In order to further explore the relation between TVPA and WISC-R scores, Table 6 shows correlations between the individual subtests. Although the expected significant correlation with Block

Design scores is confirmed (.44) for total TVPA scores, none of the individual TVPA subtest categories reached significance. No significant correlations were observed with the Coding subtest.

Finally, comparisons were done to see how any and all of these measures discriminate between the two learning groups. In a one way analysis of variance of test scores by learning group (Table 7), only four scores show any significant discrimination. Three of these scores are subtests from the WISC-R: Block Design and Coding as expected; also with Picture Arrangement which was not expected to discriminate these groups. In addition, the groups differed significantly in overall IQ. Another way of examining the data is to look at the number of subjects whose scores on any measure indicate a problem (Table 8). The criteria for doing so is as follows:

Beery Age Score < 1 year of Chronological Age
TVPA > 3 errors on any one subtest
WISC-R IQ < 85
WISC-R subtest scale scores < 7

For the Beery, 9 of the 10 subjects with learning problems achieved criterion scores, but son did 7 of the normal group. For 4 out of 6 WISC-R subtest scores, at least one child in the learning problem group achieved below average scores. For the TVPA, the tendency was reversed, so that 6 out of 10 of the normal learning group achieved "high risk" scores while only 4 from the learning problem group did so.

DISCUSSION

The author of the TVPA claims that TVPA subtests are designed to test different skills from one another. As can be seen from the data in Table 3, most intersubtest correlations are significantly different from chance, indication that a common factor is being measures. The low correlations of INTEGRATION with other subtest category scores leads one to assume that those subtests are tapping a different skill than the other categories. The negative correlation with scores on the SIZE category suggests that opposite skills may be tapped by these two categories.

In comparing the TVPA with other measures of learning abilities, for the most part the TVPA is measuring the same skills as the Beery (Table 5). And while there is no motor tasks being scored on the TVPA, there is clearly some overlapping skills between visual perception and visual motor integration. The author of the TVPA attests that visual perceptual abilities are intact by the age of eight and there is no developmental increase in abilities as a child gets older. But, as can be seen by the high correlation between chronological age and TPVA scores, this is not so. The older subjects scored higher than the younger ones regardless of which learning group they belonged.

In Table 6, the significant correlations that are seen can be expected, i.e. those subtests with significant correlations to one another are tapping the same skills. The TVPA subtest category

SHAPE is most highly correlated with the WISC-R subtests Picture Completion . Both subtests require the ability to discriminate shape, similarity between objects, etc. The TVPA subtest category DYNAMICS highly correlates with the WISC-R subtest Mazes. Both require the ability to follow objects across space. However the WISC-R subtests which are most diagnostic of visual-perceptual based learning problems, Coding and Block Design, were not highly correlated with the TVPA scores.

While the WISC-R performance IQ were shown to significantly discriminate between the two learning groups (Table 7), the mean IQ for the learning problem group (99.3) falls well within the normal range (85-100). The normal learning group had a mean IQ (116.7) more than one standard deviation above normal. Although as a measure of discrimination, the WISC-R IQ scores show a significant difference, there is no deficit in the IQ of the learning problem group. However, the above average IQ of the normal learning group may have skewed the results of the tests as the group has demonstrated above average ability on this measure.

The TVPA does not appear to be a good measure of learning problems. It tends to correlate highly with the Beery (as seen in Table 5) but the Beery is better at sorting out learning problems (Table 8). The TVPA has its poorest correlation with the WISC-R. The WISC-R seems to be the best indicator of learning problems. In examining the main effect of learning status on test scores (Table 7), the four scores that show any significance are all from the

WISC-R. In Table 8, the learning problem group had more scores within the high risk zone on five WISC-R scores. Of these three measures of learning ability--the Beery, WISC-R and TVPA--the TVPA is the least predictive of learning problems within this sample group.

Critique of TVPA:

While the TVPA is generally easy to administer and easy to score, there is a lack of clarity in the manual instructions and moreover a general lack of organization. There are two versions of the TVPA--hearing and hearing-impaired--but only one manual, that of the hearing-impaired version. While the author of the test claims that the manual can be used for both versions, it is clear in the language of the instructions to the examiner as well as the language the examiner is required to use with the subjects, that the manual is intended for the hearing-impaired version. There are some alterations between the two versions which consist of omitting drawings of hand signs from the hearing-impaired version and substituting different pictures requiring similar tasks in the hearing version. But there is no mention of this in the manual and the examiner would not know this unless he/she were to peruse both versions.

Nineteen out of the twenty subjects in this current study got item 44 incorrect in the hearing version (Table 9). This is one of the substituted items between the two version. If the answer key is supposed to be the same for both versions, the correct answer

should be 1. The task is to find the shape that is within the picture. Obviously, in the hearing version, this item is too vague.

Subtest 7 is vague in what it is asking the students to do and also in the instructions provided for the examiner. Two of the same items appear on the screen--one may be larger or the same size. The students are required to watch as the objects move across the screen in some fashion and choose from three choices in the answer booklet that which best represents what they saw on the monitor. However, the author is unclear as to at what critical point in the movement of these objects must the students decide--when they move initially or at the end of the movement. Therefore, because of this confusion, the sample as a whole did poorer on this subtest than on any other.

Overall, the TVPA suffers from lack of organization which leaves the examiner either confused or forced to make decisions for him/herself. A properly designed test should take the examiner as well as the examinee step by step with little room for confusion or interpretation. The prospect of having an appropriate test for learning disabilities in hearing-impaired students is very exciting indeed. Perhaps with more field testing and re-organization, the TVPA may have proved to have been such.

APPENDIX

(TABLES)

SUBJECTS AND AGES (IN MONTHS)

NORMAL LEARNING		LEARNING PROBLEM	
(subject #)	(age)	(subject #)	(age)
NL1	174	LP1	174
NL2	169	LP2	172
NL3	169	LP3	164
NL4	155	LP4	158
NL5	137	LP5	139
NL6	127	LP6	127
NL7	119	LP7	111
NL8	116	LP8	109
NL9	106	LP9	106
NL10	98	LP10	105

(TABLE 1)

MEAN AND STANDARD DEVIATION OF TVPA SUBTESTS AS GROUPED BY PERCEPTUAL CATEGORIES

PERCEPTUAL CATEGORY	$\bar{x}$ (% CORRECT)	STANDARD DEVIATION
SHAPE (1,3,4,12)	91	3.07
SIZE (2,7)	87	1.67
INTEGRATION (6,10)	88	2.46
DYNAMICS (8,9)	95	1.37
FIG/GRND (5,11)	85	1.37

(TABLE 2)

INTERCORRELATION MATRIX OF TVPA SUBTEST CATEGORIES

	SHAPE	SIZE	INTEG.	DYNAM.	FIG/GRND	TOTAL
SHAPE						
SIZE	.27					
INTEG.	-.02	-.36				
DYNAM.	.62	.45	-.07			
FIG/GRND	.68	.44	.22	.50		
TOTAL	.81	.43	.37	.68	.87	

(TABLE 3)

MEAN AND STANDARD DEVIATION OF SCORES FROM VALIDATION MEASURES

MEASURE	$\bar{x}$	STANDARD DEVIATION
Chronological Age	137 (mo)	
Beery Age scores	108 (mo)	35.8
WISC-R Performance IQ	108	14.4
WISC-R subtests		
Picture Completion	10.9	2.9
Picture Arrangement	12.4	3.3
Block Design	10.1	2.9
Object Assembly	11.6	2.2
Coding	10.0	2.6
Mazes	10.8	2.8

(TABLE 4)

CORRELATIONS OF VALIDATION MEASURES WITH TVPA CATEGORIES

	WISC-R PERF. IQ	CHRON. AGE	BEERY AGE SCORE
SHAPE	.49*	.48*	.63*
SIZE	.37	.31	.18
INTEGRATION	-.12	.17	.26
DYNAMICS	.29	.42*	.51*
FIG/GRND	.39*	.59*	.52*
TOTAL SCORE	.43*	.58*	.66*

*$p \leq .05$

(TABLE 5)

CORRELATIONS BETWEEN TVPA CATEGORIES AND WISC-R PERFORMANCE SUBTESTS

	PICT. COMP	PICT. ARRA	BLOK DSGN	OBJ. ASBY	CODE	MAZE	P-IQ
SHAPE	.53*	.39*	.50*	.24	-.14	.48*	.49*
SIZE	.36	.25	.29	.27	.09	.36	.37
INTEG.	-.22	-.13	-.02	-.03	-.16	-.22	-.12
DYNAM.	.19	.22	.30	.24	-.21	.51*	.29
FIG/GRND	.47*	.33	.32	.26	-.27	.34	.39*
TOT TVPA	.43*	.29	.44*	.29	-.22	.39*	.43*

*$p \leq .05$

(TABLE 6)

ONE WAY ANALYSIS OF VARIANCE OF TEST SCORES BY LEARNING GROUP

WISC-R PERFORMANCE IQ

GROUP	$\bar{x}$	SD	F VALUE	p VALUE
NORMAL	116.7	13.97	11.16	.004
PROBLEM	99.3	8.73		

PICTURE ARRANGEMENT SUBTEST OF WISC-R

GROUP	$\bar{x}$	SD	F VALUE	p VALUE
NORMAL	14.1	2.03	6.73	.020
PROBLEM	10.7	3.43		

BLOCK DESIGN SUBTEST OF WISC-R

GROUP	$\bar{x}$	SD	F VALUE	p VALUE
NORMAL	11.4	3.13	4.99	.039
PROBLEM	8.8	1.93		

CODING SUBTEST OF WISC-R

GROUP	$\bar{x}$	SD	F VALUE	p VALUE
NORMAL	11.4	1.43	9.13	.007
PROBLEM	8.5	2.68		

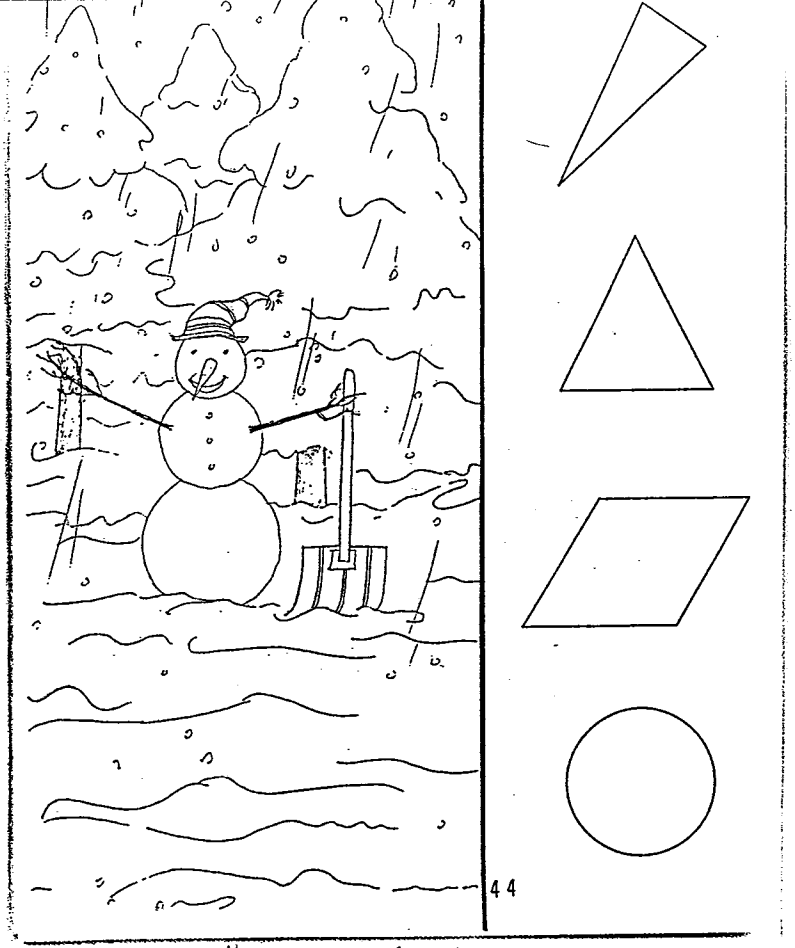
(TABLE 7)

NUMBER OF SUBJECTS IN EACH GROUP WITH SCORES INDICATING A PROBLEM

GROUP	1	2	3	4	5	6	7	8	9
NORMAL	7	6	0	0	0	0	0	0	0
PROBLEM	9	4	1	1	1	1	0	2	0

Columns:
1. Beery age scores
2. TVPA subtests
3. WISC-R performance IQ
4. Picture Completion
5. Picture Arrangement
6. Block Design
7. Object Assembly
8. Coding
9. Mazes

(TABLE 8)



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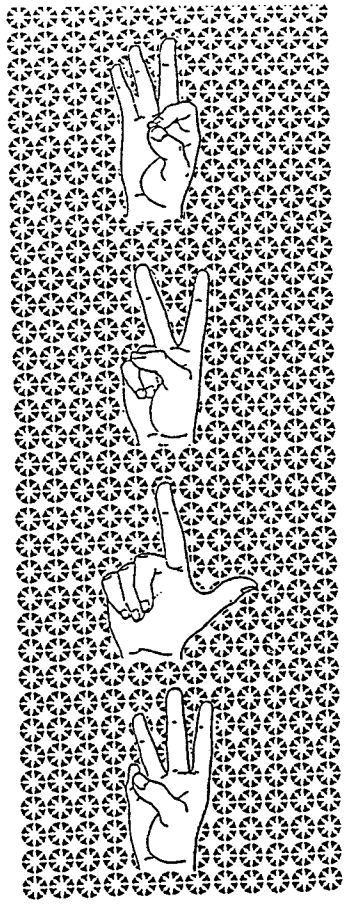
Hearing Version

(TABLE 9)



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Hearing-Impaired Version

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