DOCUMENT RESUME

ED 052 839 24 PS 004 894

AUTHOR	Hines, Brainard W.
TITLE	Analysis of Visual Perception of Children in the Early Childhood Education Program (Results of the Marianne Frostig Developmental Test of Visual Perception).
INSTITUTION	Appalachia Educational Lab., Charleston, W. Va.
SPONS AGENCY	Office of Education (DHEW), Washington, D.C. Bureau of Research.
REPORT NO	TR-5
BUREAU NO	BR-6-2909
PUB DATE	Feb 71
CONTRACT	OEC-3-7-062909-3070
NOTE	31p.
EDRS PRICE	EDRS Price MF-$0.65 HC-$3.29
DESCRIPTORS	*Evaluation Methods, Mobile Classrooms, Motor Development, Nonprofessional Personnel, Perceptual Development, *Perceptual Motor Coordination, *Preschool Programs, Program Evaluation, Sex Differences, Tables (Data), Teacher Attitudes, Teacher Role, Television, *Visual Measures, *Visual Perception
IDENTIFIERS	Frostig Developmental Test of Visual Perception

ABSTRACT

This report includes a description of the Frostig as a total instrument and an overall analysis, as well as separate analyses and descriptions of each subtest. A brief summary of the experimental design and sampling plan also is included. A summary of the AEL Early Childhood Program is available as PS 004 889. (Author/NH)

ANALYSIS OF VISUAL PERCEPTION OF CHILDREN IN THE EARLY CHILDHOOD EDUCATION PROGRAM (RESULTS OF THE MARIANNE FROSTIG DEVELOPMENTAL TEST OF VISUAL PERCEPTION)

Technical Report No. 5

Division of Research and Evaluation
Appalachia Educational Laboratory
Charleston, West Virginia

February, 1971

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ANALYSIS OF VISUAL PERCEPTION OF CHILDREN IN THE EARLY CHILDHOOD EDUCATION PROGRAM*

Introduction

A large proportion of the initial ECE curriculum[1] and the subsequent program materials are devoted to teaching motor coordination and perceptual learning tasks. Because of the difficulty of developing specific measures for each of these objectives, and because of its previous use in evaluating preschool programs, the Marianne Frostig Developmental Test of Visual Perception was used to measure behavioral change in these areas.

The Frostig shares many of the same problems as a program evaluation instrument with the ITPA. Neither was designed to be a specific measure of program effects and both are individually administered, and thus are susceptible to examiner bias. In addition, both instruments were designed to be diagnostic of perceptual, expressive, and motor deficits rather than overall treatment effects.

However, the instrument does provide a potentially valid and reliable measure of perceptual development in the preschool-age child, and most important, it provides national norms for comparison with a sample outside of the AEL region.

This report includes a description of the Frostig as a total instrument and an overall analysis, as well as separate analyses and descriptions of each subtest. A brief summary of the experimental design and sampling plan also is included.

Method

A pilot study done by Hooper and Marshall[2] included administration of the Frostig to a sample of children, aged three to six years, in northern West Virginia.

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[1]Frank H. Hooper and William H. Marshall, The Initial Phase of a Preschool Curriculum Development Project - Final Report. Morgantown, West Virginia, 1968, pp. 116-122.

[2]Ibid., pp. 75-77.

*This report was prepared by Brainard W. Hines of the AEL Research and Evaluation Division.

The results of this testing indicated overall deficits in the areas of figure-ground perception and form-constancy tasks. Both of these subtests (1 and 2) were cited by the test authors as being relevant to reading readiness. In order to further validate these data, and as a method of measuring program effects on motor learning and perceptual development, the Frostig was included as a major evaluation instrument for the ECE Program.

Data were collected in June and September of 1970 from a sample of 273 children in three treatment groups and 60 children in a Control group located in Monongahela County, West Virginia. Details of the sampling procedure are covered in the introduction to this report.

The primary method of analysis was a three way analysis of variance (ANOVA) on each of the Frostig subtest raw scores and on the total test raw score, using the BMD series computer program, compensating for unequal sample sizes. The ANOVA attempted to measure the significance of the effects of four levels of treatment (discussed above), two levels of age, and two levels of sex. An analysis of covariance procedure (ANCOVA) was also performed using chronological age and Peabody Picture Vocabulary Test raw score as covariates. This analysis provided little information beyond that available from the ANOVA.

Although perceptual quotients (PQ's) were available from the Frostig, they were not used in any of the data analyses because of the difficulties arising from using derived scores and raw scores in the same computations.

Description of Instrument and Results of Analysis

The Frostig is designed primarily as a method of assessing perceptual development in the visual area. However, hand-eye coordination and overall motor skills are involved in the child's responses to the visual configurations on the test. Unlike the ITPA, with the Frostig it is difficult to separate the receptive processes (visual acuity) from the mediating activity (figure recognition) and the expressive act (drawing, outlining, etc.). For this reason the instrument is considered to be an indicator of perceptual-motor development in the ECE evaluation plan, and no effort is made to separate the two different areas of functioning which may cause variance on the total test scores. Each of the following subtests have fairly high "face" validity and it is assumed that each measures the general area which is attributed to it.

Frostig Subtest 1 (Eye Motor Coordination)

The authors state that this subtest is:

> A test of eye-hand coordination involving the drawing of continuous straight, curved, or angled lines between boundaries of various width, or from point to point without guidelines.[3]

Mean raw scores, standard deviations, and numbers of subjects according to age, sex and treatment group for Subtest 1 are presented in Table 5-1, and the same data combined to show treatment group means are given as Table 5-2. Combining these scores produces the results which are also graphically represented in Figure 5-1 along with the mean scores of the Frostig normative sample.

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[3] Marianne Frostig, Administration and Scoring Manual, Frostig Developmental Test of Visual Perception, Consulting Psychologists Press, 1966.

TABLE 5-1

FROSTIG SUBTEST 1 (EYE-MOTOR COORDINATION) MEAN RAW SCORES, STANDARD DEVIATIONS, AND NUMBERS OF SUBJECTS BY AGE AND SEX WITHIN TREATMENT GROUPS

Age	Sex	Package	TV-HV	TV only	Control
3	M	$\bar{x}$ = 9.67 SD = 6.34 N = 9	$\bar{x}$ = 10.22 SD = 3.87 N = 9	$\bar{x}$ = 8.15 SD = 6.04 N = 13	$\bar{x}$ = 4.31 SD = 2.14 N = 13
	F	$\bar{x}$ = 8.78 SD = 7.92 N = 9	$\bar{x}$ = 15.00 SD = 4.35 N = 10	$\bar{x}$ = 9.60 SD = 8.15 N = 8	$\bar{x}$ = 7.78 SD = 4.09 N = 9
4	M	$\bar{x}$ = 14.54 SD = 8.11 N = 13	$\bar{x}$ = 19.75 SD = 4.37 N = 8	$\bar{x}$ = 13.75 SD = 8.15 N = 8	$\bar{x}$ = 7.78 SD = 4.09 N = 9
	F	$\bar{x}$ = 10.64 SD = 5.32 N = 11	$\bar{x}$ = 10.40 SD = 2.95 N = 10	$\bar{x}$ = 13.54 SD = 7.48 N = 13	$\bar{x}$ = 10.10 SD = 3.78 N = 10

TABLE 5-2

SUBTEST 1 MEAN RAW SCORES, STANDARD DEVIATIONS, AND SAMPLE SIZES FOR EACH TREATMENT GROUP

Package	TV-HV	TV only	Control
$\bar{x}$ = 11.86 SD = 6.99 N = 40	$\bar{x}$ = 13.62 SD = 5.34 N = 31	$\bar{x}$ = 11.34 SD = 7.18 N = 44	$\bar{x}$ = 6.64 SD = 3.70 N = 45

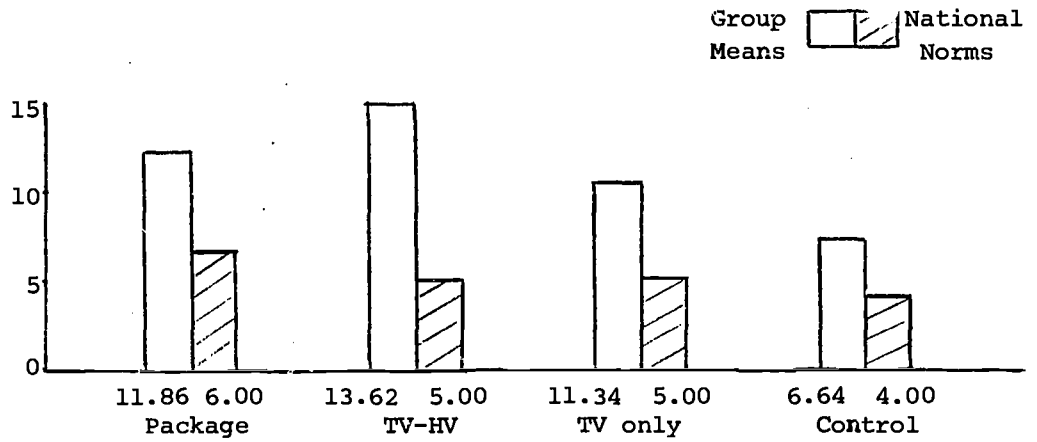

FIGURE 5-1

RAW SCORE MEANS AND NATIONAL NORMS
FOR FROSTIG SUBTEST 1 (EYE-MOTOR COORDINATION)

Several meaningful conclusions can be drawn from the previous graph. First, the three treatment groups show significantly higher means than the comparison group. Second, the TV-HV group scored slightly above the other two treatments, and finally, all three treatments scored well above the national norms for this age.

These findings are clarified by the results of the three-way analysis of variance procedure which was performed on the raw scores of Subtest 1. A summary of the ANOVA results is reproduced in Table 5-3.

TABLE 5-3

ANALYSIS OF VARIANCE TABLE FOR FROSTIG SUBTEST 1

Source	eta^2 *	D.F.	Mean Square	F	P
I(trt)	.142	3	332.0735567	10.49	P<.0005
J(sex)	.003	1	21.13977852	0.67	
K(age)	.078	1	546.2934877	17.26	P<.0005
IJ-INT	.023	3	53.12835805	1.68	
IK-INT	.004	3	9.118485656	0.29	
JK-INT	.024	1	169.8001502	5.36	P<.05
IJKINT	.047	3	110.6800582	3.50	P<.05
ERROR		150	31.64923608		

*eta^2 is a measure of the amount of variance accounted for by each source.

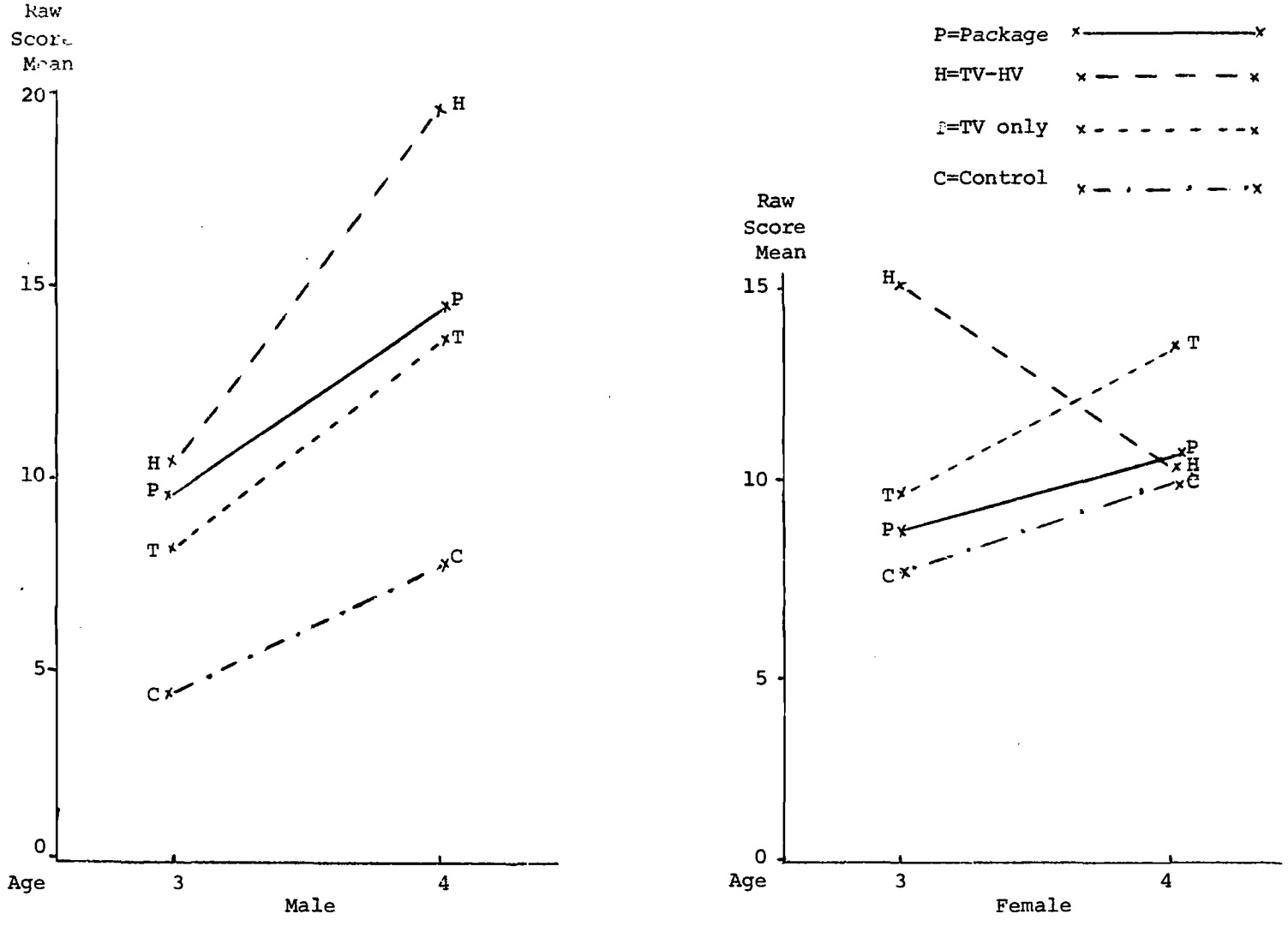

FIGURE 5-2

SIGNIFICANT TREATMENT-AGE-SEX INTERACTION
ON FROSTIG SUBTEST 1 (EYE-MOTOR COORDINATION)

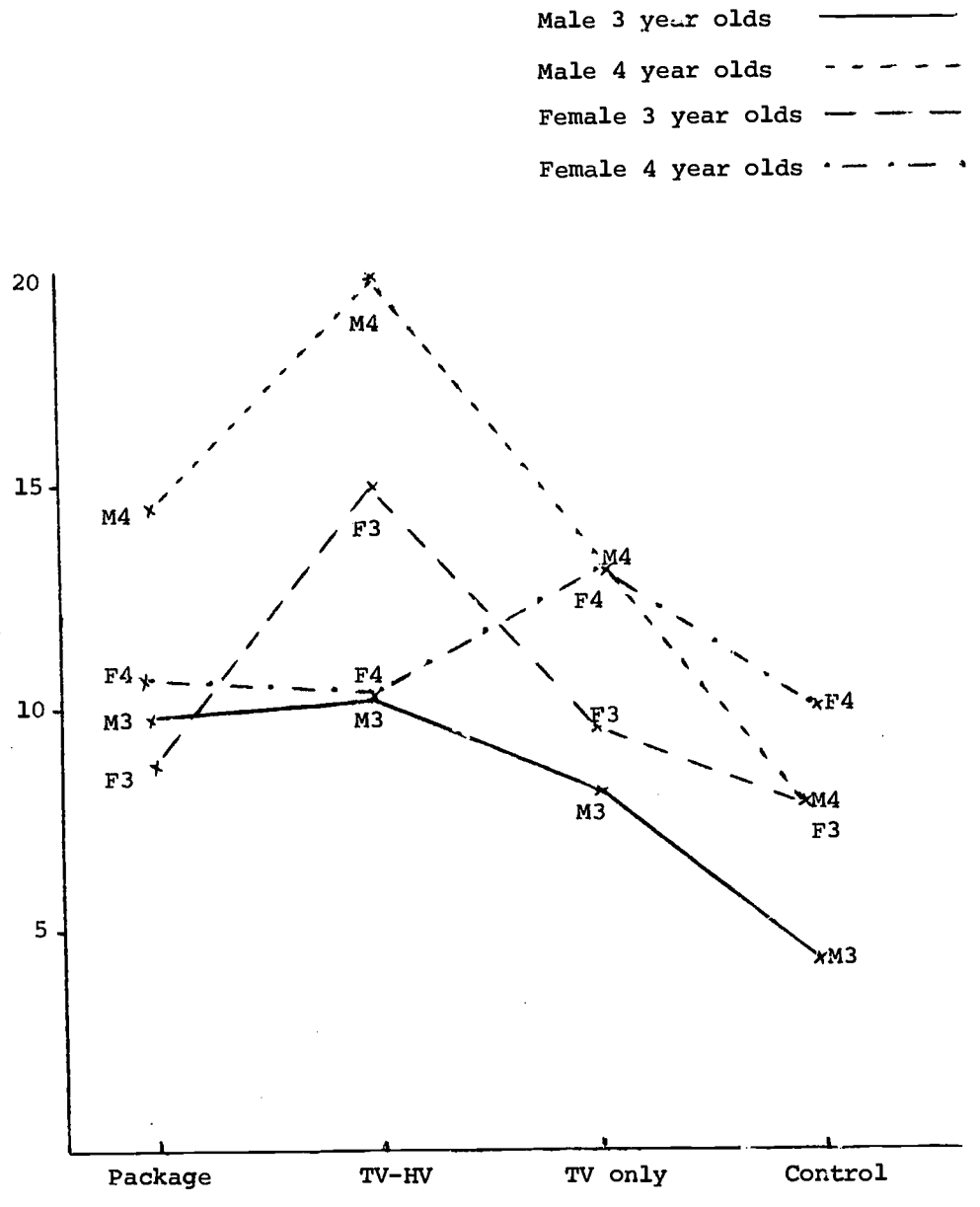

FIGURE 5-3

SEX-TREATMENT INTERACTION WITHIN AGE GROUP
ON FROSTIG SUBTEST 1

The highly significant effect of age is expected from a test which measures factors which develop rapidly with time, but it is surprising that no main sex effect was evident in this analysis. Most traditional developmental theories hypothesize that girls mature at a slightly more rapid rate than boys of this age, but no evidence was present for this contention in the ECE data.

The significant main effect of treatment ($P < .0005$) may well be due to the child's exposure to a variety of visual and expressive stimuli in the television program, through the home visitor, and in the mobile classroom. A Scheffe post-hoc comparison indicated that the comparison group scored significantly below all three treatment groups. A great many of the program's objectives involve activities with brush, crayon, or pencil which provide motor learning experiences for the child, and many of these same activities were concerned with visual discrimination tasks.

A significant treatment-sex-age interaction and a significant age-sex interaction effect were evident on Subtest 1, which complicates the process of drawing inferences about main effects. Figures 5-2 and 5-3 illustrate these interactions graphically.

In Figure 5-2, the three treatment groups show clear superiority over the Control group, especially for male subjects. In fact, four year old females in the home visitor group showed decrements in mean score with increases in age, reaching the performance level of the Control group. Only the "TV" group produced similar gains for males and females. Figure 5-3 illustrates the relative superiority of the Package and home visitor groups over the TVonly and Control groups for males. It is of interest that the three year old males produced consistently low scores and the four year old males produced considerably higher scores over all four treatment conditions. It is possible that the home visitor reacts best with older boys in each of the two groups with which she is in contact.

Frostig Subtest 2 (Figure-Ground)

Frostig Subtest 2, according to the authors, is a measure of ability to perceive "...shifts in perception of figures against increasingly complex grounds. Intersecting and 'hidden' geometric forms are used."[4]

Subtest 2 is thought to correlate highly with reading readiness, in that it measures the ability to discriminate shapes and configurations from their context. The same ability is necessary in recognition of letters and numbers in written material.

Table 5-4 indicates mean raw scores, standard deviations, and numbers of subjects for each age by sex cell within the four treatments. Table 5-5 shows the same parameters collapsed across treatment groups.

TABLE 5-4

FROSTIG SUBTEST 2 (FIGURE-GROUND) MEAN RAW SCORES, STANDARD DEVIATIONS, AND NUMBERS OF SUBJECTS BY AGE AND SEX WITHIN TREATMENT GROUPS

Age	Sex	Package	TV-HV	TV only	Control
3	M	$\bar{x}$ = 3.25 SD = 3.69 N = 8	$\bar{x}$ = 2.89 SD = 5.84 N = 9	$\bar{x}$ = 5.00 SD = 5.45 N = 13	$\bar{x}$ = 4.15 SD = 5.01 N = 13
	F	$\bar{x}$ = 2.75 SD = 4.17 N = 8	$\bar{x}$ = 5.10 SD = 5.70 N = 10	$\bar{x}$ = 1.10 SD = 1.60 N = 10	$\bar{x}$ = 4.62 SD = 5.72 N = 13
4	M	$\bar{x}$ = 7.92 SD = 6.30 N = 13	$\bar{x}$ = 12.38 SD = 4.75 N = 8	$\bar{x}$ = 4.50 SD = 5.37 N = 8	$\bar{x}$ = 8.67 SD = 6.14 N = 9
	F	$\bar{x}$ = 8.73 SD = 6.42 N = 11	$\bar{x}$ = 9.10 SD = 6.19 N = 10	$\bar{x}$ = 6.85 SD = 5.60 N = 13	$\bar{x}$ = 11.00 SD = 6.18 N = 10

[4] Ibid., p. 5.

TABLE 5-5

SUBTEST 2 MEAN RAW SCORES, STANDARD DEVIATIONS, AND SAMPLE SIZES FOR EACH TREATMENT GROUP

Package	TV-HV	TV only	Control
$\bar{x}$ = 8.51	$\bar{x}$ = 9.20	$\bar{x}$ = 7.17	$\bar{x}$ = 7.55
SD = 5.34	SD = 5.97	SD = 5.01	SD = 6.09
N = 40	N = 37	N = 44	N = 45

Figure 5-4 is a graphic presentation of the treatment group means, and means from the normative sample are also presented for comparable age groups.

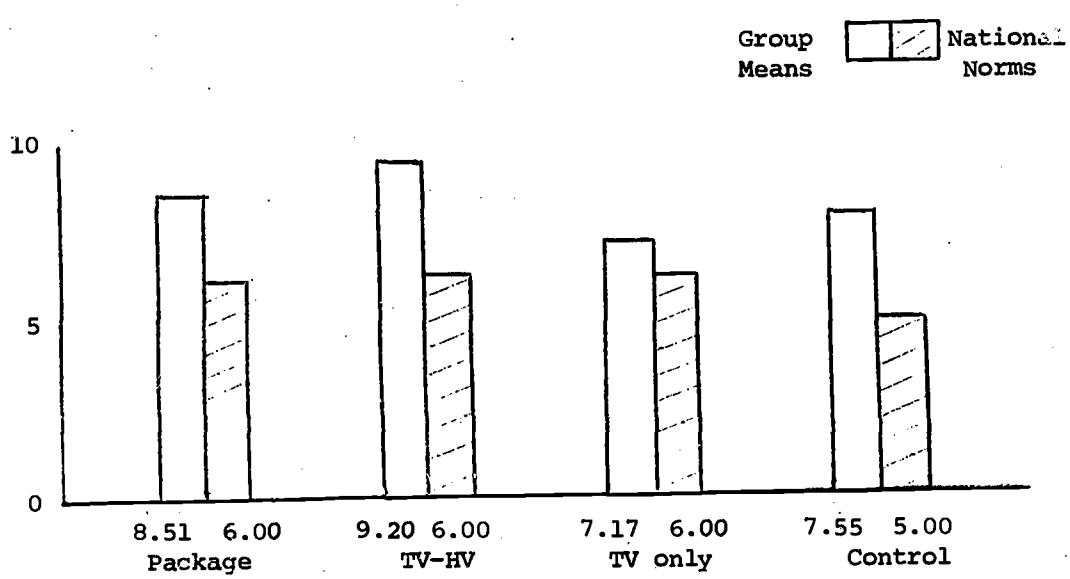

FIGURE 5-4

RAW SCORE MEANS AND NATIONAL NORMS FOR FROSTIG SUBTEST 2 (FIGURE-GROUND)

As Figure 5-4 indicates, the two treatment groups which received visits from the paraprofessional (TV-HV and Package) scored well above national norms and above the TVonly and comparison groups. This type of "embedded figures" discrimination plays a part in several of the ECE program objectives,[5] and the paraprofessional very likely was able to facilitate learning in this area.

The results of the analysis of variance procedure are summarized in Table 5-6.

TABLE 5-6

ANALYSIS OF VARIANCE TABLE FOR FROSTIG SUBTEST 2

Source	eta^2	D.F.	Mean Square	F	P
I(trt)	.039	3	75.46514520	2.63	$P < .05$
J(sex)	.000	1	0.1450048560	0.00	
K(age)	.167	1	1015.481660	33.64	$P < .0005$
IJ-INT	.005	3	10.08502952	0.33	
IK-INT	.015	3	30.23640181	1.00	
JK-INT	.002	1	9.696379930	0.32	
IJKINT	.028	3	56.99396452	1.89	
ERROR		150	30.18686882		

A Scheffe post-hoc comparison did not reveal any single pair of means with a difference that contributed significantly to the treatment effect. The main effect of age which is apparent at a highly significant level ($P < .0005$) validates the developmental nature of the factor which this subtest measures, and is also evident in the increases from the three to four year old groups shown in Table 5-4.

It seems evident that the home visitor played an important role in reaching this particular area of functioning, perhaps providing practice

[5] Frank H. Hooper and William H. Marshall, The Initial Phase of a Preschool Curriculum Development Project, Morgantown, West Virginia, p. 139.

in categorizing and recognition of geometric shapes, as well as differentiating these shapes from a complex background.

Frostig Subtest 3 (Constancy of Shape)

This section is designed to measure:

> Recognition of certain geometric figures presented in a variety of sizes, shadings, textures, and positions in spaces, and their discrimination from similar geometric figures. Circles, squares, rectangles, ellipses, and parallelograms are used.[6]

Since these figures are relatively common, it would be expected that the child's familiarity with the shapes would correlate positively with his performance on the test. Many of the ECE curriculum objectives do involve recognition and labeling of these and similar geometric figures, and could thus be expected to influence scores on the subtest.

Table 5-7 indicates means, standard deviations, and numbers of subjects for each age by sex cell within the four treatment groups.

TABLE 5-7

FROSTIG SUBTEST 3 (CONSTANCY OF SHAPE) RAW SCORE MEANS, STANDARD DEVIATIONS, AND NUMBERS OF SUBJECTS BY AGE AND SEX WITHIN TREATMENT GROUPS

Age	Sex	Package	TV-HV	TV only	Control
3	M	$\bar{x}$ = 3.50 SD = 3.21 N = 8	$\bar{x}$ = 3.78 SD = 4.00 N = 9	$\bar{x}$ = 3.23 SD = 3.40 N = 13	$\bar{x}$ = 3.15 SD = 2.48 N = 13
	F	$\bar{x}$ = 4.50 SD = 3.16 N = 8	$\bar{x}$ = 4.00 SD = 2.31 N = 10	$\bar{x}$ = 1.40 SD = 2.07 N = 10	$\bar{x}$ = 2.92 SD = 2.40 N = 13
4	M	$\bar{x}$ = 3.54 SD = 3.20 N = 13	$\bar{x}$ = 5.38 SD N = 8	$\bar{x}$ = 3.25 SD = 2.87 N = 8	$\bar{x}$ = 2.00 SD = 1.73 N = 9
	F	$\bar{x}$ = 5.82 SD = 4.07 N = 11	$\bar{x}$ = 6.20 SD = 4.54 N = 10	$\bar{x}$ = 3.69 SD = 4.44 N = 13	$\bar{x}$ = 4.80 SD = 4.40 N = 10

[6] Frostig, Op. Cit., p. 5.

Combining these scores results in the means which are presented in Table 5-8 and shown in Figure 5-5. Mean scores from the normative sample are also presented in Figure 5-5.

TABLE 5-8

SUBTEST 3 MEAN RAW SCORES, STANDARD DEVIATIONS, AND SAMPLE SIZES FOR EACH TREATMENT GROUP

Package	TV-HV	TV only	Control
$\bar{x}$ = 3.80	$\bar{x}$ = 5.55	$\bar{x}$ = 5.00	$\bar{x}$ = 3.62
SD = 2.73	SD = 3.43	SD = 3.08	SD = 2.87
N = 40	N = 37	N = 44	N = 45

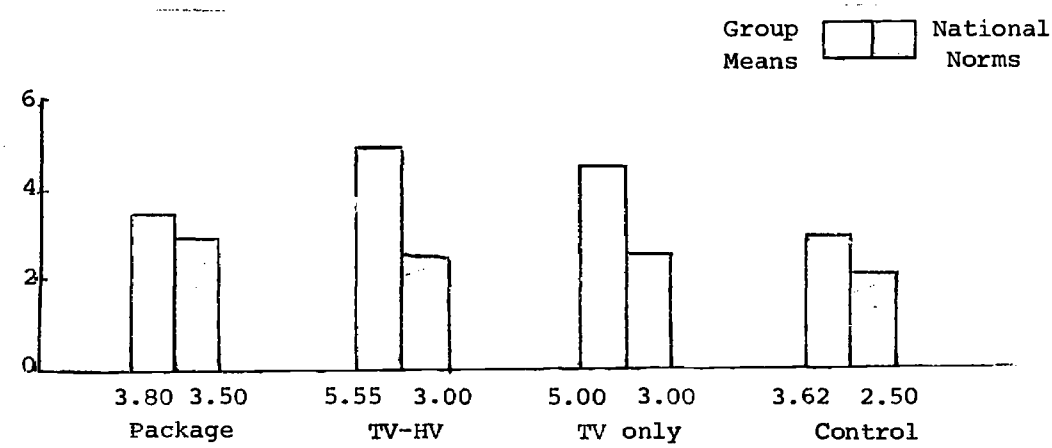

FIGURE 5-5

RAW SCORE MEANS AND NATIONAL NORMS FOR FROSTIG SUBTEST 3 (CONSTANCY OF SHAPE)

The trends which were evident in the previous two subtests are also present in this measure. Although all groups scored slightly above the national norms, two of the three treatment groups scored at nearly twice the raw score means of the children in the normative sample.

Table 5-9 presents a summary of the ANOVA results for Subtest 3, and clarifies the findings presented above.

TABLE 5-9

ANALYSIS OF VARIANCE TABLE FOR FROSTIG SUBTEST 3

Source	eta^2	D.F.	Mean Square	F	P
I(trt)	.051	3	33.34296240	2.94	P<.05
J(sex)	.010	1	18.98604364	1.67	
K(age)	.022	1	41.96611427	3.70	P<.05
IJ-INT	.017	3	10.99674278	0.97	
IK-INT	.001	3	4.373339517	0.38	
JK-INT	.016	1	32.32273501	2.85	
IJKINT	.005	3	2.878773868	0.25	
ERROR		150	11.35393331		

A Scheffe post-hoc comparison revealed that the treatment effect which is present ($P < .05$) favors the two treatment groups which received visits from the paraprofessional in comparison to the TVonly and Control group. That is, the paraprofessional made a contribution to the learning that is measured by this subtest above that which is produced by the television program.

The effect of age provides further evidence for the developmental nature of the construct which Subtest 3 is measuring. This is not surprising in light of the purpose of the instrument and the relatively high intercorrelations of the subtests which also showed a significant age effect. (These varied from approximately $r = .38$ to $r = .58$).

Frostig Subtest 4 (Position in Space)

This particular measure involves:

> The discrimination of reversals and rotating of figures presented in series. Schematic drawing representing common objects are used.[7]

The ability to follow explicit directions and to comprehend the meaning of same and different is also involved in the responses to this subtest.

[7] Ibid., p. 5.

Table 5-10 presents raw score means, standard deviations, and numbers of subjects for each age and sex cell within the treatment groups. The same data summarized according to the four treatment groups is given in Table 5-11.

TABLE 5-10

FROSTIG SUBTEST 4 (POSITION IN SPACE) RAW SCORE MEANS, STANDARD DEVIATIONS, AND NUMBERS OF SUBJECTS BY AGE AND SEX WITHIN TREATMENT GROUPS

Age	Sex	Package	TV-HV	TV only	Control
3	M	$\bar{x}$ = 3.00 SD = .71 N = 9	$\bar{x}$ = 3.22 SD = .83 N = 9	$\bar{x}$ = 3.69 SD = 1.44 N = 13	$\bar{x}$ = 2.62 SD = 1.12 N = 13
	F	$\bar{x}$ = 2.44 SD = .88 N = 9	$\bar{x}$ = 3.20 SD = 1.03 N = 10	$\bar{x}$ = 3.50 SD = 1.51 N = 10	$\bar{x}$ = 2.00 SD = .91 N = 13
4	M	$\bar{x}$ = 4.62 SD = .96 N = 13	$\bar{x}$ = 5.13 SD = 1.64 N = 8	$\bar{x}$ = 3.25 SD = 1.58 N = 8	$\bar{x}$ = 3.33 SD = 1.58 N = 9
	F	$\bar{x}$ = 4.00 SD = 1.95 N = 11	$\bar{x}$ = 4.40 SD = 1.84 N = 10	$\bar{x}$ = 3.92 SD = 1.66 N = 13	$\bar{x}$ = 2.60 SD = 1.17 N = 10

TABLE 5-11

SUBTEST 4 MEAN RAW SCORES, STANDARD DEVIATIONS, AND SAMPLE SIZES FOR EACH TREATMENT GROUP

Package	TV-HV	TV only	Control
$\bar{x}$ = 3.68 SD = 1.50 N = 40	$\bar{x}$ = 3.94 SD = 1.50 N = 37	$\bar{x}$ = 3.73 SD = 1.47 N = 44	$\bar{x}$ = 2.63 SD = 1.18 N = 45

Figure 5-6 indicates these same scores, combined for each of the four groups, and means scores from the age norms.

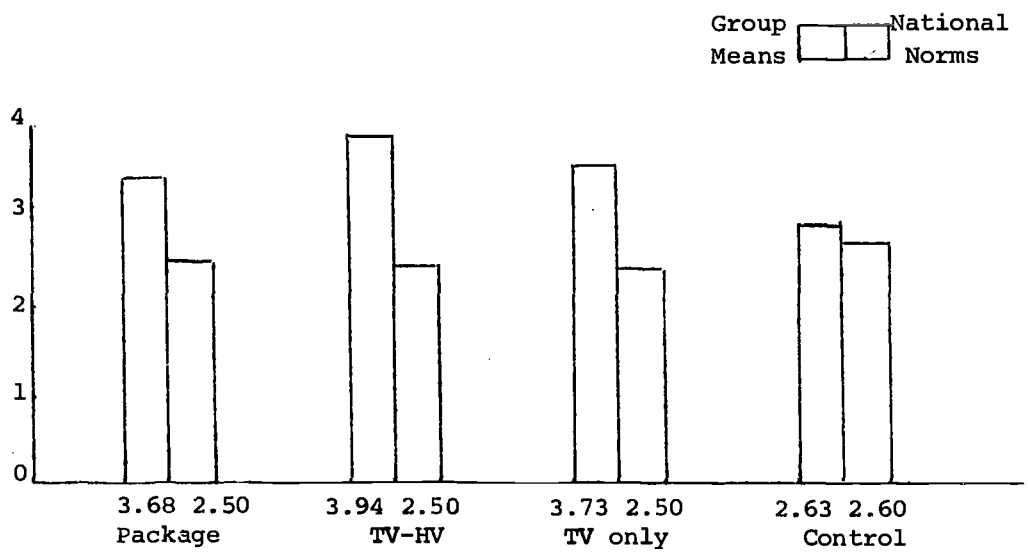

FIGURE 5-6

RAW SCORE MEANS AND NATIONAL NORMS FOR FROSTIG SUBTEST 4 (POSITION IN SPACE)

Each of the three treatment groups scored well above the national sample of their age peers and significantly above the group which received none of the program components. Contrary to our expectations, the paraprofessional and mobile facility did not add linear or constant amounts to the learning which took place from viewing the television program.

The summary of the three-way analysis of variance procedure which was performed on Subtest 4 is presented in Table 5-12.

TABLE 5-12

SUMMARY OF ANALYSIS OF VARIANCE FOR FROSTIG SUBTEST 4

Source	eta^2	D.F.	Mean Square	F	P
I(trt)	.108	3	13.82877956	7.74	$P < .0005$
J(sex)	.010	1	4.062976402	2.27	
K(age)	.105	1	39.55301889	22.14	$P < .0005$
IJ-INT	.021	3	2.439771335	1.43	
IK-INT	.039	3	5.133064246	2.87	$P < .05$
JK-INT	.000	1	0.0820025159	0.04	
IJKINT	.013	3	1.554584917	0.87	
ERROR		150	1.786242165		

The main effect of treatment which was evident from Figure 5-4 is emphasized again in the ANOVA results. A post-hoc comparison revealed that all three treatment groups scored significantly above the Control group in respect to Subtest 4. We can assume that the factor which caused the elevation in scores was associated with the television program, since the other components did not produce noticeable increments in mean scores. It is likely that the combination of teaching manual skills - such as drawing and outlining - and the recognition of geometric shapes, both contributed to the effect of Around the Bend on this subtest.

The main effect of age is constant throughout practically the entire test battery, and can be considered almost inevitable on any measure dependent on motor development or new experiences during this age range.

An interaction effect of treatment and age is also present, favoring the older children in the TV-HV and Package groups. This interaction is represented graphically in Figure 5-7. The paraprofessional was most likely more effective in teaching the skills measured by Subtest 4 to the older children whom she visited. This is indicated by the difference for the home visitor and Package groups actual scores when compared to their expected scores due to increases in age only.

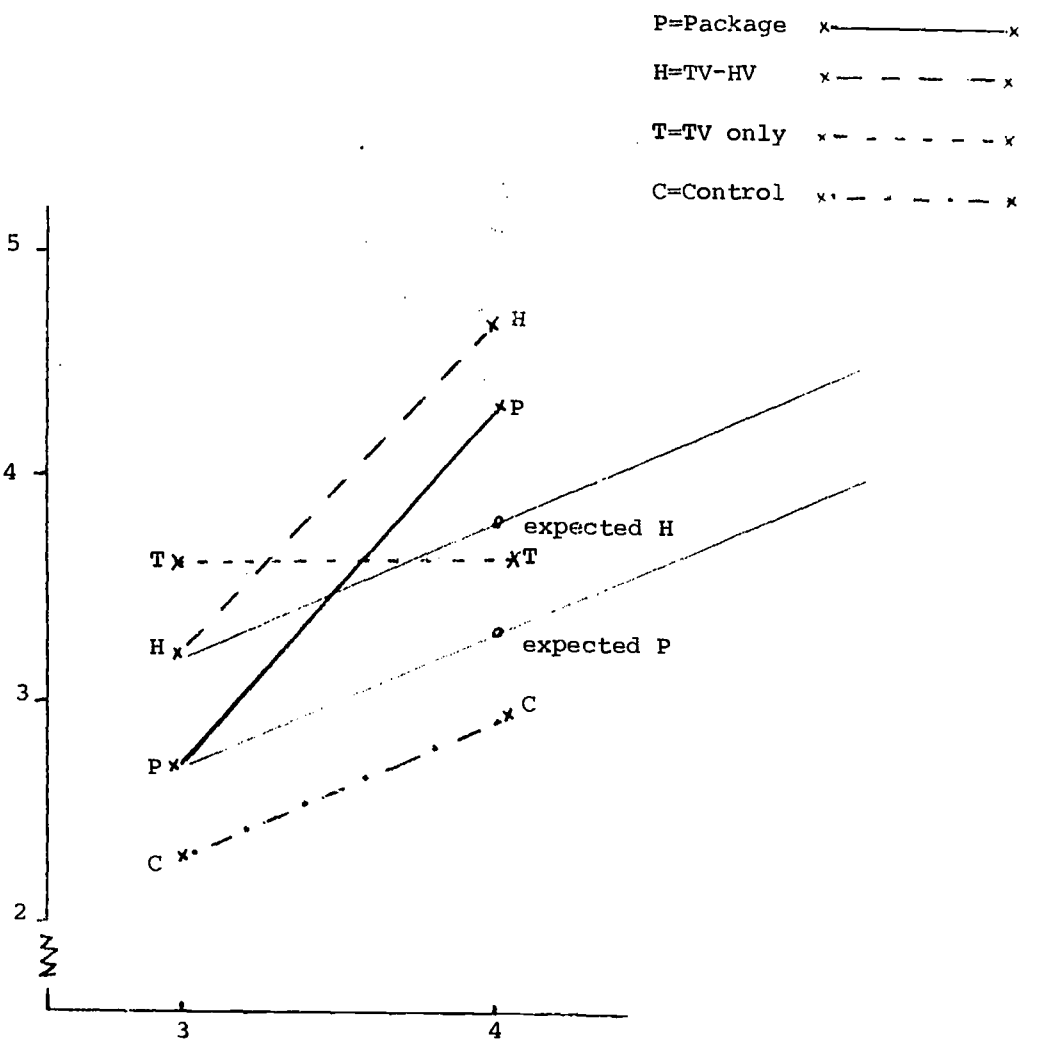

FIGURE 5-7

TREATMENT AGE INTERACTION ACROSS SEX
(AVERAGED FOR MALE AND FEMALE) ON FROSTIG SUBTEST 4

Frostig Subtest 5 (Spatial Relationships)

This section of the Frostig measures the ability to make:

> The analysis of simple forms and patterns. These consist of lines of various lengths and angles which the child is required to copy, using dots as guide points.[8]

Essentially, this task involves transposing a specific configuration of lines onto a set of dots, a task which involves both motor coordination and short-term memory for visual designs.

Scores for each age by sex cell within the four treatments are reflected in the means, standard deviations, and numbers of subjects presented in Table 5-13.

TABLE 5-13

FROSTIG SUBTEST 5 (SPATIAL RELATIONSHIPS)
RAW SCORE MEANS, STANDARD DEVIATIONS, AND NUMBERS OF SUBJECTS
BY AGE AND SEX WITHIN TREATMENT GROUPS

Age	Sex	Package	TV-HV	TV only	Control
3	M	$\bar{x}$ = .89 SD = .93 N = 9	$\bar{x}$ = .78 SD = .97 N = 9	$\bar{x}$ = .92 SD = .86 N = 13	$\bar{x}$ = .62 SD = .96 N = 13
	F	$\bar{x}$ = .75 SD = 1.04 N = 8	$\bar{x}$ = 1.00 SD = 1.41 N = 10	$\bar{x}$ = .50 SD = .71 N = 10	$\bar{x}$ = 1.08 SD = 1.61 N = 13
4	M	$\bar{x}$ = 2.00 SD = 1.73 N = 13	$\bar{x}$ = 2.00 SD = 1.85 N = 8	$\bar{x}$ = .63 SD = .74 N = 8	$\bar{x}$ = 1.67 SD = 1.87 N = 9
	F	$\bar{x}$ = 2.09 SD= 1.51 N = 11	$\bar{x}$ = 2.00 SD = 1.70 N = 10	$\bar{x}$ = 1.62 SD = 1.61 N = 13	$\bar{x}$ = 1.10 SD = 1.45 N = 10

These results produce the combined means, which are presented in Table 5-14 for each of the four treatment groups and these data along with the age-equivalent group of the normative sample are given in Figure 5-8

[8] Ibid., p. 6.

TABLE 5-14

SUBTEST 5 MEAN RAW SCORES, STANDARD DEVIATIONS, AND SAMPLE SIZES FOR EACH TREATMENT GROUP

Package	TV-HV	TV only	Control
$\bar{x}$ = 2.10	$\bar{x}$ = 2.04	$\bar{x}$ = 1.65	$\bar{x}$ = 1.82
SD = 1.34	SD = 1.48	SD = 1.05	SD = 1.23
N = 40	N = 37	N = 44	N = 45

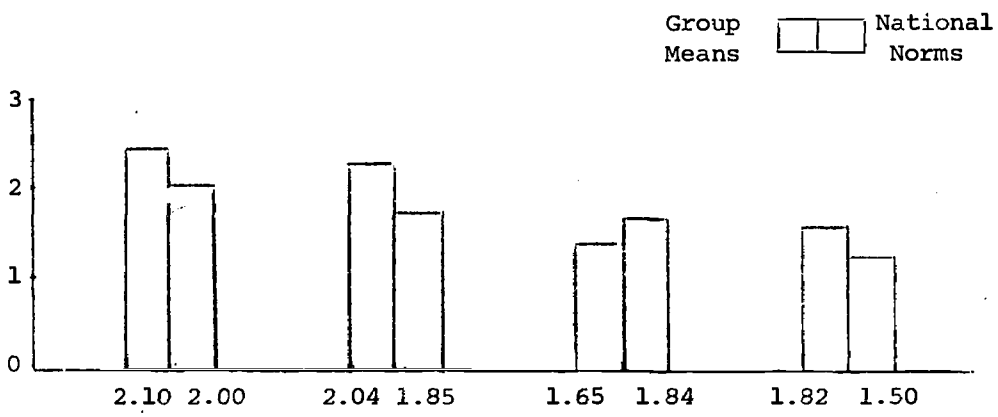

FIGURE 5-8

RAW SCORE MEANS AND NATIONAL NORMS FOR FROSTIG SUBTEST 5 (SPATIAL RELATIONSHIPS)

As is apparent from the above and proven by the ANOVA results, no significant differences appeared between the four group means. However, the fact that the TV only group continued its trend to lower scores in comparison with the other treatments, is evidence for the existence of small deficits in the area measured by Subtest 5.

Table 5-15 indicates the results of the ANOVA which was performed on Subtest 5.

TABLE 5-15

ANALYSIS OF VARIANCE SUMMARY FOR FROSTIG SUBTEST 5

Source	eta^2	D.F.	Mean Square	F	P
I(trt)	.032	3	3.312763498	1.92	
J(sex)	.000	1	0.0025454042	0.00	
K(age)	.096	1	29.93948280	17.3	P<.0005
IJ-INT	.006	3	0.6342173558	0.37	
IK-INT	.012	3	1.246202147	0.72	
JK-INT	.002	1	0.5834185059	0.34	
IJKINT	.019	3	1.977176031	1.14	
ERROR		150	1.729289951		

The only significant F-ratio which was evident from the ANOVA results was that for age, which was expected for the entire test battery. No other main or interaction effects were revealed by the ANOVA.

Frostig Total Raw Score

As a total instrument, the Frostig measures overall perceptual level as well as the ability to recall and transform visual configurations. It also gives an indication of the child's motor development as reflected by his hand-eye coordination.

Total Frostig raw scores are presented in Table 5-16.

TABLE 5-16

FROSTIG TOTAL RAW SCORE MEANS,
STANDARD DEVIATIONS, AND NUMBERS OF SUBJECTS
BY AGE AND SEX WITHIN TREATMENT GROUPS

Age	Sex	Package	TV-HV	TV only	Control
3	M	$\bar{x}$ = 20.88 SD = 9.25 N = 8	$\bar{x}$ = 19.78 SD = 11.66 N = 9	$\bar{x}$ = 21.00 SD = 14.14 N = 13	$\bar{x}$ = 14.85 SD = 9.41 N = 13
	F	$\bar{x}$ = 18.25 SD = 13.59 N = 8	$\bar{x}$ = 28.30 SD = 9.94 N = 10	$\bar{x}$ = 16.10 SD = 8.94 N = 10	$\bar{x}$ = 15.38 SD = 9.60 N = 13
4	M	$\bar{x}$ = 32.31 SD = 11.18 N = 13	$\bar{x}$ = 44.63 SD = 11.75 N = 8	$\bar{x}$ = 25.38 SD = 14.14 N = 8	$\bar{x}$ = 23.44 SD = 12.87 N = 9
	F	$\bar{x}$ = 31.18 SD = 12.89 N = 11	$\bar{x}$ = 32.10 SD = 14.31 N = 10	$\bar{x}$ = 29.92 SD = 14.25 N = 13	$\bar{x}$ = 29.60 SD = 11.86 N = 10

The extreme jump between age levels provides good evidence for the face validity of this test, but such a consistent pattern is not evident for male-female contrasts. Generally, males outscore females in the ECE Program groups, but score slightly lower than the females in the Control group. The total scores are combined within treatment groups in Table 5-17, and Figure 5-9 presents a graphical depiction of these combined scores for each treatment group, along with mean scores from the normative age-group sample.

TABLE 5-17

TOTAL SCORES COMBINED WITHIN TREATMENT GROUPS

Package	TV-HV	TV only	Control
$\bar{x}$ = 26.90 SD = 12.93 N = 40	$\bar{x}$ = 31.05 SD = 14.01 N = 37	$\bar{x}$ = 23.31 SD = 13.76 N = 44	$\bar{x}$ = 20.08 SD = 11.95 N = 40

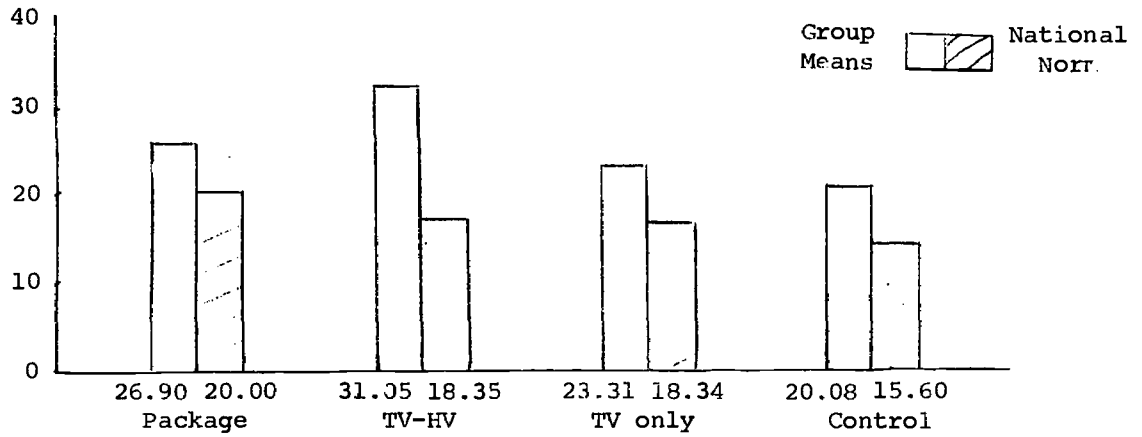

FIGURE 5-9

RAW SCORE MEANS AND NATIONAL NORMS
FOR THE FROSTIG TOTAL SCORES

Figure 5-9 illustrates the fairly large differences between the three program groups and the Control group, both in respect to inter-treatment differences, and also in contrast with the national norms. Of particular interest is the elevation of the total score of the TV-HV group and its relation to the other scores, and the norms for this age.

The ANOVA summary presented in Table 5-18 provides statistical validation for the trends which are already apparent in the above data. A Scheffe post-hoc comparison shows that the TV-HV group differed significantly from the TVonly and Control groups. It seems possible that the paraprofessionals in the TV-HV group expend more effort with "their" children than they do with children who visit the van and have an advantage in learning experience.

TABLE 5-18

ANALYSIS OF VARIANCE SUMMARY - FROSTIG TOTAL RAW SCORE

Source	eta^2	D.F.	Mean Square	F	P
I(trt)	.080	3	815.7246772	5.76	$P < .001$
J(sex)	.000	1	3.070650526	0.02	
K(age)	.175	1	5367.325769	37.87	$P < .0005$
IJ-INT	.007	3	75.89917242	0.54	
IK-INT	.004	3	37.71936663	0.27	
JK-INT	.000	1	8.473664112	0.06	
IJKINT	.040	3	409.6338903	2.89	$P < .05$
ERROR		150	141.7155088		

First, the total test score presumably reflects some developmental factor ($P < .0005$) since a main effect of age was very likely present. This age effect was constant throughout the entire group of Frostig subtests, indicating that the range of factors measured by the instrument did indeed show a maturation effect.

Also, an age by sex by treatment interaction effect was present ($P < .05$), which made interpretation of main effects more difficult than would ordinarily be the case. It is interesting to note that the four year old males' mean raw score total in the TV-HV group was 44.63, which placed them far ahead of their age peers in visual-motor development. Figures 5-10 and 5-11 illustrates this interaction of treatment age and sex graphically. For both males and females, the Control group scored below the three treatment groups and well below those two groups who received visits from the para-professional. Figure 5-11 indicates that among three year old male subjects the program had the equivalent effect of a year's maturation. The home visitor seems to be interacting differentially with female subject and does not seem to produce a pattern of gains for females which are as large

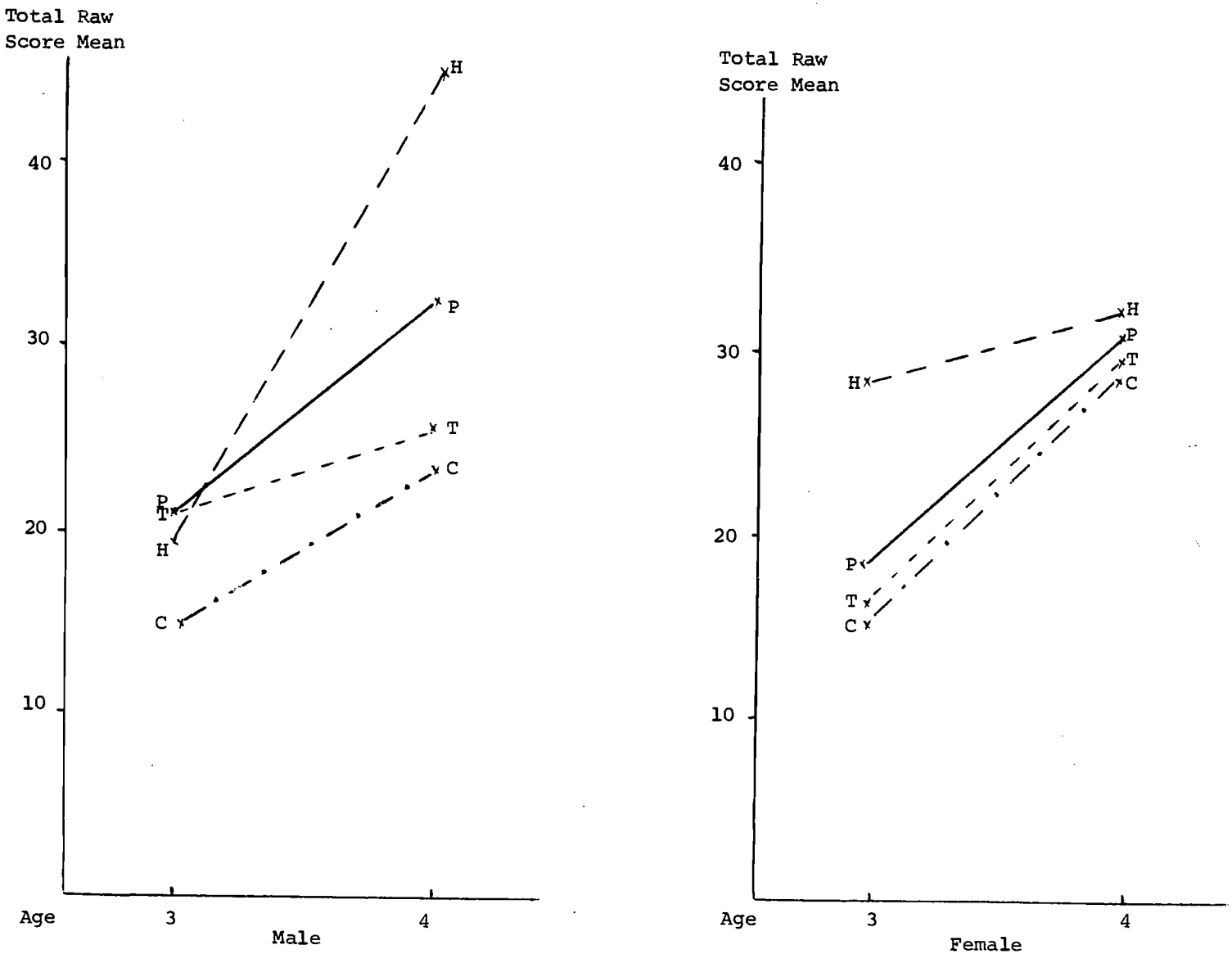

FIGURE 5-10

SIGNIFICANT TREATMENT-AGE-SEX INTERACTION ON THE OVERALL FROSTIG TEST

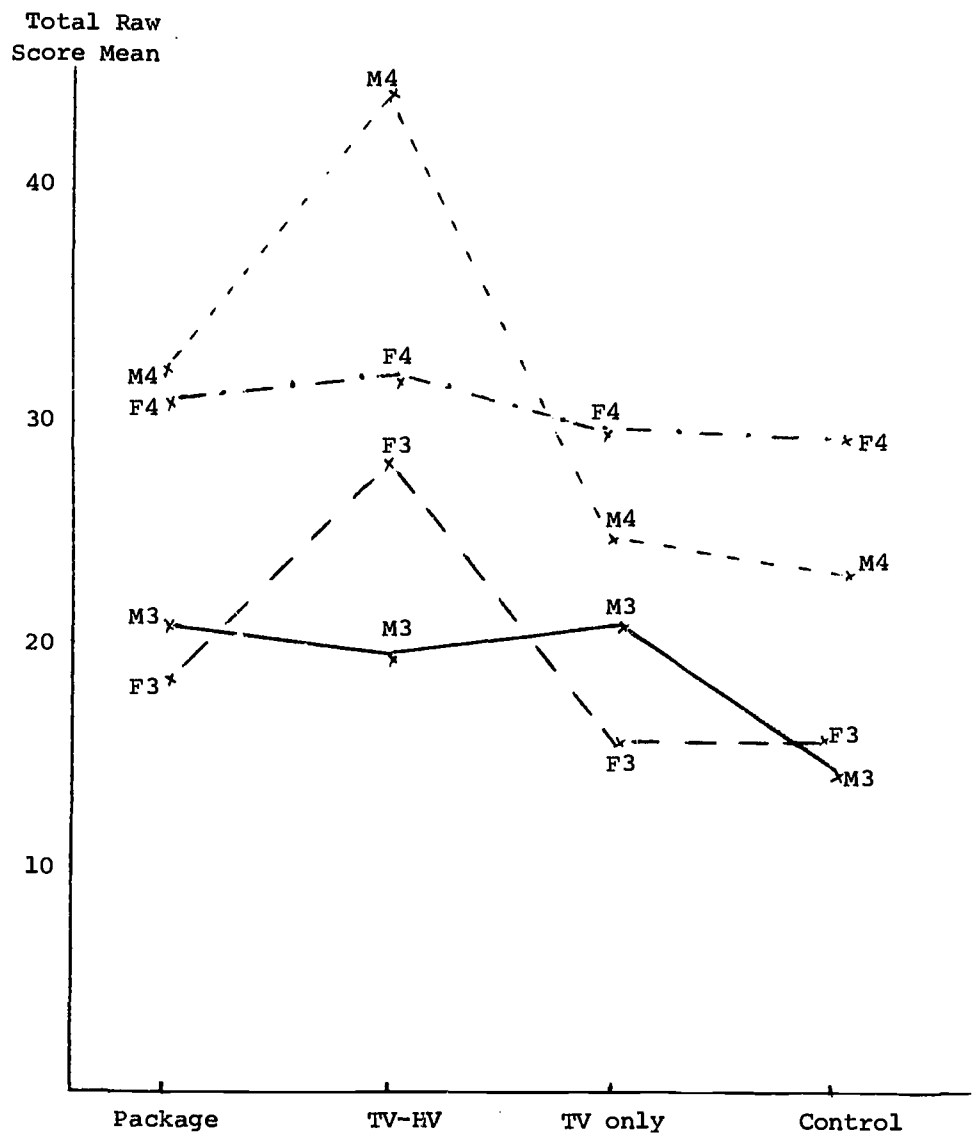

FIGURE 5-11

SEX-TREATMENT INTERACTION WITHIN
AGE GROUP ON THE OVERALL FROSTIG TEST

as those for males. The TV-HV group showed the largest sex differences in overall Frostig raw scores and the Package group showed the smallest sex differences.

The main effect of treatment is indicative of the emphasis which was placed on artistic and graphic activities throughout the course of the year's television programming. Children were constantly encouraged by the television teacher to draw with brushes, crayons, and other art materials. The high degree of child-teacher involvement which existed during the program made it more likely that the child would respond overtly to suggestions to try these activities. Thus, the activities of drawing, outlining, and copying figures, along with the related visual memory tasks which were taught on Around the Bend and reinforced by the paraprofessional, seems to have a positive effect on the child's ability to perceive, remember, and reproduce visual configurations.

In several of the tasks, the paraprofessional added to the effect of the television program on the areas measured by the Frostig. There was no substantial additive effect of the mobile facility in the area of psychomotor functioning, which may well be due to the limited amount of time available for individual treatment from the van.

Essentially, then, the television program and paraprofessional are potentially very effective means for encouraging the child's visual-perceptual level and motor coordination as it relates to his visual field.