

CHAPTER III

RESULTS

The results of the present study are presented in the following order: First analysis of central memory scores, next analysis of incidental memory scores and last correlation between central and incidental memory scores.

Central memory scores and serial position

Performance on the central memory assessed for two scores: total number of correct responses on central memory task and number of correct responses for each serial position on central memory task. Means, standard deviation and proportion correct for each age group were computed from the total number of correct responses on central memory task scores. The results are presented in Table II.

(Insert Table II)

A chart of the proportion of the correct number of responses on central memory scores is presented in Figure I.

(Insert Figure I)

Table II

Means, S.D. and Proportion Correct on Central Memory Scores by Age Group and by Sex

	Ages 4 - 5			Ages 7 - 8			Ages 10-11			Ages 14-15			Ages 20-21		
	males	females	total	males	females	total	males	females	total	males	females	total	males	females	total
\bar{X}	4.00	4.10	4.05	4.60	5.30	4.95	6.00	5.60	5.80	6.70	6.10	6.40	6.30	5.50	5.90
S.D.	1.25	1.19	1.19	0.97	2.11	1.64	2.98	1.65	2.28	1.89	1.37	1.63	1.49	2.12	1.80
Proportion Correct	0.28	0.29	0.29	0.33	0.38	0.35	0.43	0.40	0.41	0.48	0.43	0.46	0.45	0.39	0.42

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Figure 1
Central Memory Scores over Ages Groups: (summed over serial position)

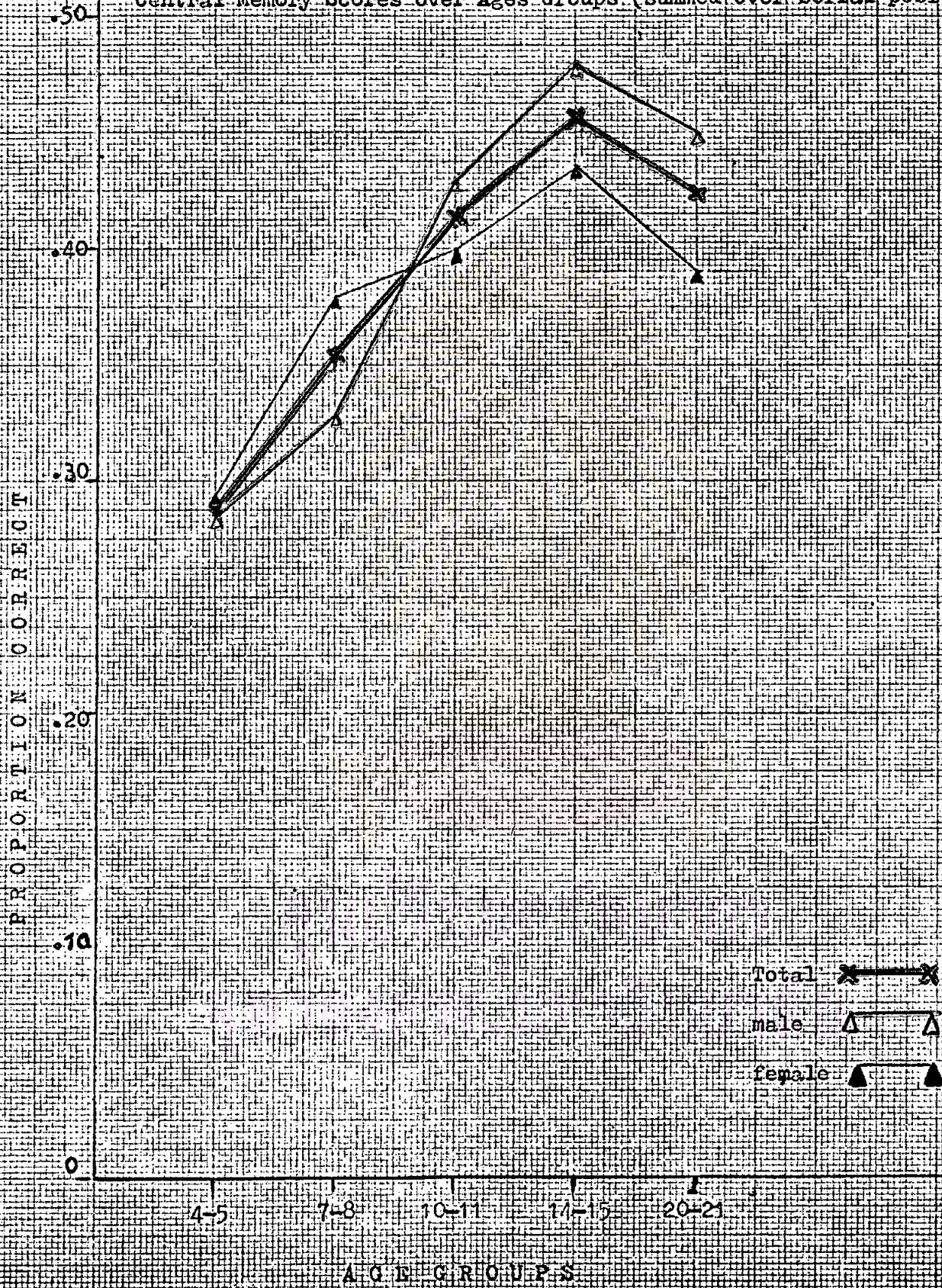


Figure I showed that proportion of the correct number of responses on central memory increased from ages 4 - 5 to ages 14 - 15 and then declined at the oldest age level (20 - 21).

Correct responses for each serial position on central memory scores were calculated in order to find means, standard deviation and proportion correct. The results are presented in Table III.

(Insert Table III)

A chart of the proportion of the correct number of responses at each serial position for each age group is presented in Figure II.

(Insert Figure II)

The results of Figure II showed that the lowest performance of each age group was on the primacy while the highest performance of each group was on the recency. The performance on primacy seemed to increase with age more than the performance on recency or the performance on the middle - position.

Table III

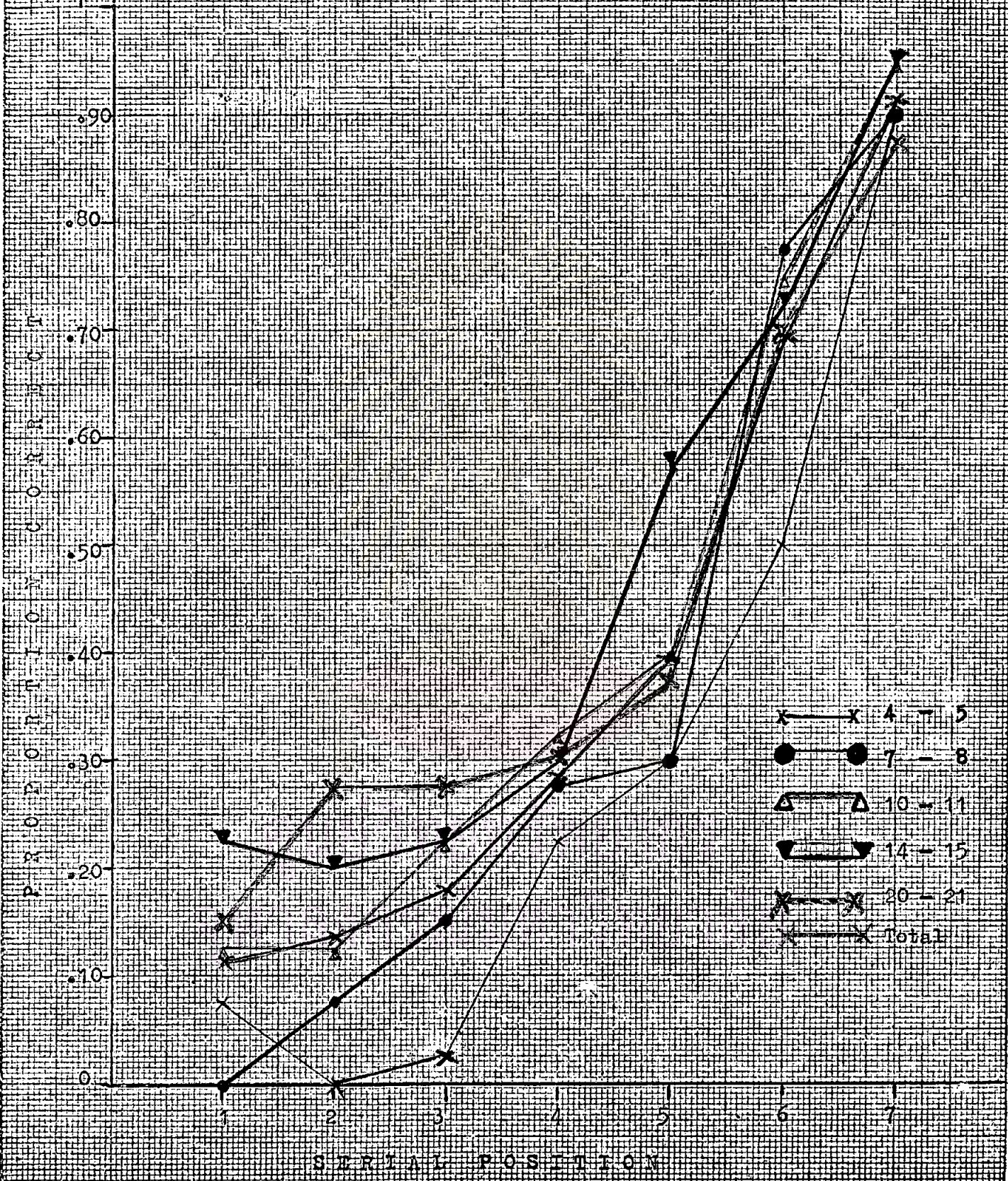
Means, S.D. and Proportion Correct on Central Memory Scores by Serial Position

Serial position	Age groups																	
	4 - 5			7 - 8			10 - 11			14 - 15			20 - 21			Total		
	\bar{X}	S.D.	Proportion Correct	\bar{X}	S.D.	Proportion Correct	\bar{X}	S.D.	Proportion Correct	\bar{X}	S.D.	Proportion Correct	\bar{X}	S.D.	Proportion Correct	\bar{X}	S.D.	Proportion Correct
1	0.15	0.37	0.07	0.00	0.00	0.00	0.25	0.44	0.12	0.45	0.60	0.22	0.30	0.57	0.15	0.23	0.51	0.11
2	0.00	0.00	0.00	0.15	0.37	0.07	0.25	0.44	0.12	0.40	0.60	0.20	0.55	0.60	0.27	0.27	0.49	0.13
3	0.05	0.22	0.02	0.30	0.57	0.15	0.45	0.69	0.22	0.45	0.60	0.22	0.55	0.82	0.27	0.36	0.63	0.18
4	0.45	0.69	0.22	0.55	0.69	0.27	0.65	0.59	0.32	0.60	0.60	0.30	0.60	0.60	0.30	0.57	0.62	0.28
5	0.60	0.60	0.30	0.60	0.68	0.30	0.80	0.70	0.40	1.15	0.74	0.57	0.75	0.85	0.37	0.78	0.73	0.39
6	1.00	0.65	0.50	1.55	0.51	0.77	1.50	0.69	0.75	1.45	0.60	0.72	1.40	0.82	0.70	1.38	0.68	0.70
7	1.80	0.41	0.90	1.80	0.41	0.90	1.90	0.31	0.95	1.90	0.31	0.95	1.75	0.44	0.87	1.83	0.38	0.91

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Figure II

Central Memory Scores by Serial Position at Different Age



A two - way analysis of variance was performed on central memory scores at every position in all age group by defining the variation in row as a function of serial position and the variation in column as a function of age group to explore the differences among all age groups and serial position, and the interaction between age and serial position. The results are presented in Table IV.

Table IV

Two - Way Analysis of Variance between Age and Serial Position on Central Memory Scores

Source of variation	S.S.	df	M.S.	F
<u>Between subjects</u>	51.1943	99	0.5171	
(A) age groups	9.8086	4	2.4521	5.5691*
Subject within group	41.8357	95	0.4403	
<u>Within subjects</u>	13.1429	600	0.0219	
(B) serial position	224.5372	6	37.4286	117.7370
age group X serial position	7.3914	24	0.3079	0.9685 (N.S.)
serial position X subject within groups	181.2143	570	0.3179	

*p < .01

The results of Table IV showed that there were significant differences both by age level ($F = 5.5691$, $p < .01$) and by serial position ($F = 117.7370$, $p < .01$). There was no interaction between age and serial position (N.S.).

T - test comparisons were performed to examine the differences between age groups on central memory scores. The results are presented in Table V.

Table V

T - test Comparisons between Age Groups on Central Memory Scores

Age groups	4-5 $\bar{X}=4.05$	7-8 $\bar{X}=4.95$	10-11 $\bar{X}=5.80$	14-15 $\bar{X}=6.40$	20-21 $\bar{X}=5.90$
4 - 5 $\bar{X} = 4.05$	-	2.0000	1.4912	5.2200*	3.8541*
7 - 8 $\bar{X} = 4.95$	-	-	1.3709	2.8431*	1.7592
10 - 11 $\bar{X} = 5.80$	-	-	-	0.9677	0.1536
14 - 15 $\bar{X} = 6.40$	-	-	-	-	0.9259
20 - 21 $\bar{X} = 5.90$	-	-	-	-	-

* $p < .01$, $df = 38$

The results of the t - test showed that performance on central memory at ages 4 - 5 was significantly different from the performance on central memory at ages 14 - 15 ($t = 5.2200$, $p < .01$) and ages 20 - 21 ($t = 3.8541$, $p < .01$). There were no significant differences for the performance on central memory between ages 4 - 5 and 7 - 8 (N.S.), between ages 4 - 5 and 10 - 11 (N.S.). The performance on central memory at ages 7 - 8 was significantly different from the performance at ages 14 - 15 ($t = 2.8431$, $p < .01$). There were no significant differences between the performance on central memory at ages 7 - 8 and 10 - 11 (N.S.), and between the performance at ages 7 - 8 and 20 - 21 (N.S.). There were no significant differences between the performance at ages 10 - 11 and 14 - 15 (N.S.) and between the performance at ages 10 - 11 and 20 - 21 (N.S.). The performance on central memory at ages 14 - 15 was not significantly different from the performances on central memory at ages 20 - 21 (N.S.).

T - test comparisons were also used to find out the differences on central memory task scores between males and females. The results are revealed in Table VI.

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Table VI

T - test Comparisons between Males and Females on Central Memory Scores

Age groups	\bar{X} of males	\bar{X} of females	t
4 - 5	4.0	4.1	.1851 (N.S.)
7 - 8	4.6	5.3	.9589 (N.S.)
10 - 11	6.0	5.6	.3738 (N.S.)
14 - 15	6.7	6.1	.8219 (N.S.)
20 - 21	6.3	5.5	.9925 (N.S.)

The results showed that there were no significant differences between males and females at any age level (N.S.).

One - way analysis of variance was performed in order to examine the differences for serial position performance within each age group. The results are presented in Table VII for age 4 - 5, Table VIII for ages 7 - 8, Table IX for ages 10 - 11, Table X for ages 14 - 15 and Table XI for ages 20 - 21.

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Table VII

One - Way Analysis of Variance for Different Serial Positions on
Central Memory Scores at Ages 4 - 5

Source of variation	S.S.	df	M.S.	F
Between people	3.8500	19	0.2026	
Within people	76.2858	120	0.6357	
Treatments	39.6858	6	6.4143	20.6052*
Residual	36.6000	114	0.3210	
Total	80.1358	139	0.5765	

*p < .01

The results of the analysis indicated that there were significant differences on the performance for different serial position at ages 4 - 5 ($F = 20.6052$, $p < .01$).

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Table VIII

One - Way Analysis of Variance for Different Serial Positions on Central Memory Scores at Ages 7 - 8

Source of variation	S.S.	df	M.S.	F
Between people	7.2786	19	0.3830	
Within people	85.7143	120	0.7142	
Treatments	58.3429	6	9.7238	40.4989*
Residual	27.3714	114	0.2401	
Total	92.9929	139	0.6690	

*p < .01

The results of the analysis indicated that there were significant differences on the performance at different serial positions at ages 7 - 8 ($F = 40.4989$, $p < .01$).

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Table IX

One - Way Analysis of Variance for Different Serial Position on
Central Memory Scores at Ages 10 - 11

Source of variation	S.S.	df	M.S.	F
Between people	14.1715	19	0.7458	
Within people	79.7143	120	0.6642	
Treatments	48.8858	6	8.1476	30.1316*
Residual	30.8285	114	0.2704	
Total	93.8858	139	0.6754	

*p < .01

The results of the analysis indicated that there were significant differences on the performance at different serial positions at ages 10 - 11 ($F = 30.1316$, $p < .01$).

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Table X

One - Way Analysis of Variance for Different Serial Positions on
Central Memory Scores at Ages 14 - 15

Source of variation	S.S.	df	M.S.	F
Between people	7.2572	19	0.3819	19.2878*
Within people	83.7143	120	0.6976	
Treatments	42.1715	6	7.0285	
Residual	41.5428	114	0.3644	
Total	90.9715	139	0.6544	

*p < .01

The results of the analysis indicated that there were significant differences on the performance at different serial positions at ages 14 - 15 ($F = 19.2878$, $p < .01$).

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Table XI

One - Way Analysis of Variance for Different Serial Positions on Central Memory Scores at Ages 20 - 21

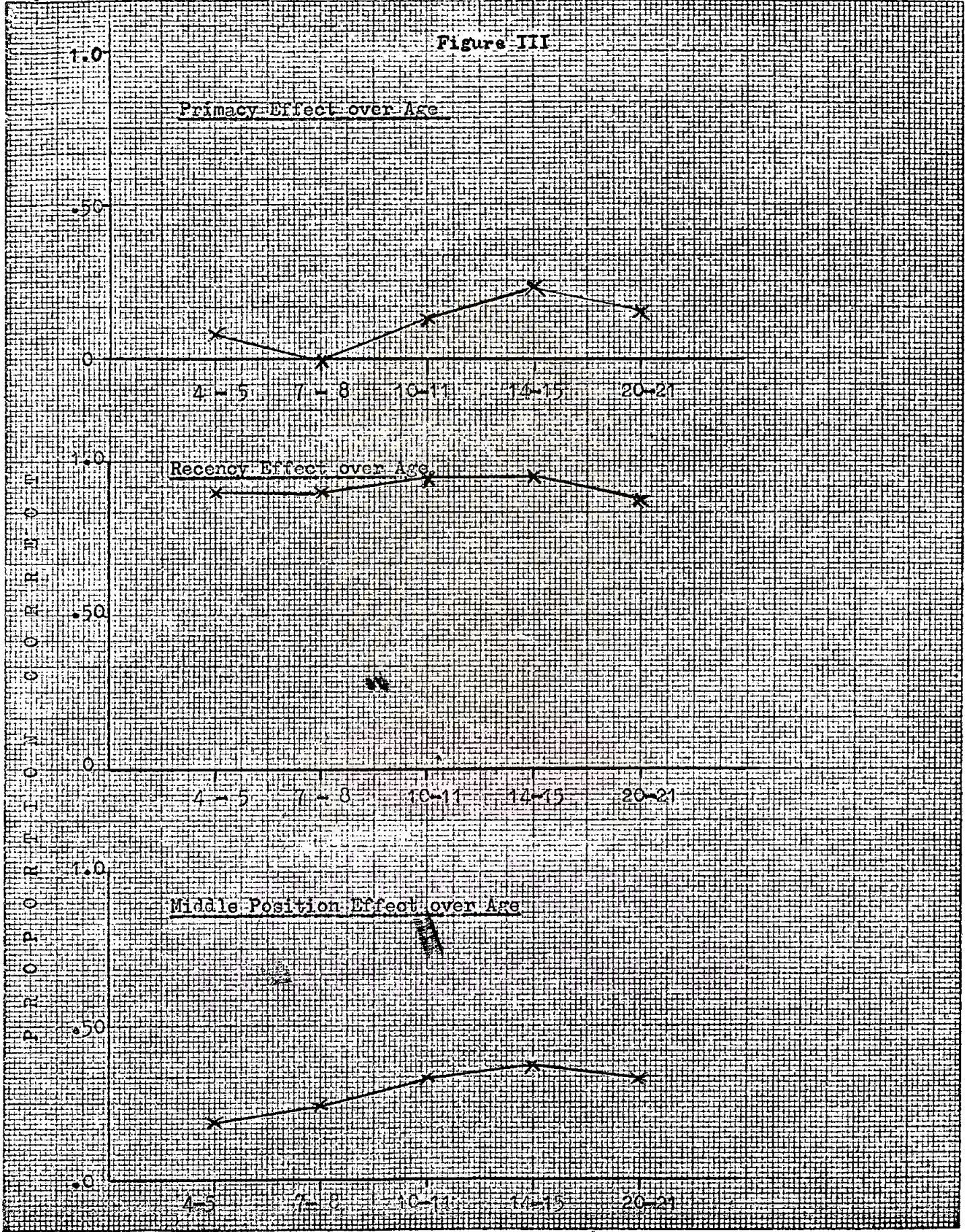
Source of variation	S.S.	df	M.S.	F
Between people	8.8286	19	0.4646	
Withing people	87.7143	120	0.7309	
Treatments	33.3429	6	5.5571	11.6525*
Residual	54.3714	114	0.4769	
Total	96.5429	139	0.6945	

*p < .01

The results of the analysis indicated that there were significant differences on the performance at different serial positions at ages 20 - 21 ($F = 11.6526$, $p < .01$).

The proportion of the correct number of responses at different serial positions on central memory scores could be presented in a different way to clarify the locus of inter-group differences within a trial. Figure III shows such age comparison separately for primacy, recency and middle positions.

Figure III



AGE GROUPS

The top panel of Figure III showed the primacy effect (Position 1), the second panel showed the recency effect (Position 7) and the bottom panel showed the middle positions (mean of Position 3, 4, 5).

Figure III indicated slight increase in the primacy and middle position scores and nearly constant scores for recency for all age groups.

One - way analysis of variance was performed on central memory scores at a given serial - position: primacy, recency and middle position separately in order to examine if the performance of different age groups at a given serial position would be significantly different from the performance of other age groups. The results are presented in Table XII for primacy effect, Table XIII for recency effect and Table XIV for middle positions effects.

Table XII

One - Way Analysis of Variance for Primacy Effect on Central Memory Scores

Source of variation	S.S.	df	M.S.	F
Between groups	2.26	4	0.5650	2.2893 (N.S.)
Within groups	23.45	95	0.2468	
Total	25.26	99		

The results of Table XII showed that there were no significant differences among age groups on the performance for primacy recall (N.S.).

Table XIII

One - Way Analysis of Variance for Recency Effect on Central Memory Scores

Source of variation	S.S.	df	M.S.	F
Between groups	0.36	4	0.0900	0.6220 (N.S.)
Within groups	13.75	95	0.1447	
Total	14.11	99		

The results of Table XIII showed that there were no significant differences among age groups on the performance for recency recall (N.S.).

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Table XIV

One - Way Analysis of Variance for Middle - Positions Effect on Central Memory Scores

Source of variation	S.S.	df	M.S.	F
Between groups	15.04	4	2.8023	1.7337 (N.S.)
Within groups	153.55	95	1.6163	
Total	168.59	99		

The results of Table XIV showed that there were no significant differences among age groups on the performance for middle position recall (N.S.).

T - test comparisons were used to calculate the differences on central memory performance for the primacy effect, recency effect and middle - position effect to examine if the performance on primacy differed from the performance on recency and the performance on middle - position, and to find out if the performance on recency differed from the performance on middle - position. The findings are presented in Table XV.

Table XV

T - test Comparisons between the Different Serial Positions on Central Memory Scores

Serial position	Primacy $\bar{X} = .23$	Recency $\bar{X} = 1.83$	Middle position $\bar{X} = .57$
Primacy $\bar{X} = .23$	-	25.39*	4.00*
Recency $\bar{X} = 1.83$	-	-	16.15*
Middle position $\bar{X} = .57$	-	-	-

* $p < .01$, $df = 98$

The results indicated that there were significant differences between the primacy performance and the recency performance ($t = 25.39$, $p < .01$) and between the primacy performance and the performance for middle - positions ($t = 4.00$, $p < .01$). The recency performance was also significantly different from the performance for middle - position ($t = 16.15$, $p < .01$).

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Incidental memory scores

Performance on the incidental memory task was the number of pairings of animals and objects recalled following completion of the central memory task. Means, standard deviation and proportion correct at each age group are presented in Table XVI.

(Insert Table XVI)

A chart on the proportion of correct number of responses on incidental memory scores was presented in Figure IV.

(Insert Figure IV)

Figure IV showed that proportion of correct number of responses on incidental memory scores increased up to ages 14 - 15 and then decreased at ages 20 - 21.

One - way analysis of variance was performed on incidental memory scores in all age groups to examine the differences among age groups. The results are shown in Table XVII.

(Insert Table XVII)

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Table XVI

Means, S.D. and Proportion Correct on Incidental Memory Scores at Each Age Group and by Sex

Age groups	4 - 5			7 - 8			10 - 11			14 - 15			20 - 21		
	males	females	total	males	females	total	males	females	total	males	females	total	males	females	total
\bar{X}	0.60	0.20	0.40	2.20	2.00	2.10	1.60	2.10	1.85	2.20	2.40	2.30	1.20	1.00	1.10
S.D.	1.25	0.42	0.91	1.32	2.05	1.18	1.07	1.73	1.42	1.82	1.90	1.81	1.32	1.05	1.16
Proportion correct	0.08	0.03	0.06	0.31	0.28	0.30	0.23	0.30	0.26	0.31	0.34	0.33	0.17	0.14	0.16

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Figure IV

Incidental Memory Scores over Age

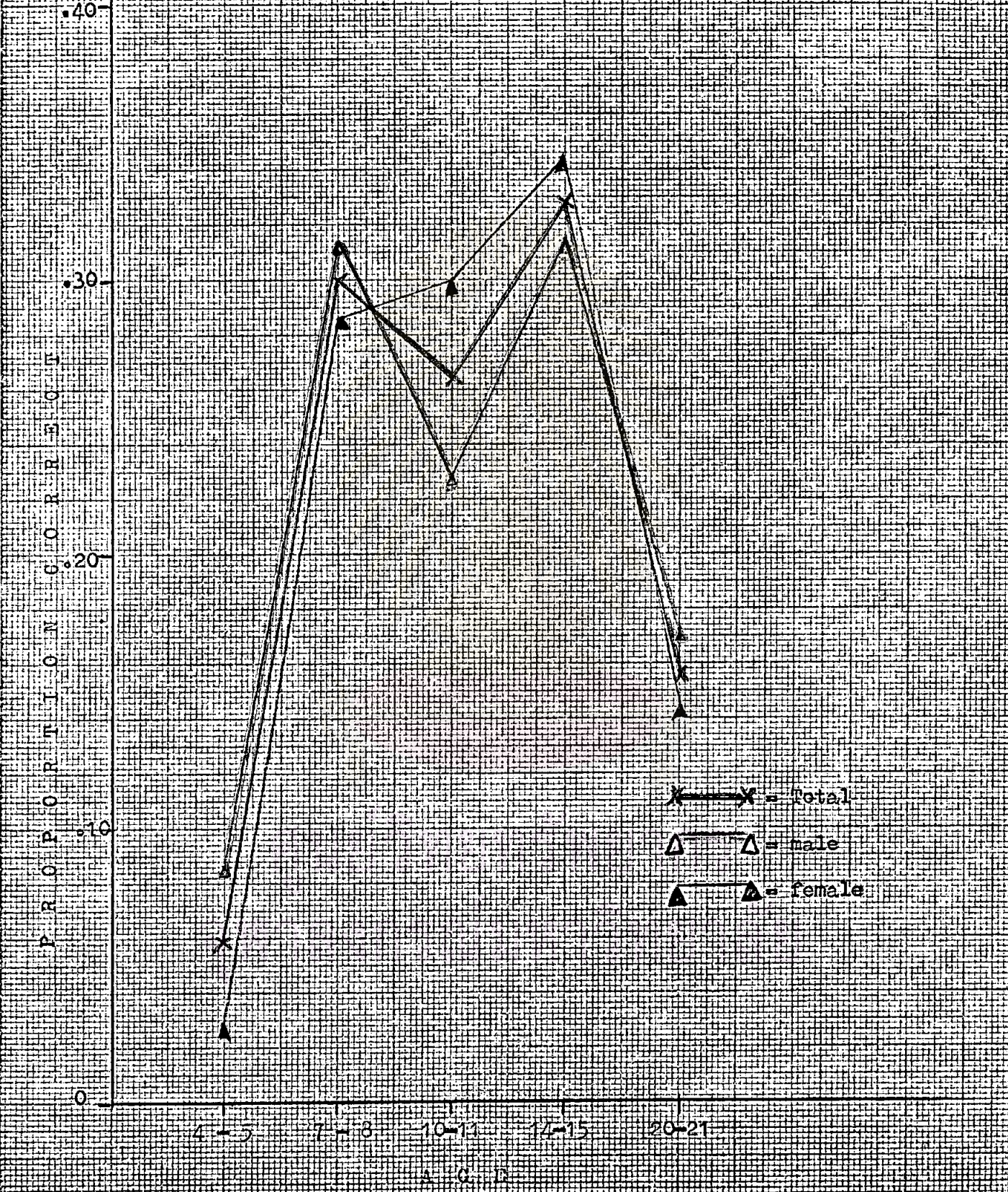


Table XVII

One - Way Analysis of Variance among Age Groups on Incidental Memory Scores

Source of variation	S.S.	df	M.S.	F
Between groups	49.60	4	12.40	5.9753*
Within groups	197.15	95	2.0752	
Total	246.75	99		

*p < .01

The results of Table XVII showed that there were significant difference among age groups ($F = 5.9753$, $p < .01$).

T - test comprisons were made to find out performance on incidental memory at which age group was significantly different from other age groups. The results are shown in Table XVIII.

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Table XVIII

T - test Comparisons between Age Groups on Incidental Memory Scores

Age groups	4-5 $\bar{X} = 0.4$	7-8 $\bar{X} = 2.1$	10-11 $\bar{X} = 1.85$	14-15 $\bar{X} = 2.3$	20-21 $\bar{X} = 1.1$
4 - 5 $\bar{X} = 0.4$	-	4.1463*	3.8157*	4.2222*	2.1212
7 - 8 $\bar{X} = 2.1$			0.5102	0.3636	2.2222
10 - 11 $\bar{X} = 1.85$				0.8823	1.7857
14 - 15 $\bar{X} = 2.3$					2.5000
20 - 21 $\bar{X} = 1.1$					

* $p < .01$, $df = 38$

The results showed that performance on incidental memory at ages 4 - 5 was significantly different from the performance at ages 7 - 8 ($t = 4.1463$, $p < .01$), ages 10 - 11 ($t = 3.8157$, $p < .01$) and ages 14 - 15 ($t = 4.2222$, $p < .01$), but not significantly different from the performance at ages 20 - 21 (N.S.). There were no significant differences between the performance at ages 7 - 8 and ages 10 - 11 (N.S.), between the performance at ages 7 - 8 and ages 14 - 15 (N.S.), and between ages 7 - 8 and ages 20 - 21 (N.S.). The performance at ages 10 - 11 was not significantly different from the performance at ages 14 - 15 (N.S.) and ages 20 - 21 (N.S.). There were no significant differences between the performance at ages 14 - 15 and 20 - 21 (N.S.).

T - test comparisons were also performed to examine the differences on incidental memory scores between males and females. The results are presented in Table XIX.

Table XIX

T - test Comparison between Males and Females on Incidental Memory Scores

Age groups	\bar{X} of males	\bar{X} of females	t
4 - 5	0.60	0.20	.9523 (N.S.)
7 - 8	2.20	2.00	.2597 (N.S.)
10 - 11	1.60	2.10	.7812 (N.S.)
14 - 15	2.20	2.40	.2439 (N.S.)
20 - 21	1.20	1.00	.3773 (N.S.)

There were no sex differences at any age group (N.S.).

Relationship between central and incidental memory scores

Performance on central and incidental memory were correlated for all groups to examine the relationship between the central and incidental memory scores. The results are presented in Table XX.

Table XX

Correlations between Central and Incidental Memory Scores for All Age Groups

Age groups	\bar{X} of central memory scores	\bar{X} of incidental memory scores	r_{xy}
4 - 5	4.05	0.40	.1200 (N.S.)
7 - 8	4.95	2.10	.1900 (N.S.)
10 - 11	5.80	1.85	-.0900 (N.S.)
14 - 15	6.40	2.30	.1717 (N.S.)
20 - 21	5.90	1.10	-.1953 (N.S.)
Total	5.42	1.55	.1610 (N.S.)

The results showed no relationship between central and incidental memory scores at any age group (N.S.).

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