Results

Data are reported for the recall task and the four pretest-posttest transfer test dependent measures (Spelling, Vocabulary Discrimination, Definition, Open-ended Sentence Completion). The analyses of primary interest are the contrasts for the levels of the between group speed of instruction factor, speeded (S) and nonspeeded instruction (NS), and for contrasts among levels of the semantic list type within subject factor (taxonomic, thematic, and mixed). Data from the control group are reported to convey the pattern of results that could have been expected on the posttests if the instruction had not taken place.

In order to determine the effectiveness of the experimental manipulations, two analyses of covariance were performed. Each covariate controlled for two sources of variations that significantly differed. The first source of variation was a significant difference in pretest scores on the three Semantic List types (taxonomic, mixed, thematic). Scores were higher for the thematic items than items from the other two list types. Pretest scores were used as a covariate in the analyses of the effect of the treatment on the different semantic lists. The second source of variation was a significant difference between the treatment groups on the number of trials needed to reach criterion. Speeded group subjects required twice as many trials, on the average, as the Nonspeeded group. Number of trials-to-criterion was used as a covariate to test the relative effectiveness of the S and NS manipulations on the four posttests.

Pretest Analyses

The top portion of Tables 5, 6, 7, and 8 show the percent correct performance on each pretest for the three groups (S, NS, Control) and the three semantic list types (taxonomic, mixed, thematic). A repeated measures analysis of variance was performed for each pretest. There were no effects of instruction, indicating that S, NS, and the control groups started out equal in overall vocabulary knowledge on the four pretests.

However, Semantic List type scores on three of the four measures did not start out equal. There was a significant main effect of list type on the Spelling pretest (see Table 5), $F(2,44) = 5.15$, $p < .009$, the Vocabulary Discrimination pretest (see Table 6), $F(2,44) = 6.80$, $p < .002$, and the Definition pretest (see Table 7), $F(2,44) = 18.28$, $p < .001$. There was no interaction between the instructional and semantic list factors for any of these three dependent variables.

Contrasts between levels of the semantic list type factor (taxonomic versus thematic, taxonomic versus mixed, thematic versus mixed) for the three dependent variables that differed on the pretests were performed.

1. Spelling. Pretest scores were higher for Thematic list type than Taxonomic, $F(1,22) = 4.33$, $p < .04$. The difference between Thematic and Mixed list types was insignificant.

2. Vocabulary Discrimination. Thematic list pretest scores were higher than the taxonomic, $F(1,22) = 9.29$, $p < .005$, and Mixed list type,

Table 5

Pretest and Posttest Raw Percent Correct on the
Spelling Test.

| Test Interval | Category | | Instructional Group | | | |
			Speeded	NonSpeeded	Control	Total
	Taxonomic	M	33.75	35.00	33.75	34.20
		SD	14.57	12.99	12.46	
	Mixed	M	40.62	39.44	48.12	42.60
		SD	15.45	11.30	22.50	
Pretest	Thematic	M	8.12	44.44	47.50	46.60
		SD	23.44	10.73	16.47	
	Total	M	40.83	39.62	43.12	41.13
		SD	17.82	11.67	17.14	
	Taxonomic	M	65.62	52.77	41.25	53.20
		SD	23.05	21.66	21.83	
	Mixed	M	71.25	52.00	46.25	56.60
		SD	18.85	11.21	20.13	
Posttest	Thematic	M	75.00	63.88	59.37	66.00
		SD	22.03	25.09	17.61	
	Total	M	70.62	56.48	48.95	58.60
		SD	21.31	19.32	19.52	

Table 6

Pretest and Posttest Raw Percent Correct on the
Vocabulary Discrimination Test

| Test Interval | Category | | Instructional Group | | | |
			Speeded	NonSpeeded	Control	Total
Pretest	Taxonomic	M	31.25	30.55	30.00	30.60
		SD	11.57	15.89	11.95	
	Mixed	M	37.50	32.22	36.87	35.40
		SD	8.86	10.63	10.99	
	Thematic	M	41.87	45.00	45.62	44.20
		SD	17.51	12.24	19.35	
~	Total	M	36.87	35.90	37.49	36.73
		SD	12.64	12.92	14.10	
Posttest	Taxonomic	M	60.00	55.00	31.87	49.20
		SD	26.04	18.20	14.37	
	Mixed	M	56.87	37.22	31.87	41.80
		SD	20.34	16.60	18.11	
	Thematic	M	68.12	56.66	51.25	58.60
		SD	22.82	21.93	23.26	
	Total	M	61.66	49.62	38.33	49.80
		SD	23.07	18.91	18.58	

Table 7

Pretest and Posttest Raw Percent Correct on the Definition Test.

| Test Interval | Category | | Instructional Group | | | |
			Speeded	NonSpeeded	Control	Total
Pretest	Taxonomic	M	40.00	25.55	32.50	32.40
		SD	9.63	8.45	11.64	
	Mixed	M	38.75	33.33	44.37	38.60
		SD	15.97	12.50	11.16	
	Thematic	M	53.75	43.88	53.12	50.00
		SD	18.66	17.63	20.16	
	Total	M	44.16	34.25	43.33	40.33
		SD	14.75	12.86	14.32	
Posttest	Taxonomic	M	63.12	45.55	33.75	47.40
		SD	28.67	17.03	15.75	
	Mixed	M	60.62	46.11	45.00	50.40
		SD	16.13	10.83	15.11	
	Thematic	M	63.12	63.88	50.62	59.40
		SD	21.86	19.16	20.25	
	Total	M	62.29	51.84	42.70	52.40
		SD	22.09	15.67	17.04	

Table 8

Pretest and Posttest Raw Scores of the Open-ended
Test for Appropriate Word Responses.

		Instructional Group			
Test Interval	Category	Speeded	NonSpeeded	Control	Total
Posttest	Taxonomic M	0.78	0.52	0.78	0.69
	SD	0.12	0.20	0.14	
	Mixed M	0.67	0.64	0.71	0.67
	SD	0.21	0.20	0.13	
	Thematic M	0.57	0.63	0.57	0.59
	SD	0.26	0.32	0.27	
	Total M	0.67	0.59	0.69	0.65
	SD	0.19	0.24	0.18	
Pretest	Taxonomic M	0.68	0.62	0.63	0.64
	SD	0.08	0.25	0.16	
	Mixed M	0.69	0.70	0.81	0.73
	SD	0.15	0.17	0.10	
	Thematic M	0.75	0.65	0.66	0.69
	SD	0.16	0.14	0.21	
	Total M	0.71	0.65	0.70	0.69
	SD	0.13	0.19	0.16	

F(1,22) = 8.66, p< .008. The difference between Taxonomic and Mixed lists was insignificant.

  3. Definition. Pretest scores were higher for the Thematic list than Taxonomic, F(1,22) = 23.48, p< .0001, and Mixed, F(1,22) = 19.59, p< .0002. Mixed list pretest scores were significantly higher than Taxonomic, F(1,22) = 6.00, p< .02.

  The significant pretest differences for semantic lists on these dependent measures were controlled for in the posttest analyses. Each of the three pretest was used as a covariate in its matched posttest analysis, when levels of the semantic list factor were compared.

  Open-ended Sentence Completion. Table 8 shows percentage scores on the open-ended sentence completion posttest. Percentage of appropriate instructional items used to complete sentences was the measure in this analysis. The results were insignificant on all factors. Another measure of performance on this test was also used and its outcome reflects what contributed to most of the variance. The proportion of appropriate noninstructional items used to complete sentences was the dependent variable for the measures in this second analysis. All subjects, on the average, were able to conjure up their own words to fill in the sentence blanks appropriately, resulting in very little room for improvement on this score. This was demonstrated by their high pretest scores. They continued to use words other than the instructional items to complete the task appropriately on the posttest. As a result further reports on this test will be excluded until the discussion section.

Trials to Criterion

The trials to criterion data are shown in Table 9 representing semantic list type and instructional group. The top portion of the Table refers to trials to criterion, ignoring semantic list presentation order, while the bottom portion refers to order of presentation, ignoring list type. Control group subjects did not receive the instruction, therefore these data are relevant to the two treatment groups only (S, NS).

An unweighted means repeated measures analysis of variance was performed on these data. The relevant means show that subjects in the speeded (S) condition required more than twice as many trials to reach criterion (M = 34.2) as the nonspeeded (NS) group subjects (M = 15.2) and the difference is significant, F(1,15) = 68.84, p< .001. The effect for semantic list type was not significant, nor was there an interaction.

Because of theese differences, the trials to criterion covariate was used in posttest comparisons between the two instructional groups.

Posttest results using Pretest scores as Covariates

The results of three posttests will be discussed in this section: Spelling, Discrimination, and Definition. Due to the specific nature of the predictions, these results will be discussed in two parts: (1) comparisons between each instructional group (S, NS) with the control and (2) semantic list contrasts (taxonomic versus thematic, taxonomic versus mixed, thematic versus mixed), using experimental

Table 9

Trials to criterion as a function of instruction and list type.

Instructional Group

List Type		Speeded	NonSpeeded	Total
Taxonomic	M	36.2	17.1	26.1
	SD	18.4	7.6	
Mixed	M	38.8	15.6	26.5
	SD	25.6	9.3	
Thematic	M	27.7	13.0	19.9
	SD	16.3	7.6	
Total	M	34.2	15.2	24.2
	SD	20.1	8.1	

List Order

		Speeded	NonSpeeded	Total
First List	M	58.7	22.1	39.3
	SD	11.6	8.4	
Second List	M	27.7	13.3	20.1
	SD	10.1	7.2	
Third List	M	16.3	10.3	13.7
	SD	2.2	2.3	
Total	M	34.2	15.2	24.2
	SD	7.9	5.9	

groups only. Comparisons between instructional groups (S and NS), which required the use of the trials to criterion covariates, will be discussed in the next section.

Spelling Test. Table 10 shows the adjusted percent correct spelling posttest responses.

1. Overall Instruction comparisons. The comparisons between the control and each treatment group, using the adjusted means (see Table 10) were significant, indicating that both S and NS produced higher scores than the control, F(1,13) = 20.66, p< .0005 and F(1,14) = 5.15, p< .03, respectively.

2. Semantic list manipulation. The semantic list type planned contrasts, controlling for pretest differences, indicate that adjusted mean scores (see Table 10) were significantly higher for the thematic list items than items from the mixed lists, F(1,21) = 8.26, p< .009. Thematic list item scores were also significantly higher than taxonomic item scores, F(1,21) = 5.47, p< .02. The difference between taxonomic list scores and mixed scores was insignificant.

The results suggest that when pretest differences in spelling knowledge are controlled for, spelling knowledge improvement was greatest for the thematic lists than the mixed or taxonomic. Figure 4 characterizes this effect.

Vocabulary Discrimination test. The adjusted posttest scores for the Vocabulary Discrimination posttest are shown in Table 11.

Table 10

Adjusted Percent Correct Scores on the Spelling Test.

Instructional Group

Category	Speeded	NonSpeeded	Control	Total
Taxonomic	68.63	55.44	44.46	56.24
Mixed	71.47	53.51	43.21	56.06
Thematic	71.96	62.44	56.60	63.64
Total	70.75	57.13	48.09	58.43
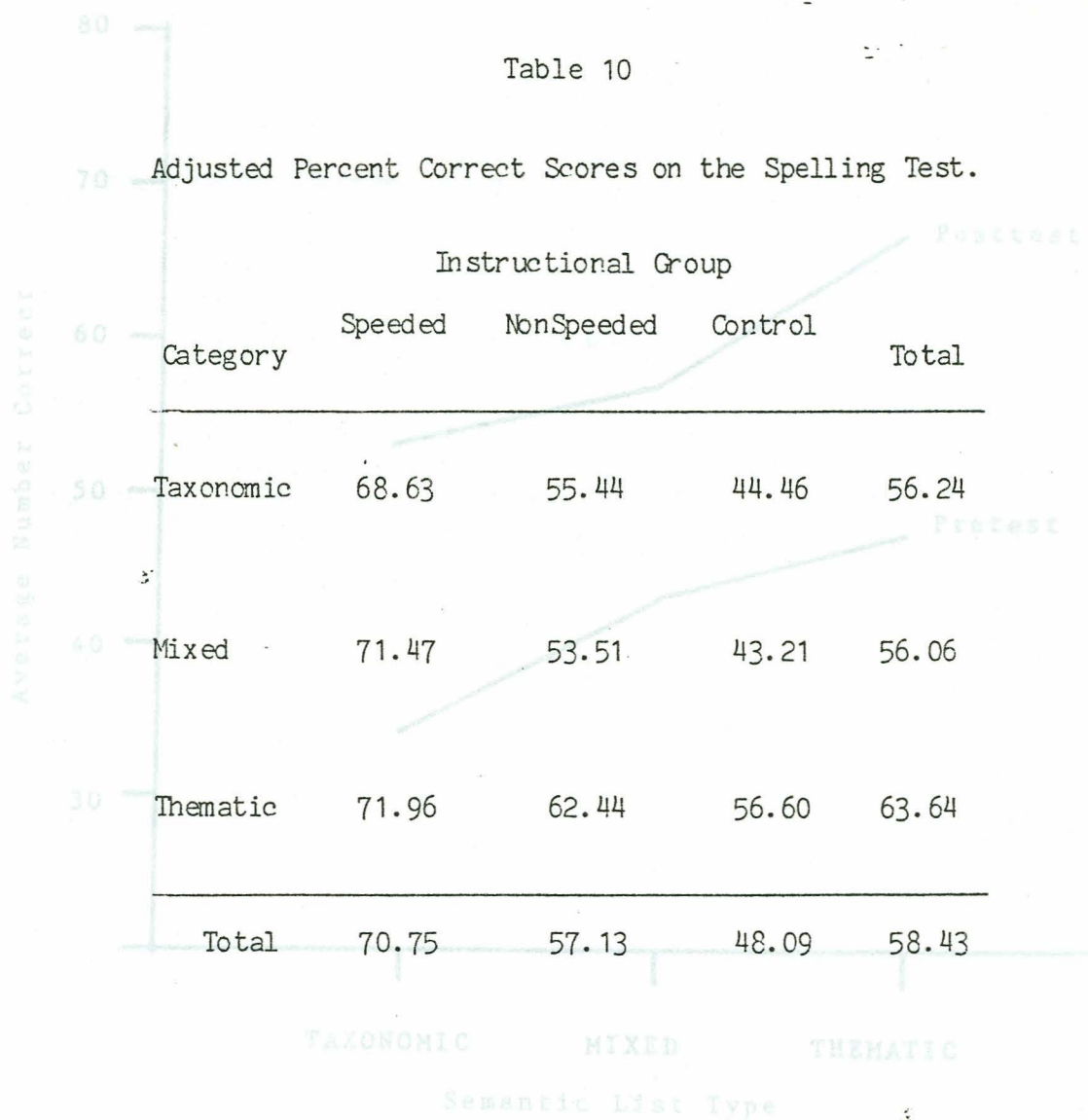
Figure 4. Spelling knowledge as a function of semantic list type and test interval.

Table 11

Adjusted Percent Correct Scores on the Vocabulary Discrimination Test

Instructional Group

Category	Speeded	NonSpeeded	Control	Total
Taxonomic	62.06	57.32	34.41	51.26
Mixed	56.58	39.92	31.82	42.44
Thematic	66.18	53.55	47.90	55.87
Total	61.60	49.93	38.04	49.85

1. <u>Overall</u> <u>instruction</u> <u>comparisons</u>. Both contrasts were significant, indicating that the S group (M = 61.60) produced higher adjusted scores than the control (M = 38.04), F(1, 13) = 16.45, p< .001, and higher scores than NS (M = 49.93), F(1, 14) = 6.01, p< .02.

2. <u>Semantic</u> <u>list</u> <u>manipulation</u>. The results of the semantic list type contrasts indicate that adjusted scores for taxonomic lists (see Table 12) were significantly higher than for mixed lists, F(1,21) = 4.66, p< .04, as were the thematic items in contrast to mixed list items, F(1,21) = 11.09, p< .003. The difference between scores for taxonomic and thematic was insignificant. Figure 5 characterizes these results.

These results indicate that, when pretest differences in ability to use appropriate vocabulary words to fill in sentence blanks are controlled for, there was equal improvement in vocabulary knowledge for the thematic and taxonomic lists. Both improved significantly more than the mixed lists.

<u>Definition test</u>. The posttest scores for the vocabulary discrimination transfer test are shown in the bottom portion of Table 7.

1. <u>Overall</u> <u>instruction</u> <u>comparisons</u>. Both the S and NS groups' scores were significantly higher than the control scores, F(1, 14) = 14.89, p< .001 for S, and F(1, 14) = 9.85, p< .007, for NS. The adjusted means are shown in Table 11.

Table 12
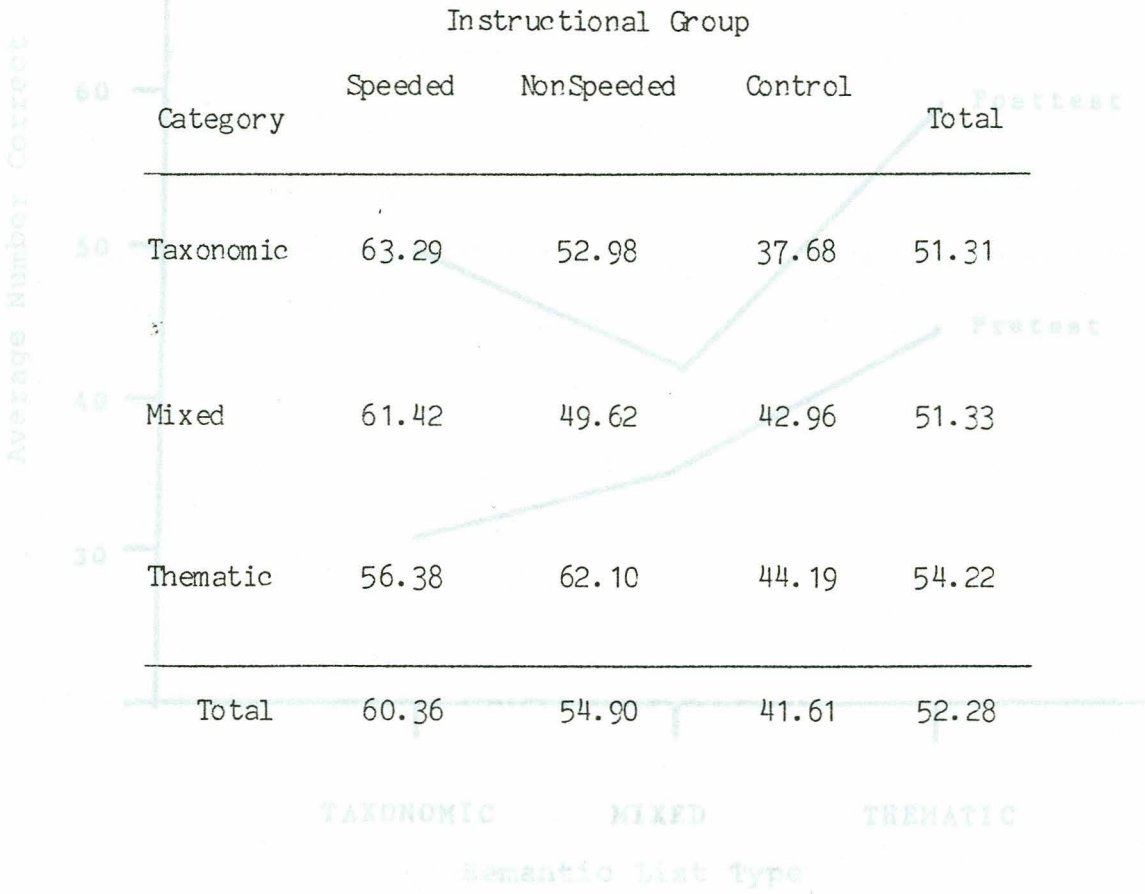
Adjusted Percent Correct Scores on the Definition Test.

Instructional Group

Category	Speeded	NonSpeeded	Control	Total
Taxonomic	63.29	52.98	37.68	51.31
Mixed	61.42	49.62	42.96	51.33
Thematic	56.38	62.10	44.19	54.22
Total	60.36	54.90	41.61	52.28

Figure 5. Discrimination test as a function of semantic list type and test interval.

2. Semantic list manipulation. The effect of semantic list was insignificant. Figure 6 characterizes these results.

Posttest comparisons using the Trials to Criterion covariates

Spelling. The results of the comparison between instructional treatment groups (S, NS) will be discussed in this section. Table 10 shows the corresponding adjusted percent correct spelling posttest responses. The comparison between the S and NS posttest adjusted mean scores was performed, controlling for trials to criterion. The

difference between S group and the NS group scores was insignificant, indicating that spelling knowledge increases was equal across the two treatments.

Vocabulary Test. Table 11 shows the corresponding adjusted percent correct Vocabulary Posttest responses.

The planned contrast between S and NS mean scores (see Table 11), controlling for trials to criterion, indicates that the two treatment groups increased their scores on this test equally.

Definition Test. Table 12 shows the adjusted percent correct scores for the definition posttest.

The planned contrast, controlling for trials to criterion, was insignificant, indicating that the two treatment groups' adjusted mean scores (see Table 12), indicate equal improvement on this posttest.
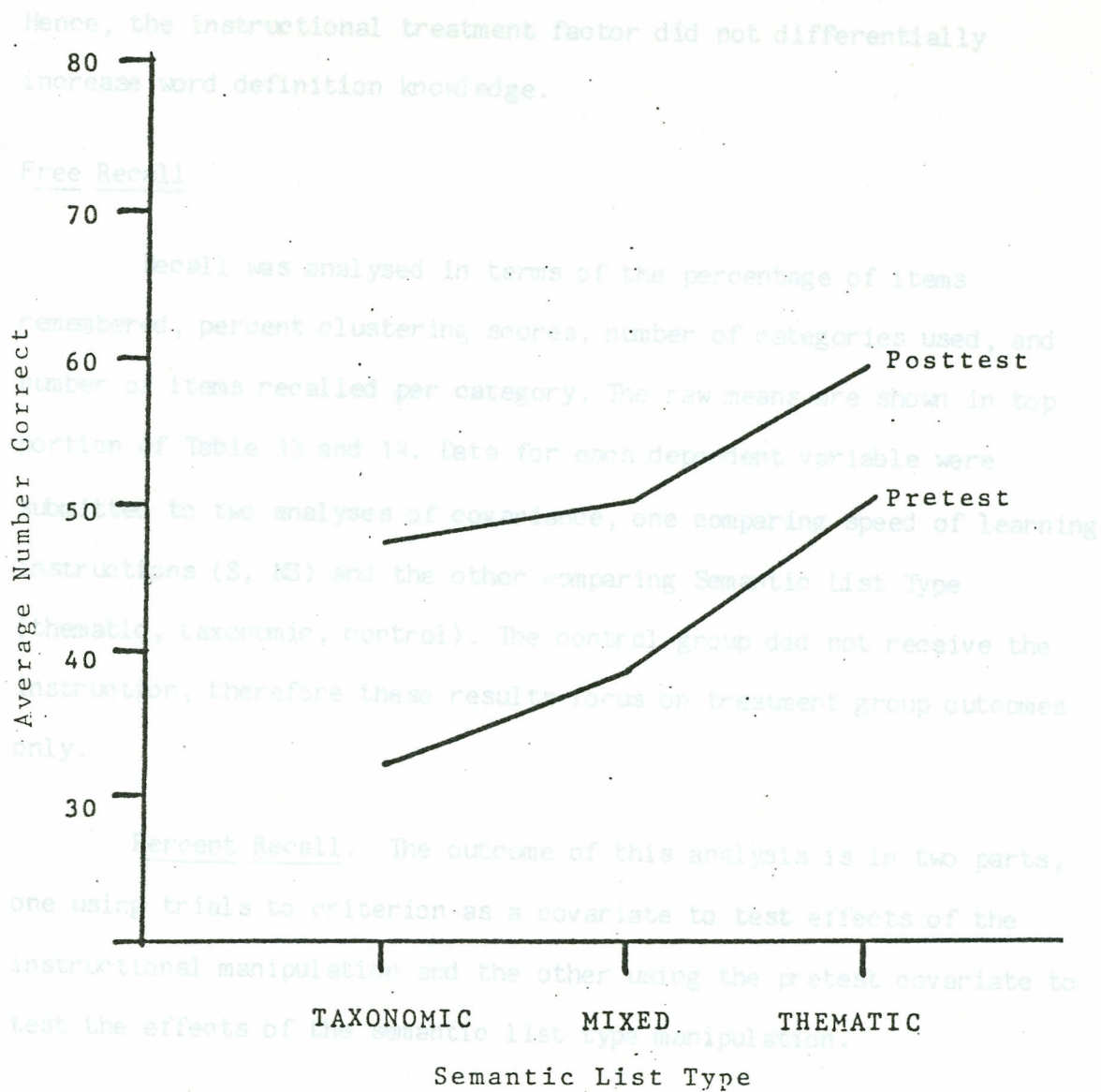
Figure 6. Vocabulary Definition Knowledge as a function of semantic list and test interval.

Hence, the instructional treatment factor did not differentially increase word definition knowledge.

Free Recall

Recall was analysed in terms of the percentage of items remembered, percent clustering scores, number of categories used, and number of items recalled per category. The raw means are shown in top portion of Table 13 and 14. Data for each dependent variable were submitted to two analyses of covariance, one comparing speed of learning instructions (S, NS) and the other comparing Semantic List Type (thematic, taxonomic, control). The control group did not receive the instruction, therefore these results focus on treatment group outcomes only.

Percent Recall. The outcome of this analysis is in two parts, one using trials to criterion as a covariate to test effects of the instructional manipulation and the other using the pretest covariate to test the effects of the semantic list type manipulation.

1. Instructional group manipulation. The comparison between instructional groups, using the trials to criterion covariate showed that S condition (adjusted M = .29) and NS condition (adjusted M = .25) mean recall scores did not differ. Thus, the speed of instruction manipulation did not differentially affect the amount subjects recalled.

2. Semantic list type manipulation. The pretest covariate was used to analyze semantic list type effects. The different levels of this manipulation, Taxonomic list type (adjusted M = .26), Mixed (adjusted

Table 13

Recall and clustering performance as a
function of instruction and list type.

| | | | Instructional Group | |
| | | | Speeded | Non Speeded |
	Semantic List			
Percent recalled	Taxonomic	M	0.33	0.21
		SD	1.12	0.08
	Mixed	M	0.29	0.30
		SD	0.16	0.17
	Thematic	M	0.32	0.20
		SD	0.04	0.12
	Total	M	0.32	0.24
		SD	0.11	0.12
Clustering	Taxonomic	M	0.61	0.47
		SD	0.25	0.28
	Mixed	M	0.43	0.52
		SD	0.25	0.27
	Thematic	M	0.67	0.71
		SD	0.30	0.34
	Total	M	0.57	0.57
		SD	0.27	0.29

Table 14

Average number of categories recalled and average number of
items per category recalled for Instructional Group as a
function of Speed of Instruction and Semantic List Type.

| Semantic List Type | | | Instructional Group | |
			Speeded	NonSpeeded
Category Recall	Taxonomic	M	5.1	4.8
		SD	1.1	1.3
	Mixed	M	5.0	5.5
		SD	1.0	0.7
	Thematic	M	5.2	4.7
		SD	0.7	1.1
	Total	M	5.1	5.0
		SD	0.9	1.1
Item Recall	Taxonomic	M	3.99	2.53
		SD	1.12	0.64
	Mixed	M	3.30	3.40
		SD	1.46	1.42
	Thematic	M	3.60	2.48
		SD	0.40	0.84
	Total	M	3.63	2.80
		SD	0.99	0.97

M = .29), and Thematic (adjusted M = .25), did not emerge as a significant factor.

Clustering. The important question pertaining to clustering in recall is the extent to which semantic list type facilitated within-list organization. Clustering data can be useful for describing how semantic organization is affected by instructional speed differences and the extent to which list type differences relate to number of items recalled. Clustering of items in recall according to categorical organization was measured using the Relative Ratio of Repetition (RRR) (Bousfield & Bousfield, 1966). This measure varies from 0 in the case of no clustering to 1.0 in the case of perfect clustering. The raw means from this analysis are shown in the bottom half of Table 0.

1. Instructional group manipulation. Using the trials to criterion covariate, the difference between S (M = .54) and NS (M = .59) adjusted mean scores was insignificant. This outcome indicates that speed of instruction did not differentially influence clustering.

2. Semantic list type manipulation. The pattern of results, using the pretest covariate, indicates that the difference between Taxonomic (adjusted M = .56), Mixed (adjusted M = .48) and Thematic (adjusted M = .65) list types was insignificant. It appears that each semantic list type promoted clustering equally.

Category use in recall. Here we consider the question of whether or not subjects used categorical structure in free recall. First, we will investigate whether the groups differed in the tendency to use category structure in recall and if different list types

influenced category structure differentially. The raw mean scores can be inspected in the top portion of Table 0.

1. Instructional group manipulation. The results of the analysis, using trials to criterion as a covariate, indicate that the difference between S (M = 5.1) and NS (M = 5.0) groups on number of categories recalled was insignificant. This finding indicates that the subjects in each group accessed information from an average of 5 of 6 categories from each semantic list.

2. Semantic list type manipulation. Using the pretest covariate, the results of the analyses contrasting the three semantic list type comparisons, taxonomic (M = 5.0) versus mixed (M = 5.2), taxonomic versus thematic (M = 5.0), and thematic versus mixed indicate that the means did not differ significantly.

Next, we investigate whether or not there were differences in terms of the average number of items recalled per category. The raw scores are shown in the bottom portion of Table 0.

1. Instructional manipulation. The results of the analysis, using the trials to criterion as a covariate, indicate that the difference between mean scores for S (M = 3.63) and NS (M = 2.80) groups was insignificant. Different levels of the speed of instruction factor did not differentially affect the number of items subjects recalled per category.

2. Semantic list type manipulation. Using the pretest as a covariate, we find that the Taxonomic (adjusted M = 3.22), Mixed

(adjusted M = 3.35), Thematic (adjusted M = 3.01), semantic list types

did not produce significant outcomes on any of the three comparisons.

This indicates that levels of this factor did not differentially affect

number of items retrieved.