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USE OF THE SEMANTIC DIFFERENTIAL TECHNIQUE TO MEASURE PROSPECTIVE ELEMENTARY SCHOOL TEACHER ATTITUDE TOWARD MATHEMATICS AND OTHER SUBJECTS. FINAL REPORT.

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The first objective of this research was to compare the attitudes of prospective elementary school teachers toward mathematics and three other areas-- language arts, science, and social studies--as academic disciplines and as future teaching areas. The second objective was to test the predictive validity of congruity theory when applied to Ss and concepts from elementary education. The third objective was to study semantic differential (SD) factor structure for the educational concepts and Ss studied. The final objective was to describe the locations in semantic space of the meaning of each concept studied and to describe any cluster patterns among these meanings. Subjects in this study were prospective elementary school teachers on whom substantial efforts had been expended to enhance their mathematical sophistication. Each of the four sections of this report deals with those aspects of the research which bear on one of the objectives listed above. (RP)

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U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

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Final Report

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Use of the Semantic Differential Technique to Measure Prospective Elementary School Teacher Attitude Toward Mathematics and Other Subjects

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U. S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

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Contents

Contents (contd)

Tables

Contents (contd)

Tables

Figures

Summary

This research was conducted in four stages: the factor analysis study, the attitude study, the congruity study, and the semantic distance study. Each of these studies is reported in a separate section of this document.

✓The objective of the factor analysis study was to determine the factorial structure of semantic differential (SD) scales that have been accepted widely as paradigms of the three SD factors named evaluation, potency, and activity when these scales are used by prospective elementary teachers to rate educational concepts. The following questions were raised:

1. Are evaluation, potency, and activity factors evident?

2. Are the factor loadings of scales that are paradigms for each of these three factors consistant with their reputations for high and relatively pure loadings?

3. Do any of the scales reverse polarity when used by prospective elementary teachers to rate educational concepts?

Seventeen concepts related to elementary school classroom activities were selected. Each Concept was rated on 14 SD scales that had been used to study a variety of concepts rated by widely divergent Ss. Concept, scale, and the order of "positive" and "negative" adjectives within scales were all randomized. Four separate random concept presentation orders were employed. A sample SD questionnaire is exhibited in the Appendix. Ss responded to the complete SD questionnaire during each of two administrations nine weeks apart. Thirty-four 14 x 14 correlation matrices were factor analyzed using principal components analysis with unities as estimates of communality. Orthogonal rotations were completed. The proportion of total variance accounted for by the first three factors ranged from 0.462 to 0.664.

Factor I was clearly the evaluative dimension but a traditional activity scale loaded heavily with the evaluative scales. Factor II was defined by two SD scales; one was traditionally an activity scale, the other a potency scale. This factor seems to be associated with intellectual or academic rigor rather than physical hardness or strength and thus might be thought of as a special kind of potency dimension. Factor III seems to be an activity dimension that includes the scale masculine-feminine. The positive polarity of this scale shifts from "masculine" to "feminine" across concepts rated. This study indicates that it is unwise to assume that an SD scale has a fixed factorial content at the outset of an experiment. Similarly scale polarity may also vary across Ss and concepts. Experiments that use the SD with educational concepts should include factor analysis as an initial step in data analysis.

In the attitude study prospective elementary school teachers' attitudes toward nine concepts: four academic areas, toward teaching children and toward teaching children in each of the academic areas were measured with the SD evaluative scales that withstood the factor analysis study. Additionally, attitudes toward mathematics and teaching children mathematics were correlated with S's achievement in collegiate courses in mathematics and teaching mathematics.

Mean attitude toward each of the nine concepts was significantly higher than neutrality. The difference between attitudes toward social studies and teaching children social studies was significant. Differences between all other pairs of the form (x, teaching children x) were not significant. No significant differences existed among attitudes toward the four academic areas. The mean attitude toward teaching children was significantly higher than any other mean attitude. Attitudes toward mathematics and teaching children mathematics were positively related to achievement in collegiate mathematics and mathematics education courses. Of particular note is that attitude scores for mathematics, science, and teaching children in these areas are no less positive than attitudes toward language arts and social studies as disciplines and teaching areas.

A third study was designed to determine whether or not the principle of congruity (Osgood, Suci, and Tannenbaum, 1957) predicts composite concept meaning from component concept meanings in the event that Ss and concepts stem from elementary education. In brief, the congruity principle stipulates that if two component concepts of measured meaning such as Goldwater and Republican are combined to form a composite concept Goldwater Republican, the meaning of the composite may be predicted by applying the congruity formula to each dimension of the semantic space.

The component concepts studied included language arts, mathematics, science, social studies, and teaching children. The composite concepts included all four combinations of the form teaching children x. The congruity model predicted Factor II with more precision than either Factor I or III. Obtained measures for composite concepts were systematically lower than predicted measures. It appears that the prediction formula could be improved by adding a constant, c, such that $-0.3 \leq c \leq -0.2$. Obtained and predicted factor scores were correlated to index their relationship independent of any systematic error. These data suggest that the congruity formula does predict responses to composite concepts from responses to component concepts.

The location of nine concepts in semantic 3-space was determined by generating an ordered triple of mean factor scores (S_I, S_{II}, S_{III})

Each ordered triple defines the centroid of the cloud of points (one from each S) for its respective concept. These centroids were plotted to yield a graphical display of the concepts' connotative meanings for the Ss involved. Distances between selected pairs of concepts were computed.

These data may be viewed as a dictionary of connotative meanings for the concepts studied among the prospective elementary teachers involved. In addition to providing a quantitative method of assigning meaning this analysis yields a measure of the distance between connotative meanings of pairs of concepts.

Introduction

One objective of this research was to compare the attitudes of prospective elementary school teachers toward mathematics and three other areas, language arts, science, and social studies as academic disciplines and as future teaching areas. The subjects were prospective elementary school teachers on whom substantial efforts had been expended to enhance their mathematical sophistication. A second objective was to test the predictive validity of congruity theory when applied to Ss and concepts from elementary education. SD scales have exhibited some shifting among factors and polarity inversions when applied to different concepts or families of concepts. The third objective was to study SD factor structure for the educational concepts and Ss studied. A final objective was to describe the locations in semantic space of the meaning of each concept studied and to describe any cluster patterns among these meanings.

The body of this report is organized into four sections each dealing with those aspects of the research which bear on one of the objectives listed above. Each section may be studied independently of the others, but since the results of the factor analysis study were used to determine the SD scales used in the remaining studies it is presented first.

The Factor Analysis Study

Semantic Differential (SD) bipolar adjective scales exhibit stability across a wide variety of S's, but they do not exhibit comparable stability across concepts. Shaw (1955), Osgood, Suci, and Tannenbaum (1957), Husek and Wittrack (1962), Osgood (1962), Hartman (1963), Tanka and Osgood (1963), Ohnmacht (1966). Thus, while subject-scale interaction is low, concept-scale interaction tends to be high. None the less the three classic SD factors labeled evaluation, potency, and activity generally appear and usually account for 50% or more of the total variance.

Osgood, Suci, and Tannenbaum (1957) cautioned that the meanings of scale-defining adjectives may change from concept to concept and that the assumption of a fixed polarity for a scale may not be tenable as concepts are varied. Moreover they reported that the activity factor fared poorly in single concept factor analyses. Among 19 concepts tested, activity was identifiable as a factor in only eight; it was distributed among other factors for various concepts.

The problem was to determine the factorial structure of SD scales that have become accepted widely as paradigms of the three factors termed evaluation, potency, and activity when they are used by prospective elementary teachers to rate educational concepts. In particular answers to the following questions were sought:

1. Are factors discernable as evaluation, potency, and activity evident?

2. Do scales which have become associated with one of the three factors listed above continue to register high and relatively pure loadings on their respective factors?

3. For each scale does the adjective traditionally associated with the positive end of the scale maintain this posture when the scale is used to rate educational concepts?

Methods

Seventeen concepts were selected that are directly related to classroom activities in the elementary schools. Nine of them related to the major curricular areas: they were language arts, mathematics, science, social studies, teaching children, teaching children language arts, teaching children mathematics, teaching children science, and teaching children social studies. The remaining eight concepts consisted of the defining sentences of Flanders' (1960) categories of teacher behavior: The teacher criticizes or deprecates pupil behavior with intent to change it. The teacher gives directions or orders. The teacher expresses or lectures about her own ideas. The teacher asks questions to orient pupils to school work. The teacher asks questions to stimulate pupil participation in decision making. The teacher accepts, clarifies, and supports the ideas and feelings of pupils. The teacher praises or encourages pupils. The teacher justifies his own position or authority. Each concept was rated on 14 scales which were selected by reviewing the literature for SD scales which consistently exhibited high and relatively pure factor loadings across a variety of concepts judged by different kinds of subjects. The scales are listed in Table 1.

Table 1

SD Scales Selected Because of Their Factorial Stability

Evaluation	Potency	Activity
good-bad	strong-weak	fast-slow
nice-awful	heavy-light	active-passive
positive-negative	hard-soft	hot-cold
heavenly-hellish	masculine-feminine	difficult-easy
optimistic-pessimistic		
happy-sad		

The S's were 71 seniors in elementary education. The SD's were administered in an educational foundations course. Each S responded to the questionnaire both before and after an 8-week student teaching period. Four random orders of concept presentation were used. The scale presentation order was selected randomly, and the order of "positive" and "negative" adjectives within scales was randomized. Each questionnaire included directions to S as suggested by Osgood, Suci, and Tannenbaum (1957). The S's were given ample in-class time to complete the questionnaire, and every S completed every item.

Thirty-four 14 x 14 matrices of product-moment correlations were produced. Each of these was factored using principal components analysis. Unities were used to estimate communality, and each analysis was followed by an orthogonal rotation to Kaiser's (1958, 1960) Varimax criterion. Linear correlations were justified because no systematic nonmonotonicity was observed among variables in the several matrices. While nonlinear relations undoubtedly exist among the variables, a linear correlation model yields a reasonable measure of the degree of relationship for a monotonic relation.

Findings and Analysis

Tables 2 and 3 list the proportion of total variance accounted for by the set of rotated factors for each analysis.

Table 2

Proportion of Total Variance for Rotated Factors: First Administration

Concept	Factors I	II	III	IV	V	CUM
Social Studies	.418	.150	.092	-	-	.660
Science	.318	.140	.090	-	-	.548
Mathematics	.419	.122	.092	-	-	.633
Language Arts	.354	.162	.079	.076	-	.671
Teaching Children	.218	.141	.103	.080	.073	.615
Teaching Children Social Studies	.357	.158	.075	-	-	.590
Teaching Children Science	.302	.137	.104	.088	-	.631
Teaching Children Mathematics	.368	.150	.083	-	-	.601
Teaching Children Language Arts	.308	.160	.086	.075	-	.629
Teacher criticizes of deprecates pupil behavior with intent to change it	.415	.123	.096	-	-	.634
Teacher gives directions or orders	.431	.121	.090	.078	-	.720
Teacher expresses or lectures about her own ideas	.461	.112	.090	-	-	.663
Teacher asks questions to orient pupils to school work	.366	.144	.081	-	-	.591
Teacher asks questions to stimulate pupil participation in decision making	.267	.127	.105	.096	.078	.673
Teacher accepts, clarifies, and supports the ideas and feelings of pupils	.378	.113	.086	.081	-	.658
Teacher praises or encourages pupils	.290	.121	.095	.093	-	.599
Teacher justifies his own position or authority	.317	.129	.113	.078	.077	.714

Table 3

Proportion of Total Variance for Rotated Factors: Second Administration

Concept	Factors I	II	III	IV	V	CUM
Social Studies	.420	.128	.104	-	-	.652
Science	.406	.125	.083	.078	-	.692
Mathematics	.358	.124	.089	.080	-	.651
Language Arts	.398	.180	.076	-	-	.654
Teaching Children	.271	.116	.099	.091	.072	.649
Teaching Children Social Studies	.414	.114	.084	.074	-	.686
Teaching Children Science	.355	.130	.098	.086	-	.669
Teaching Children Mathematics	.333	.137	.088	.081	-	.639
Teaching Children Language Arts	.356	.166	.087	-	-	.609
Teacher criticizes or deprecates pupil behavior with intent to change it	.384	.135	.097	.076	-	.692
Teacher gives directions or orders	.450	.107	.091	.083	-	.731
Teacher expresses or lectures about her own ideas	.446	.106	.085	.069	-	.706
Teacher asks questions to orient pupils to school work	.332	.127	.105	.088	.083	.735
Teacher asks questions to stimulate pupil participation in decision making	.301	.114	.104	.080	.072	.671
Teacher accepts, clarifies, and supports the ideas and feeling of pupils	.350	.103	.091	.076	-	.620
Teacher praises or encourages pupils	.311	.125	.089	.077	-	.620
Teacher justifies his own position or authority	.439	.125	.088	-	-	.652

The Varimax criterion terminated the rotation after three factors in 12 of the 34 analyses, and in no case was the rotation of more than five factors necessary. The proportion of total variance accounted for by the first three factors ranged from 0.462 to 0.663. When fourth and fifth factors was rotated, they appeared to be reoccurrences of heavy loadings on evaluative scales, or a factor which more frequently appeared as Factor II or III but was deposed in that particular analysis, or they seemed uninterpretable. This report will, therefore, be restricted to an analysis of the factor loadings for the first three rotated factors.

Factor I

Factor loadings $\geq$ 0.30 for the first factor are displayed in Tables 4 and 5. (Decimal points are omitted and loadings are rounded to hundredths.)

Factor I is quite clearly the evaluative dimension. All six of the scales chosen because they exhibited high and relatively pure loadings on the evaluative dimension in other studies yielded loadings $\geq$ 0.30 in 29 or more of the 34 factor analyses summarized here. In addition the scale active-passive qualified in 32 of the 34 cases and the scale strong-weak qualified in 31 of the 34 cases.

Table 4

Factor I Loadings ≥ 30: First Administration

Concept	Heavy-Light	Happy-Sad	Active-Passive	Hard-Soft	Good-Bad	Fast-Slow	Difficult-Easy	Masculine-Feminine	Heavenly-Hellish	Hot-Cold	Positive-Negative	Nice-Awful	Optimistic-Pessimistic	Strong-Weak
								Scales						
Social Studies		-81	-88		-83	-75			-41	-51	-90	-89	-72	-76
Science		-65	-68		-50				-58	-45	-81	-63	-79	-76
Mathematics		75	66		71	48			48	52	82	75	81	80
Language Arts		-74	-83		-80				-37		-80	-70	-79	-60
Teaching Children	-33	56						-34	63			80		
Teaching Children Social Studies	57	-65	-32		-61				-70	-63	-59	-68	-54	-40
Teaching Children Science	33	-61	-83		-76									
Teaching Children Mathematics		-72	-71		-70	-51			-43	-35	-76	-69	-79	-82
Teaching Children Language Arts		-77	-57		-66				-48		-78	-77	-74	-78
Teacher criticizes or deprecates pupil behavior with intent to change it		80	61		83				73	42	86	90	86	82
Teacher gives directions or orders		-66	-65		-79	-36			-56	-42	-91	-86	-86	-86
Teacher expresses or lectures about her own ideas		88	76		84	49			76	58	91	88	82	86
Teacher asks questions to orient pupils to school work		-74	-78		-76	-37			-64	-38	-79	-82	-80	-67
Teacher asks questions to stimulate pupil participation in decision making		-42	-82		-87						-78	-47	-57	-39
Teacher accepts, clarifies, and supports the ideas and feelings of pupils		-76	-72		-85	-41			-58		-84	-83	-73	-80
Teacher praises or encourages pupils								-73	64	77		39		57
Teacher justifies his own position or authority		-59	-60		-84					-54	-82	-56	-73	-76

Table 5

Factor I Loadings $\geq$ 30: Second Administration

Concept	Heavy-Light	Happy-Sad	Active-Passive	Hard-Soft	Good-Bad	Fast-Slow	Difficult-Easy	Masculine-Feminine	Heavenly-Hellish	Hot-Cold	Positive-Negative	Nice-Awful	Optimistic-Pessimistic	Strong-Weak
	Scales													
Social Studies	39	83	83		68	44	-32		58	57	86	84	85	63
Science		83	69		70		-32		65	34	76	82	82	65
Mathematics		78	63		64	66			39	58	81	71	59	74
Language Arts		76	81		75	63			54	50	88	83	79	72
Teaching Children		48	54		60				49		78	73	64	50
Teaching Children Social Studies		84	70		80	34	-38		54		87	81	78	68
Teaching Children Science		71	82		72				66		75	73	81	60
Teaching Children Mathematics		56	67		58	47				40	76	52	77	74
Teaching Children Language Arts		79	73		65	51			50	39	82	78	81	76
Teacher criticizes or deprecates pupil behavior with intent to change it		85	64		83				65	48	91	89	86	70
Teacher gives directions or orders		88	78		89	39	38		70	54	93	88	90	76
Teacher expresses or lectures about her own ideas		79	79		80	57			77	41	88	91	82	87
Teacher asks questions to orient pupils to school work		57	71		72				50		77	85	78	75
Teacher asks questions to stimulate pupil participation in decision making	32	72	65		56	64	34					39	52	
Teacher accepts, clarifies, and supports the ideas and feelings of pupils		62	77		81	34	-41		38		74	68	69	55
Teacher praises or encourages pupils		69	68		55		-60		60		53	82	67	74
Teacher justifies his own position or authority		87	89		88	53			50	61	87	81	88	82

Factor II

Data for Factor II are tabulated in Tables 6 and 7.

Factor II is best defined by the scales hard-soft and difficult-easy. In only four cases out of 34 does one of these scales meet the 0.30 criterion while the other scale does not. Moreover, in 19 cases out of the 30 in which they are paired they are ranked first and second. Except for the second administration of the Flanders' categories, the scale heavy-light loads consistently on Factor II.

Table 6

Factor II Loadings $\geq$ 30: First Administration

Concept	Heavy-Light	Happy-Sad	Active-Passive	Hard-Soft	Good-Bad	Fast-Slow	Difficult-Easy	Masculine-Feminine	Heavenly-Hellish	Hot-Cold	Positive-Negative	Nice-Awful	Optimistic-Pessimistic	Strong-Weak
Social Studies	-71			-67					67	-36				
Science	68	-44		81			67		-40	33		-38		
Mathematics	-65			-78		40	-71		55			41		
Language Arts	31			90			86							
Teaching Children	-60			-81		57	-58							
Teaching Children Social Studies	46			77			67	69						46
Teaching Children Science	66			76			69							
Teaching Children Mathematics	-67	42		-70			-75		61			47		
Teaching Children Language Arts	-71			-84			-86							
Teacher criticizes or deprecates pupil behavior with intent to change it	73	-31	41	80			32							
Teacher gives directions or orders	85			78					-33					
Teacher expresses or lectures about her own ideas	-74			-80			-31	-37						
Teacher asks questions to orient pupils to school work	-66			-71			-70				-36			-47
Teacher asks questions to stimulate pupil participation in decision making	-77					-33		-71						-51
Teacher accepts, clarifies, and supports the ideas and feelings of pupils			31	84			66			36				
Teacher praises or encourages pupils	69			57	-43									41
Teacher justifies his own position or authority.	-78								79	-39		52		

Table 7

Factor II Loadings ≥ 30: Second Administration

Concept	Heavy-Light	Happy-Sad	Active-Passive	Hard-Soft	Good-Bad	Fast-Slow	Difficult-Easy	Masculine-Feminine	Heavenly-Hellish	Hot-Cold	Positive-Negative	Nice-Awful	Optimistic-Pessimistic	Strong-Weak
Social Studies	-42			-89			-82		49					
Science	-50		-31	-78			-70		40					
Mathematics				-84			-78		68			30	35	
Language Arts	61			83		-31	81		-48					
Teaching Children	41			69			79		-40					
Teaching Children Social Studies	-51			-84			-71	-33	37					
Teaching Children Science	40			85			83		-47			-36		
Teaching Children Mathematics	-39	47		-79		38	-79		70			61		
Teaching Children Language Arts				79			87		-66					
Teacher criticizes or deprecates pupil behavior with intent to change it	-81		-33	-68			-54			39				
Teacher gives directions or orders				80				71						
Teacher expresses or lectures about her own ideas				77			76		-30					
Teacher asks questions to orient pupils to school work				80			78		43	35				
Teacher asks questions to stimulate pupil participation in decision making				73			79	60	-45					
Teacher accepts, clarifies, and supports the ideas and feelings of pupils	-83	48				50			55	47		37		
Teacher praises or encourages pupils		36		61		59				77				
Teacher justifies his own position or authority				79			80		-39	37				

Factor III

Tables 8 and 9 display the data for Factor III.

Factor III is defined by the following scales: fast-slow, masculine-feminine, and hot-cold.

Table 8

Factor III Loadings ≥ 30: First Administration

Concept	Heavy-Light	Happy-Sad	Active-Passive	Hard-Soft	Good-Bad	Fast-Slow	Difficult-Easy	Masculine-Feminine	Heavenly-Hellish	Hot-Cold	Positive-Negative	Nice-Awful	Optimistic-Pessimistic	Strong-Weak
Social Studies				-40			-86	-57						
Science						76		72		32				
Mathematics						30		88		61				
Language Arts						-74								-41
Teaching Children		-59	-84		-77									
Teaching Children Social Studies			-70		-49	-71		38			-59	-49	-56	-47
Teaching Children Science		31				71		74		68				
Teaching Children Mathematics				-40				-77		-75				
Teaching Children Language Arts								-78	53	58				
Teacher criticizes or deprecates pupil behavior with intent to change it						64	-64	-59		-43				
Teacher gives directions or orders						-63		88	-36	-63				
Teacher expresses or lectures about her own ideas						-51	81	-57						
Teacher asks questions to orient pupils to school work	-37					-60		-66		48				
Teacher asks questions to stimulate pupil participation in decision making				83			73							
Teacher accepts, clarifies, and supports the ideas and feelings of pupils	71					-69	31		-33	-36				
Teacher praises or encourages pupils		36	61		61						81	56	68	34
Teacher justifies his own position or authority			40	75			81							38

Table 9

Factor III Loadings $\geq$ 30: Second Administration

Concept	Heavy-Light	Happy-Sad	Active-Passive	Hard-Soft	Good-Bad	Fast-Slow	Difficult-Easy	Masculine-Feminine	Heavenly-Hellish	Hot- ld	Positive-Negative	Nice-Awful	Optimistic-Pessimistic	Strong-Weak
								Scales						
Social Studies	57					61		84						
Science			-30		34	66		-77	30	53	39			35
Mathematics	-72		-38					68						
Language Arts	32							82		-71				
Teaching Children	-50		33			41		-47	43	76				54
Teaching Children Social Studies						61			32	91				30
Teaching Children Science						56		-62		83				32
Teaching Children Mathematics	61							-82						
Teaching Children Language Arts	-73							-59		71				
Teacher criticizes or deprecates pupil behavior with intent to change it						-63	81		-51					
Teacher gives directions or orders	47					55	-76							
Teacher expresses or lectures about her o.n ideas	-83	34						30		49				
Teacher asks questions to orient pupils to school work		47				66		64		67				
Teacher asks questions to stimulate pupil participation in decision making	-54	32							48	50	80	66	54	72
Teacher accepts, clarifies, and supports the ideas and feelings of pupils				-46			-60	-66		58			35	44
Teacher praises or encourages pupils	-72							-56	32		44			
Teacher justifies his own position or authority	75					-32		-63		-31				

Factor "Purity"

Data in Table 10 provide information relative to the factorial "purity" of the high-loading scales for Factors I, II, and III across the set of educational concepts studied.

Table 10

Frequency of Occurrence of Factor Loadings ≥ 0.30 on Factors for Which Scale Is Not Listed

	Relative frequency with which scale loads ≥ 0.30 on other factors
Factor I scales	
happy-sad	0.18
active-passive	0.16
good-bad	0.07
heavenly-hellish	0.43
positive-negative	0.09
nice-awful	0.16
optimistic-pessimistic	0.16
strong-weak	0.21
Factor II scales	
hard-soft	0.07
difficult-easy	0.24
Factor III scales	
fast-slow	0.37
masculine-feminine	0.12
hot-cold	0.44

If we were to reject all scales with loadings ≥ 0.30 on other factors in 25% or more of the cases, then heavenly-hellish, fast-slow, and hot-cold would be eliminated.

Conclusions and Recommendations

Note that active-passive, the traditional paradigm of the activity factor, is clearly an evaluative scale with these educational concepts and subjects. In only three cases out of

68 does it load above 0.50 on Factor II or III. Similarly strong-weak, a traditional potency scale, becomes an evaluative scale. In only two cases does it load above 0.50 on Factor II or III. Factor II is a hybred of the traditional activity and potency factors. In light of the concepts rated and the factor loadings it appears that hard-soft and difficult-easy become synonomous, and that Factor II is associated with intellectual rigor, profundity, substance, and opaqueness rather than physical hardness, strength, or the like. The shift in connotative meaning among Factor II scales may account for the masculine-feminine scale's low loadings on this factor. While masculine-feminine may link with hard-soft for physical attributes, it certainly does not form such a link for intellectual attributes connected with these educational concepts. In these settings it is linked with two traditional activity scales in Factor III.

While masculine-feminine is the "purest" scale in Factor III, it does not maintain a stable polarity across the concepts included. An indication of this instability may be observed in Table 11.

Table 11

Comparison of the Polarities of Pairs of Scales Whose Loadings Were $\geq$ 0.30 on Factor III

	Same Polarity	Opposite Polarity
masculine-feminine with fast-slow	10	6
masculine-feminine with hot-cold	8	10
fast-slow with hot-cold	27	2

These data suggest that in about one-half of the cases 'feminine' defines the positive end of the scale. Considering the predominance of female teachers in elementary school classrooms, this outcome is not surprising.

It seems clear that some scales which have come to be regarded as activity or potency scales because of their relatively consistant performance in many studies did not perform in expected ways with these educational concepts and subjects. Kerlinger (1964) quotes Osgood as suggesting that SD's should always include scales of known factorial content. This study emphasizes that it is dangerous to suppose that a scale has a "known" factorial content that can be assumed at the outset. Moreover, one scale's polarity switched from concept to concept for the same subjects during a single SD administration. Erroneous results and conclusions would be generated by scoring and analyzing responses based on assumed scale performance.

The 34 factor analyses including rotations required only 3.4 minutes on an IBM 7094 computer. Those who use the SD with educational concepts should perform factor analysis as a first step in data analysis.

The Attitude Study

Substantial efforts are being made to improve the mathematical sophistication of prospective elementary teachers. The activity of the Committee on the Undergraduate Program in Mathematics (CUPM) of the Mathematical Association of America, increases in mathematics course requirements for teacher certification, new instructional material for the prospective teacher, and the growing demand of school districts for better mathematical preparation for teachers have all helped to initiate and sustain these efforts. (CUPM 1961, 1963, 1964, 1965a, and 1965b.)

One effect of this activity has been to make obsolete many of the research findings on prospective teachers' attitudes toward mathematics and teaching children mathematics. The constancy of group attitude structures enjoys only a limited half-life under most circumstances. This coupled with the amount of attention recently bestowed upon mathematics education suggests the need to measure current attitudes of prospective elementary teachers.

Dutton (1952, 1954, 1962) reported that many prospective elementary teachers dislike arithmetic, that these negative attitudes are acquired in elementary and junior high schools, and that university courses in mathematics and methods of teaching mathematics do little to induce more positive attitudes. Smith (1964) reported that his Ss held more favorable attitudes toward arithmetic than did Dutton's 1954 Ss since 88.6% of the 1964 Ss rated their feelings toward arithmetic either neutral or favorable compared with 79.5% of the 1954 Ss. Kane (1968) noted that a comparison of 12 specific attitude statements reported in the studies of 1954, 1962, and 1964 revealed no trend toward more positive attitudes in 1964 over the earlier responses. He suggested the increase from 79.5 to 88.6 percent may be an artifact of socially acceptable behavior stemming from knowledge of curricular revision in school mathematics rather than evidence of a shift in underlying attitudinal disposition. Aiken and Dregen (1961) found attitudes toward mathematics related to numerical ability, intelligence, achievement in mathematics, and attitudes toward former teachers. Aiken (1963) concluded that Ss holding favorable attitudes toward mathematics tended to be socially and intellectually more mature, self-controlled, and theoretically oriented. Huettig and Newell (1966) demonstrated an inverse relationship between the number of years of teaching experience and favorable attitudes toward modernizing elementary school mathematics curricula. They also reported that the amount of training in updated mathematics was related closely to Ss attitudes toward curriculum revision. Todd (1966) showed a positive relationship between understanding arithmetic concepts and attitudes toward arithmetic. Kane (1968) reported that for prospective intermediate grade teachers attitudes were higher toward mathematics than towards social studies, science, and language arts. Prospective K-3 teachers ranked language arts highest; the other three areas were closely aligned and below language arts.

Attitudes are presumably acquired in much the same way as other internal learned activity. They may be thought of as mediating evaluative behavior; they are referred to as favorable or unfavorable as though being located on some basic bipolar continuum. One way to assess them is to measure their direction (favorable-unfavorable) and distance from a neutral point (slightly favorable, very favorable, etc.).

The Semantic Differential (SD) with which S responds to a concept such as "mathematics" by rating it on a set of seven point scales each defined by a pair of bipolar adjectives such as "good-bad" or "heavy-light", provides a means of measuring attitudes. Not the least of the SD's advantages is that it looks less like an attitude questionnaire than other standard techniques. Factor analyses of SD data have consistently yielded a first factor identified as evaluation. Scales such as "good-bad", "positive-negative", and "successful-unsuccessful" characteristically load heavily on Factor I. Osgood, Suci, and Tannenbaum (1957), Osgood (1962), Miron (1961), Diob (1965), Mueller (1966), DiVesta and Dick (1966). Attitude may be identified with the evaluative dimension of the semantic space. Thus, attitude toward a concept is defined as the projection of the concept's point in semantic space onto the evaluative axis. The reliability and validity of the SD as an attitude measurement instrument have been established for Ss ranging in age from eight years to adulthood. Osgood, Suci, and Tannenbaum (1957), Miron (1961), DiVesta and Dick (1966).

In this study attitudes of prospective elementary teachers toward four academic areas, teaching children, and teaching children in each of the four academic areas were measured with a SD. Differences among these measures were analyzed. Additionally, relationships between attitudes toward mathematics and achievement in collegiate courses in mathematics and teaching mathematics were determined. Similarly the relationship between teaching children mathematics and achievement was determined.

Methods

A SD questionnaire was constructed including the following nine concepts to be rated: language arts, mathematics, science, social studies, teaching children, teaching children language arts, teaching children mathematics, teaching children science, and teaching children social studies. Each concept was rated on 14 bipolar adjective scales of which six were picked as evaluative. These scales were selected by reviewing the literature for SD scales which consistently exhibited high and relatively pure factor loadings across a variety of concepts judged by many different sorts of subjects.

Four random orders of concept presentation were used. The scale presentation order was selected randomly and the order of "positive" and "negative" adjectives within scales was randomized. Each questionnaire included directions to S suggested by Osgood, Suci, and Tannenbaum (1957). The Ss were given ample time to complete the questionnaire and every S completed every item.

The Ss were 71 seniors in elementary education. The SDs were administered in an Educational Foundations course by a professor who was not associated with any of the four disciplines named in the concepts. The Ss were informed that the procedure was part of a research project supported by the faculty in elementary education. No connection to a specific faculty member or area of specialization was made. S's responses were factor analyzed to determine whether or not each scale evidenced high factor loadings (0.3 or greater) on the factor for which it was chosen. On the basis of this analysis one prospective evaluative scale was discarded. The remaining five evaluative scales were: good-bad, nice-awful, positive-negative, optimistic-pessimistic, and happy-sad.

A score from 0 to 6 was recorded for each S on each evaluative scale. Thus the possible range of attitude scores was 0-30. A score of 0 indicates maximum intensity of negative attitude toward the concept being rated; a score of 15 indicates neutrality; a score of 30 indicates maximum positive attitude.

Findings and Analysis

Means and standard deviations of attitude scores for each concept are reported in Table 12. The first trend to note is that the group attitude toward each of the nine concepts,

Table 12

Means and Standard Deviations of Attitude Scores Toward Nine Concepts for 71 Prospective Elementary School Teachers

Concept	Mean	Standard Deviation
Teaching Children (TC)	26.27	3.41
Language Arts (LA)	23.49	4.16
Teaching Children Language Arts (TCLA)	24.06	3.30
Mathematics (M)	21.52	5.31
Teaching Children Mathematics (TCM)	22.98	4.32
Science (S)	23.37	3.92
Teaching Children Science (TCS)	24.25	3.26
Social Studies (SS)	21.13	5.04
Teaching Children Social Studies (TCSS)	23.00	4.24

is significantly ($\alpha < 0.001$) higher than the neutral point. Not only do these prospective teachers claim favorable attitudes toward teaching children and teaching children in each of the four curriculum areas, but their dispositions toward the four disciplines themselves are clearly positive.

Several interesting questions remain. First, what differences in stated attitude exist between pairs of concepts of the form x and teaching children x? In Table13 t-scores are reported for each pair. Only the difference between attitudes toward social studies and teaching children social studies is significant at the 0.05 level.

Table 13

An Analysis of the Differences between Mean Attitude Scores for Concept Pairs of the Form X and Teaching Children X

Concept Pairs	t
LA and TCLA	0.90
S and TCS	1.47
M and TCM	1.79
SS and TCSS	2.39*

* Significant: $t_{0.05} = 1.98$.

Two additional questions are (1) what differences exist among the mean attitudes toward the four academic disciplines, and (2) what differences exist among the mean attitudes toward teaching children and concepts of the form teaching children x? Table 14 includes ANOVA results in response to these questions.

Table 14

ANOVA of Mean Attitude Scores Toward Four Academic Areas and Toward Five Teaching Categories

Concept Groups	df	Mean Square	F
LA, M, S, SS	3, 280	106.96	4.94
TC, TCLA, TCM, TCS, TCSS	4, 280	127.34	9.91*

*Significant at the 0.05 level

$F_{0.05} = 8.54$ for df = 3, 280; thus no significant difference among the means was found for attitudes toward language arts, mathematics, science, and social studies. $F_{0.05} = 5.65$ for df = 4, 280; thus significant differences exist at the 0.05 level among the mean attitude scores toward the concepts teaching children and teaching children in each of the four areas. Tukey's procedure was employed to determine which pairs of means differed significantly from one another. (Bowker and Lieberman, 1959). In Table 15 differences between the means for each pair are displayed.

Table 15

Differences Between Pairs of Mean Attitude Scores Toward Five Teaching Concepts

Concept Pairs	Differences
TC, TCLA	2.21*
TC, TCM	3.29*
TC, TCS	2.02*
TC, TCSS	3.27*
TCLA, TCM	1.08
TCLA, TCS	0.19
TCLA, TCSS	1.06
TCM, TCS	1.27
TCM, TCSS	0.02
TCS, TCSS	1.25

*Significant at the 0.05 level

To be significant at the 0.05 level a difference must be 1.63 or greater. Teaching children evoked the highest mean score of any concept in the study and the mean score for this concept differs significantly from mean scores for all other concepts. It appears that these prospective elementary teachers are most favorably disposed towards teaching children and significantly less favorably disposed toward teaching them language arts, mathematics, science, or social studies. There are no significant differences between mean scores within any pair of the form (TCx, TCy). While the differences are not significant it is interesting to note that the prospect of teaching children science generated the highest mean attitude score of all the curriculum areas.

For each S an index of achievement in mathematics was determined by averaging grades in collegiate mathematics courses and in methods of teaching elementary school mathematics. The correlation between achievement in mathematics and attitude toward mathematics was 0.41 ($p = 0.0012$). The correlation between achievement in mathematics and attitude toward teaching children mathematics was 0.36 ($p = 0.0016$).

Conclusions and Recommendations

1. The prospective elementary teachers held positive attitudes toward teaching children, toward teaching children in each of the curriculum areas studied, and toward the academic areas themselves.

2. In all cases the group attitude toward a curriculum area is lower than the group attitude toward teaching children in that area. In only one case, social studies and teaching children social studies, is the difference significant. The difference between group attitudes toward mathematics and teaching children mathematics approached the 0.05 leve.

3. Perhaps the most surprising result obtained was that no significant differences existed among the group attitudes toward the four academic areas even though mathematics and social studies evoked somewhat lower scores than did language arts and science.

4. The extraordinarily high attitude scores for teaching children generated significant differences between it and each concept of the form teaching children x. The prospective elementary school teacher seems to romanticize the role of the teacher and to think of teaching children rather differently from teaching children something in the four major curriculum areas.

5. Both attitudes toward mathematics and teaching children mathematics were positively related to S's achievement in collegiate mathematics (including achievement in a mathematics methods course).

Comparing previous findings on attitude structures of prospective elementary teachers with these results involves some risk since the SD technique was not used in the earlier studies cited. The finding of no significant differences among attitudes toward the four academic areas studied deserves replicative testing. These data imply that the concepts mathematics, science, and teaching children in these areas elicit attitudinal responses not significantly unlike those for the concepts language arts and teaching language arts.

The Congruity Study

A congruity model for predicting semantic differential (SD) factor scores for a composite concept from the factor scores of its component concepts was developed by Osgood, Suci, and Tannenbaum (1957, p. 207). Briefly stated the congruity principle asserts that if two component concepts of measured meaning such as *teaching* and *children* are combined to form the composite concept *teaching children*, the meaning of the composite may be predicted by applying the congruity model for each dimension for the semantic space. Osgood, Suci, and Tannenbaum (1957, pp. 275-284) cite evidence to support the predictive power of their model. They report that: (1) obtained factor scores for composite concepts are consistently within the limits set by the factor scores of the components; (2) obtained factor scores deviated from the predicted scores on the average only by amounts attributable to unreliability except for Factor I, the evaluative factor; (3) obtained and predicted factor scores exhibit a high positive correlation. They concluded that semantic effects follow the expectations from the congruity principle quite closely for the average meaning of composite concepts.

This study was designed to determine whether or not the principle of congruity predicts composite concept meaning with component and composite concepts as well as *S*s from elementary education.

Methods

The *S*s were 71 seniors majoring in elementary education at Purdue University who were enrolled in a professional semester during 1966-1967. A SD consisting of 14 bipolar adjective scales was presented to each *S* for each of these five component concepts: *mathematics*, *social studies*, *science*, *language arts*, and *teaching children*. Four composite concepts *teaching children mathematics*, *teaching children social studies*, *teaching children science*, and *teaching children language arts* also were included. The order of concept and scale presentation was randomized as was the order of adjectives within scales. In-class time was used to complete the questionnaire and every *S* completed every item. Principal components factor analysis with rotation to Kaiser's (1958, 1960) criterion revealed that three factors account for 0.50 to 0.75 of the variance across scales among the nine concepts. Table 16 lists the scales for each factor.

Table 16

SD Scales Associated with Each Factor

Factor I	Factor II	Factor III
happy-sad	heavy-light	fast-slow
good-bad	hard-soft	hot-cold
heavenly-hellish	difficult-easy	
positive-negative		
optimistic-pessimistic		

The remaining four scales were discarded since they were confounded across factors.

Findings and Analysis

Obtained factor scores for each S across the nine concepts were calculated. Predicted scores for each of the four composite concepts were computed using the congruity model. Mean obtained and predicted scores over Ss are presented in Table 17.

Table 17

Mean Factor Scores for Four Composite Concepts over Ss

	Factor I		Factor II		Factor III	
	Obtained	Predicted	Obtained	Predicted	Obtained	Predicted
Teaching Children Language Arts	1.81	2.10 ($\alpha < 0.01$)	.67	.55 ($\alpha < 0.50$)	.39	.69 ($\alpha < 0.05$)
Teaching Children Mathematics	1.60	2.04 ($\alpha < 0.01$)	.78	.99 ($\alpha < 0.40$)	.32	.68 ($\alpha < 0.05$)
Teaching Children Science	1.85	2.12 ($\alpha < 0.01$)	.61	.85 ($\alpha < 0.40$)	.58	.91 ($\alpha < 0.05$)
Teaching Children Social Studies	1.60	1.99 ($\alpha < 0.01$)	.18	.49 ($\alpha < 0.20$)	.40	.66 ($\alpha < 0.10$)

An *F* test indicated lack of homogeneity of variance among the scores for composite concepts on Factors I and homogeneity among those for Factors II and III. The *Z* test was used in comparing obtained and predicted means of composite concepts for Factor I (Winer, 1962, p. 36). These means were significantly different ($\alpha < 0.01$). The *t* test was used to analyze scores for Factors II and III. None of these differences was significant at $\alpha < 0.01$. The alpha level for each difference is displayed in Table 17.

It appears that the predictive power of the congruity model is stronger with Factor II scores than with scores for Factors I and III. In fact the differences between obtained and predicted scores for Factors I and III are significant at the 0.05 level in all but one case. Moreover, the predicted scores are consistently higher than the obtained scores for Factors I and III. If a constant of about -0.3 were introduced into the prediction formula the differences between predicted and obtained scores for Factors I and III would virtually disappear. The insertion of a constant of -0.3 would decrease the predictive ability of the formula in only one case among the Factor II scores.

To obtain a different measure of the predictive validity for the congruity formula, mean component concept scores over *Ss* for each factor were calculated. These scores are displayed in Table 18.

Table 18

Obtained Mean Component Concept Scores over *Ss*

	Obtained		
	Factor I	Factor II	Factor III
Language Arts	1.70	.47	.63
Mathematics	1.30	.77	.95
Science	1.67	.68	.31
Social Studies	1.23	.35	.34
Teaching Children	2.25	.13	.69

Predicted means for the composite concepts were computed by substituting the mean scores for the component concepts into the congruity formula. Table 19 includes these predictions together with the obtained means for the composite concepts.

Table 19

Predicted and Obtained Means for Composite Concepts

	Factor I			Factor II			Factor III		
	Obtained	Predicted		Obtained	Predicted		Obtained	Predicted	
Teaching Children Language Arts	1.81	2.01	($\alpha < 0.02$)	.67	.40	($\alpha < 0.10$)	.39	.66	($\alpha < 0.01$)
Teaching Children Mathematics	1.60	1.90	($\alpha < 0.01$)	.78	.68	($\alpha < 0.50$)	.32	.84	($\alpha < 0.01$)
Teaching Children Science	1.85	2.00	($\alpha < 0.10$)	.61	.59	($\alpha < 0.50$)	.58	.57	($\alpha < 0.50$)
Teaching Children Social Studies	1.60	1.89	($\alpha < 0.01$)	.18	.29	($\alpha < 0.50$)	.40	.57	($\alpha < 0.10$)

Using *t* tests two of the differences between predicted and obtained mean scores for Factor I are significant at the 0.01 level. The alpha level for each difference is displayed in Table 19. The pattern of differences between obtained and predicted scores when the predicted scores are generated from mean scores from component concepts is quite similar to the pattern observable in Table 17. Prediction of Factor II scores is better than prediction of Factor I and III scores. In Factors I and III the predicted scores are higher than the obtained scores in all but one case. If the constant -0.3 were inserted in the congruity formula, predictions would be improved in only six out of 12 cases. Predictions would be improved in eight out of twelve cases if the constant were -0.2.

The data summarized in Tables 17-19 indicates that predictions of mean factor scores based on the congruity formula are often too high and that it may be possible to improve the predictability by adding a constant. Product-moment correlation coefficients between obtained and predicted scores over *Ss* were computed. These data, presented in Table 20, give an indication of the relationship between obtained and predicted scores which would remain invariant if a constant were added to each predicted score.

Table 20

Correlations Between Obtained and Predicted Composite Concepts over *Ss*

	Factor I	Factor II	Factor III
Teaching Children Language Arts	.676	.785	.593
Teaching Children Mathematics	.550	.587	.749
Teaching Children Science	.603	.615	.372
Teaching Children Social Studies	.505	.565	.519

Test-immediate retest reliabilities of factor scores for seventh grade *Ss* were 0.84 for Factor I, 0.72 for Factor II, and 0.69 for Factor III (DiVesta and Dick, 1966). While these coefficients might be expected to be somewhat higher for adult *S*'s, some of the correlations reported in Table 20 appear to be pushing their upper bound. All but the correlation for Factor III under *teaching children science* are respectably high.

Conclusions and Recommendations

The ability of a congruity model to predict composite concept meaning as defined by responses to a semantic differential questionnaire was examined. The component concepts, the composite concepts, and the Ss were all associated with teaching in the elementary school. There were 71 Ss in the study. Each S was enrolled in a professional semester for prospective elementary school teachers.

Two avenues of analysis were followed. First, a series of tests of differences between predicted and obtained measures of factor scores was completed. These data revealed a trend toward obtained measures being systematically lower than predicted measures. Thus, while the prediction model failed to "hit the mark", the adjustment of adding a constant, c, such that $-0.3 \leq c \leq -0.2$, to the predicted measures would have improved its marksmanship. Second, obtained and predicted factor scores were correlated to indicate their relationship independent of a systematic error such as the one described above. After accounting for the reliability of SD factor scores the correlations indicate that the congruity model does predict responses to composite concepts from responses to component concepts.

Additional research should be undertaken to confirm or revise the estimate that $-0.3 \leq c \leq -0.2$ is an optimum constant to use in revising the model for use with concepts and Ss from the field of education.

The Distance Study

The primary intent of this study was to generate a quantitative dictionary of the connotative meanings as reported by prospective elementary school teachers of the following nine concepts: language arts, mathematics, science, social studies, teaching children, and the four composite concepts of the form teaching children x. A secondary objective was to measure the similarity or dissimilarity of connotative meaning between selected pairs of concepts.

Methods

The geometric model underlying the analysis of the SD is Euclidean n-space. For the concepts, scales, and Ss studied in this series of experiments three dimensional Euclidean space seems appropriate.* On each of the three dimensions (factors) a score was calculated by averaging the scale scores for the scales of that particular factor. Each of these mean factor scores represents the distance from the origin on one of the axes for the concept being considered. Thus an ordered triple composed of mean factor scores was computed for each concept. Each ordered triple was of the form (S_I, S_{II}, S_{III}) where S_x denotes the mean factor score on the x dimension. The set of such ordered triples constitutes a quantitative dictionary of the connotative meanings of the respective concepts for the population of Ss involved. Since each number in a given ordered triple is a mean of a distribution of factor scores, the ordered triple may be thought of as the arithmetic centroid of a cloud of points in semantic space each of which denotes the connotative meaning of the concept for a particular S. By plotting the ordered triples a graphical representation of concepts' meanings is produced.

Similarity or dissimilarity of meanings between selected concepts were measured by applying the ordinary distance formula from Euclidean 3-space analytic geometry.

Findings and Analysis

Mean factor scores together with their respective standard deviations for each concept are presented in Table 21.

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* See "The Factor Analysis Study" in this Report.

Table 21

Connotative Meanings of Selected Concepts

as Defined by Locations in

Semantic Space

	I		II		III	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Language Arts	1.9	0.9	0.0	1.4	0.5	0.9
Mathematics	2.0	0.8	1.6	0.7	0.0	0.9
Science	2.0	0.9	0.7	1.3	-0.1	1.0
Social Studies	1.7	1.1	0.2	1.2	0.2	0.9
Teaching Children	2.6	0.5	0.4	1.2	0.6	0.9
Teaching Children Language Arts	2.1	0.8	0.1	1.3	0.6	0.9
Teaching Children Mathematics	2.0	0.8	0.2	1.6	0.1	1.0
Teaching Children Science	2.2	0.7	0.5	1.4	0.2	0.9
Teaching Children Social Studies	1.9	1.0	0.2	1.2	0.2	0.8

Figure 1 depicts the location of the centroids for the four academic disciplines. Figure 2 locates the centroids for the remaining five concepts, teaching children, and those of the form teaching children X.

Distances between centroids for selected pairs of concepts appear in Table 22.

Figure I

Centroids for Four Academic Disciplines

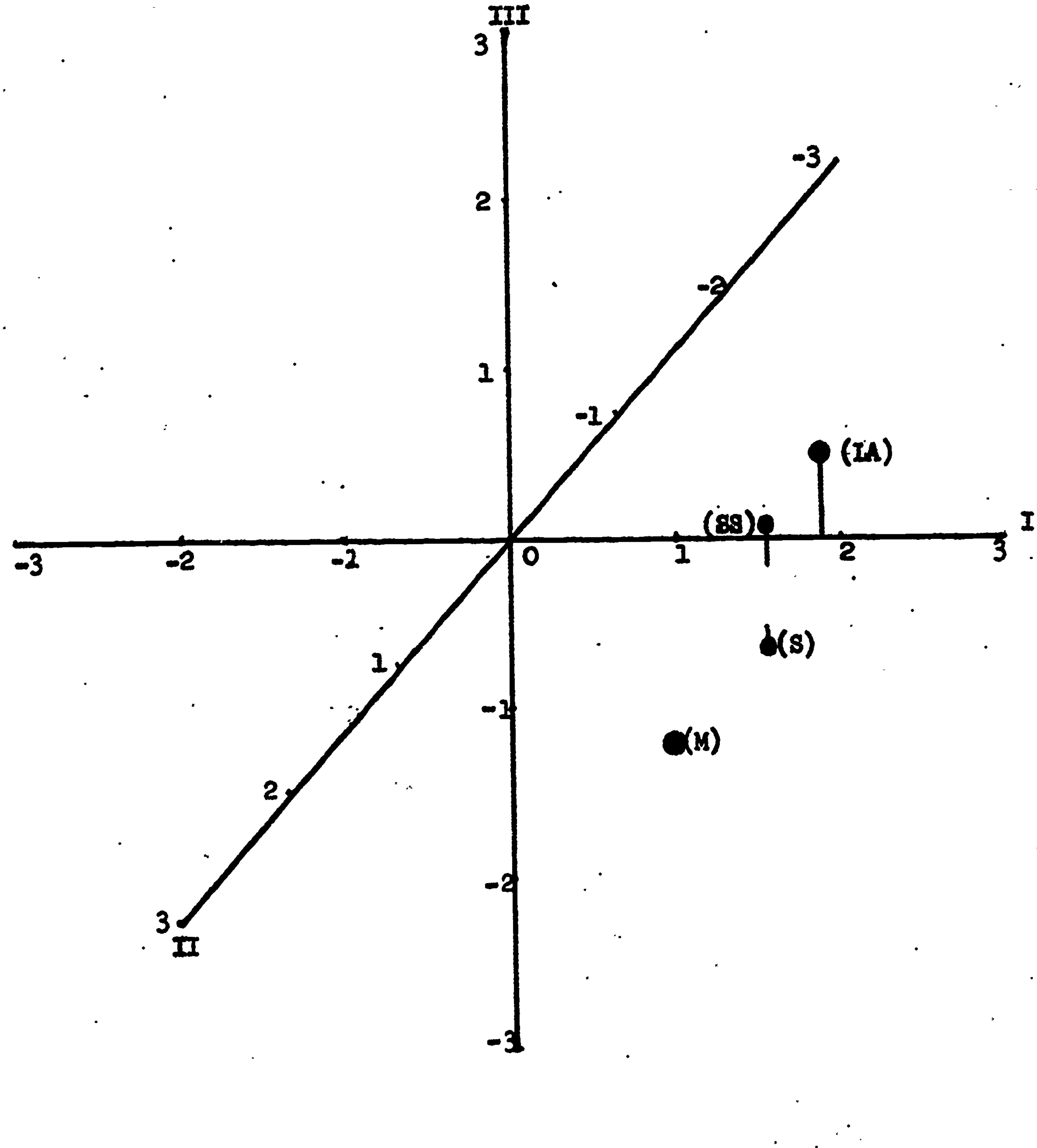

Figure 2

Centroids for Teaching Children and Four Concepts of the Form Teaching Children X

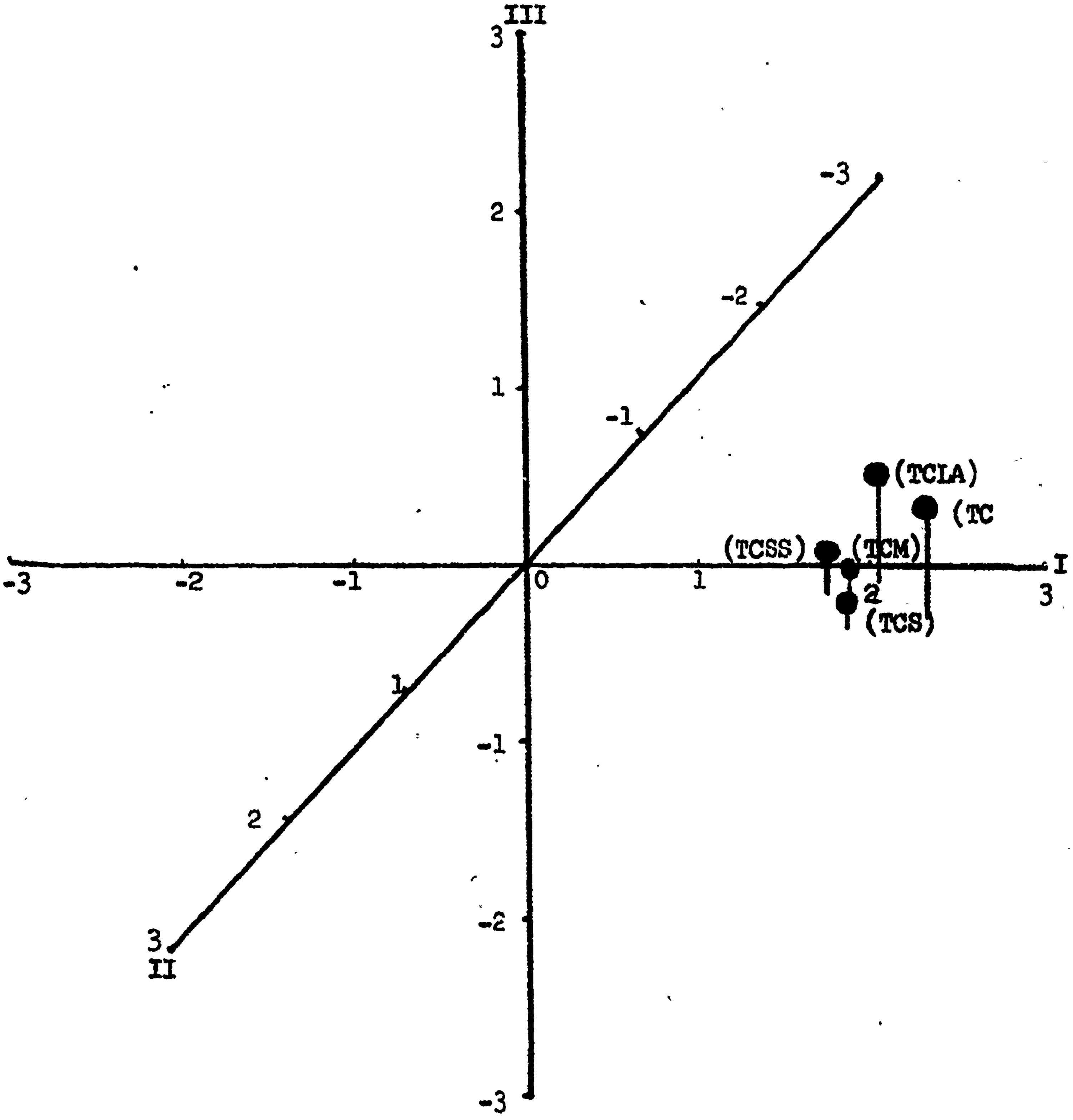

Table 22

Distances Between Selected Pairs of Concepts in Semantic Space

Concept Pair	Distance	Concept Pair	Distance
LA-M	1.7	TC-LA	0.8
LA-S	0.9	TC-TCLA	0.6
LA-SS	0.4	TC-M	1.5
M-S	1.0	TC-TCM	0.7
M-SS	1.5	TC-S	1.0
S-SS	0.6	TC-TCS	0.6
LA-TCLA	0.2	TC-SS	1.1
M-TCM	1.4	TC-TCSS	1.0
S-TCS	0.4		
SS-TCSS	0.4		

Conclusions and Recommendations

Figures 1 and 2 together with Tables 21 and 22 offer a variety of descriptive data relative to the connotative meanings of the concepts studied for the Ss used. Probably the most striking aspect of these meanings is their virtually universal presence in the first octant of semantic 3-space. Only one concept, science, is located outside octant one and then only by one-tenth of a scale unit on Factor III. The distinct difference between the concept mathematics and the other concepts on Factor II accounts for the large distances observed between mathematics and other concepts.

This method of constructing a quantitative dictionary of connotative meanings which has been utilized in a variety of studies seems to be easily applicable to educational concepts.

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Appendix

The Semantic Differential Questionnaire

The directions to S follow the suggestion of Osgood, Suci, and Tannenbaum (1957). The order of bipolar adjective scale presentation was determined in a random fashion. The order of the adjectives within a scale also was determined randomly. Four random orders of concept presentation were used. A complete SD questionnaire arranged in one of the four concept orders used is included in this appendix.

The purpose of this study is to measure the meanings of certain things to various people by having them judge them against a series of descriptive scales. In taking this test, please make your judgments on the basis of what these things mean to you. On each page of this booklet you will find a different concept to be judged and beneath it a set of scales. You are to rate the concept on each of these scales in order.

Here is how you are to use these scales:

If you feel that the concept at the top of this page is very closely related to one end of the scale, you should place your check-mark as follows:

fair__X__:_____:_____:_____:_____:_____:_____unfair

or

fair_____:_____:_____:_____:_____:_____:__X__unfair

If you feel that the concept is quite closely related to one or the other end of the scale (but not extremely), you should place your check-mark as follows:

strong_____:__X__:_____:_____:_____:_____:_____weak

or

strong_____:_____:_____:_____:_____:__X__:_____weak

If the concept seems only slightly related to one side as opposed to the other side (but is not really neutral), then you should check as follows:

active_____:_____:__X__:_____:_____:_____:_____passive

or

active_____:_____:_____:_____:__X__:_____:_____passive

The direction toward which you check, of course, depends upon which of the two ends of the scale seem most characteristic of the thing you're judging.

If you consider the concept to be neutral on the scale, both sides of the scale equally associated with the concept, or if the scale is completely irrelevant, unrelated to the concept, then you should place your check-mark in the middle space:

safe_____:_____:_____: X :_____:_____:_____dangerous

IMPORTANT: (1) Place your check-marks in the middle of spaces, not on the boundaries:

THIS NOT THIS

_____:_____:_____: X :_____X_____:_____

(2) Be sure you check every scale for every concept- do not omit any.

(3) Never put more than one check-mark on a single scale.

Sometimes you may feel as though you've had the same item before on the test. This will not be the case, so do not look back and forth through the items. Do not try to remember how you checked similar items earlier in the test. Make each item a spearate and independent judgment. Work at fairly high speed through this test. Do not worry or puzzle over individual items. It is your first impressions, the immediate "feelings" about the items, that we want. On the other hand, please do not be careless, because we want your true impressions.

E TEACHER PRAISES AND ENCOURAGES PUPILS

heavy_____:_____:_____:_____:_____:_____:_____light

sad_____:_____:_____:_____:_____:_____:_____happy

active_____:_____:_____:_____:_____:_____:_____passive

hard_____:_____:_____:_____:_____:_____:_____soft

good_____:_____:_____:_____:_____:_____:_____bad

slow_____:_____:_____:_____:_____:_____:_____fast

difficult_____:_____:_____:_____:_____:_____:_____easy

feminine_____:_____:_____:_____:_____:_____:_____masculine

heavenly_____:_____:_____:_____:_____:_____:_____hellish

cold_____:_____:_____:_____:_____:_____:_____hot

negative_____:_____:_____:_____:_____:_____:_____positive

awful_____:_____:_____:_____:_____:_____:_____nice

optimistic_____:_____:_____:_____:_____:_____:_____pessimistic

weak_____:_____:_____:_____:_____:_____:_____strong

SOCIAL STUDIES

heavy_____:_____:_____:_____:_____:_____:_____light

sad_____:_____:_____:_____:_____:_____:_____happy

active_____:_____:_____:_____:_____:_____:_____passive

hard_____:_____:_____:_____:_____:_____:_____soft

good_____:_____:_____:_____:_____:_____:_____bad

slow_____:_____:_____:_____:_____:_____:_____fast

difficult_____:_____:_____:_____:_____:_____:_____easy

feminine_____:_____:_____:_____:_____:_____:_____masculine

heavenly_____:_____:_____:_____:_____:_____:_____hellish

cold_____:_____:_____:_____:_____:_____:_____hot

negative_____:_____:_____:_____:_____:_____:_____positive

awful_____:_____:_____:_____:_____:_____:_____nice

optimistic_____:_____:_____:_____:_____:_____:_____pessimistic

weak_____:_____:_____:_____:_____:_____:_____strong

HE TEACHER EXPRESSES OR LECTURES ABOUT HER OWN IDEAS OR KNOWLEDGE

heavy ____:____:____:____:____:____:____ light

sad ____:____:____:____:____:____:____ happy

active ____:____:____:____:____:____:____ passive

hard ____:____:____:____:____:____:____ soft

good ____:____:____:____:____:____:____ bad

slow ____:____:____:____:____:____:____ fast

difficult ____:____:____:____:____:____:____ easy

feminine ____:____:____:____:____:____:____ masculine

heavenly ____:____:____:____:____:____:____ hellish

cold ____:____:____:____:____:____:____ hot

negative ____:____:____:____:____:____:____ positive

awful ____:____:____:____:____:____:____ nice

optimistic ____:____:____:____:____:____:____ pess.mistic

weak ____:____:____:____:____:____:____ strong

ACHING CHILDREN MATHEMATICS

heavy_____:_____:_____:_____:_____:_____:_____light

sad_____:_____:_____:_____:_____:_____:_____happy

active_____:_____:_____:_____:_____:_____:_____passive

hard_____:_____:_____:_____:_____:_____:_____soft

good_____:_____:_____:_____:_____:_____:_____bad

slow_____:_____:_____:_____:_____:_____:_____fast

difficult_____:_____:_____:_____:_____:_____:_____easy

feminine_____:_____:_____:_____:_____:_____:_____masculine

heavenly_____:_____:_____:_____:_____:_____:_____hellish

cold_____:_____:_____:_____:_____:_____:_____hot

negative_____:_____:_____:_____:_____:_____:_____positive

awful_____:_____:_____:_____:_____:_____:_____nice

optimistic_____:_____:_____:_____:_____:_____:_____pessimistic

weak_____:_____:_____:_____:_____:_____:_____strong

heavy_____:_____:_____:_____:_____:_____:_____light

sad_____:_____:_____:_____:_____:_____:_____happy

active_____:_____:_____:_____:_____:_____:_____passive

hard_____:_____:_____:_____:_____:_____:_____soft

good_____:_____:_____:_____:_____:_____:_____bad

slow_____:_____:_____:_____:_____:_____:_____fast

difficult_____:_____:_____:_____:_____:_____:_____easy

feminine_____:_____:_____:_____:_____:_____:_____masculine

heavenly_____:_____:_____:_____:_____:_____:_____hellish

cold_____:_____:_____:_____:_____:_____:_____hot

negative_____:_____:_____:_____:_____:_____:_____positive

awful_____:_____:_____:_____:_____:_____:_____nice

optimistic_____:_____:_____:_____:_____:_____:_____pessimistic

weak_____:_____:_____:_____:_____:_____:_____strong

HE TEACHER CRITICIZES OR DEPRECATES PUPIL BEHAVIOR WITH INTENT TO CHANGE IT

heavy_____:_____:_____:_____:_____:_____:_____light

sad_____:_____:_____:_____:_____:_____:_____happy

active_____:_____:_____:_____:_____:_____:_____passive

hard_____:_____:_____:_____:_____:_____:_____soft

good_____:_____:_____:_____:_____:_____:_____bad

slow_____:_____:_____:_____:_____:_____:_____fast

difficult_____:_____:_____:_____:_____:_____:_____easy

feminine_____:_____:_____:_____:_____:_____:_____masculine

heavenly_____:_____:_____:_____:_____:_____:_____hellish

cold_____:_____:_____:_____:_____:_____:_____hot

negative_____:_____:_____:_____:_____:_____:_____positive

awful_____:_____:_____:_____:_____:_____:_____nice

optimistic_____:_____:_____:_____:_____:_____:_____pessimistic

weak_____:_____:_____:_____:_____:_____:_____strong

E TEACHER ASKS QUESTIONS TO ORIENT PUPILS TO SCHOOL WORK

heavy_____:_____:_____:_____:_____:_____:_____light

sad_____:_____:_____:_____:_____:_____:_____happy

active_____:_____:_____:_____:_____:_____:_____passive

hard_____:_____:_____:_____:_____:_____:_____soft

good_____:_____:_____:_____:_____:_____:_____bad

slow_____:_____:_____:_____:_____:_____:_____fast

difficult_____:_____:_____:_____:_____:_____:_____easy

feminine_____:_____:_____:_____:_____:_____:_____masculine

heavenly_____:_____:_____:_____:_____:_____:_____hellish

cold_____:_____:_____:_____:_____:_____:_____hot

negative_____:_____:_____:_____:_____:_____:_____positive

awful_____:_____:_____:_____:_____:_____:_____nice

optimistic_____:_____:_____:_____:_____:_____:_____pessimistic

weak_____:_____:_____:_____:_____:_____:_____strong

E TEACHER ASKS QUESTIONS TO STIMULATE PUPIL PARTICIPATION IN DECISION-MAKING

heavy_____:_____:_____:_____:_____:_____:_____light

sad_____:_____:_____:_____:_____:_____:_____happy

active_____:_____:_____:_____:_____:_____:_____passive

hard_____:_____:_____:_____:_____:_____:_____soft

good_____:_____:_____:_____:_____:_____:_____bad

slow_____:_____:_____:_____:_____:_____:_____fast

difficult_____:_____:_____:_____:_____:_____:_____easy

feminine_____:_____:_____:_____:_____:_____:_____masculine

heavenly_____:_____:_____:_____:_____:_____:_____hellish

cold_____:_____:_____:_____:_____:_____:_____hot

negative_____:_____:_____:_____:_____:_____:_____positive

awful_____:_____:_____:_____:_____:_____:_____nice

optimistic_____:_____:_____:_____:_____:_____:_____pessimistic

weak_____:_____:_____:_____:_____:_____:_____strong

ANGUAGE ARTS

heavy_____:_____:_____:_____:_____:_____:_____light

sad_____:_____:_____:_____:_____:_____:_____happy

active_____:_____:_____:_____:_____:_____:_____passive

hard_____:_____:_____:_____:_____:_____:_____soft

good_____:_____:_____:_____:_____:_____:_____bad

slow_____:_____:_____:_____:_____:_____:_____fast

difficult_____:_____:_____:_____:_____:_____:_____easy

feminine_____:_____:_____:_____:_____:_____:_____masculine

heavenly_____:_____:_____:_____:_____:_____:_____hellish

cold_____:_____:_____:_____:_____:_____:_____hot

negative_____:_____:_____:_____:_____:_____:_____positive

awful_____:_____:_____:_____:_____:_____:_____nice

optimistic_____:_____:_____:_____:_____:_____:_____pessimistic

weak_____:_____:_____:_____:_____:_____:_____strong

heavy _____:_____:_____:_____:_____:_____:_____ light

sad _____:_____:_____:_____:_____:_____:_____ happy

active _____:_____:_____:_____:_____:_____:_____ passive

hard _____:_____:_____:_____:_____:_____:_____ soft

good _____:_____:_____:_____:_____:_____:_____ bad

slow _____:_____:_____:_____:_____:_____:_____ fast

difficult _____:_____:_____:_____:_____:_____:_____ easy

feminine _____:_____:_____:_____:_____:_____:_____ masculine

heavenly _____:_____:_____:_____:_____:_____:_____ hellish

cold _____:_____:_____:_____:_____:_____:_____ hot

negative _____:_____:_____:_____:_____:_____:_____ positive

awful _____:_____:_____:_____:_____:_____:_____ nice

optimistic _____:_____:_____:_____:_____:_____:_____ pessimistic

weak _____:_____:_____:_____:_____:_____:_____ strong

CIENCE

heavy____:____:____:____:____:____:____light

sad____:____:____:____:____:____:____happy

active____:____:____:____:____:____:____passive

hard____:____:____:____:____:____:____soft

good____:____:____:____:____:____:____bad

slow____:____:____:____:____:____:____fast

difficult____:____:____:____:____:____:____easy

feminine____:____:____:____:____:____:____masculine

heavenly____:____:____:____:____:____:____hellish

cold____:____:____:____:____:____:____hot

negative____:____:____:____:____:____:____positive

awful____:____:____:____:____:____:____nice

optimistic____:____:____:____:____:____:____pessimistic

weak____:____:____:____:____:____:____strong

ACHING CHILDREN SCIENCE

heavy ____:____:____:____:____:____:____ light

sad ____:____:____:____:____:____:____ happy

active ____:____:____:____:____:____:____ passive

hard ____:____:____:____:____:____:____ soft

good ____:____:____:____:____:____:____ bad

slow ____:____:____:____:____:____:____ fast

difficult ____:____:____:____:____:____:____ easy

feminine ____:____:____:____:____:____:____ masculine

heavenly ____:____:____:____:____:____:____ hellish

cold ____:____:____:____:____:____:____ hot

negative ____:____:____:____:____:____:____ positive

awful ____:____:____:____:____:____:____ nice

optimistic ____:____:____:____:____:____:____ pessimistic

weak ____:____:____:____:____:____:____ strong

E TEACHER ACCEPTS, CLARIFIES, AND SUPPORTS THE IDEAS AND FEELINGS OF PUPILS

heavy _____:_____:_____:_____:_____:_____:_____ light

sad _____:_____:_____:_____:_____:_____:_____ happy

active _____:_____:_____:_____:_____:_____:_____ passive

hard _____:_____:_____:_____:_____:_____:_____ soft

good _____:_____:_____:_____:_____:_____:_____ bad

slow _____:_____:_____:_____:_____:_____:_____ fast

difficult _____:_____:_____:_____:_____:_____:_____ easy

feminine _____:_____:_____:_____:_____:_____:_____ masculine

heavenly _____:_____:_____:_____:_____:_____:_____ hellish

cold _____:_____:_____:_____:_____:_____:_____ hot

negative _____:_____:_____:_____:_____:_____:_____ positive

awful _____:_____:_____:_____:_____:_____:_____ nice

optimistic _____:_____:_____:_____:_____:_____:_____ pessimistic

weak _____:_____:_____:_____:_____:_____:_____ strong heavy_____:_____:_____:_____:_____:_____:_____light

sad_____:_____:_____:_____:_____:_____:_____happy

active_____:_____:_____:_____:_____:_____:_____passive

hard_____:_____:_____:_____:_____:_____:_____soft

good_____:_____:_____:_____:_____:_____:_____bad

slow_____:_____:_____:_____:_____:_____:_____fast

difficult_____:_____:_____:_____:_____:_____:_____easy

feminine_____:_____:_____:_____:_____:_____:_____masculine

heavenly_____:_____:_____:_____:_____:_____:_____hellish

cold_____:_____:_____:_____:_____:_____:_____hot

negative_____:_____:_____:_____:_____:_____:_____positive

awful_____:_____:_____:_____:_____:_____:_____nice

optimistic_____:_____:_____:_____:_____:_____:_____pessimistic

weak_____:_____:_____:_____:_____:_____:_____strong

E TEACHER GIVES DIRECTIONS OR ORDERS

heavy ____:____:____:____:____:____:____ light

sad ____:____:____:____:____:____:____ happy

active ____:____:____:____:____:____:____ passive

hard ____:____:____:____:____:____:____ soft

good ____:____:____:____:____:____:____ bad

slow ____:____:____:____:____:____:____ fast

difficult ____:____:____:____:____:____:____ easy

feminine ____:____:____:____:____:____:____ masculine

heavenly ____:____:____:____:____:____:____ hellish

cold ____:____:____:____:____:____:____ hot

negative ____:____:____:____:____:____:____ positive

awful ____:____:____:____:____:____:____ nice

optimistic ____:____:____:____:____:____:____ pessimistic

weak ____:____:____:____:____:____:____ strong

ATHEMATICS

heavy_____:_____:_____:_____:_____:_____:_____light

sad_____:_____:_____:_____:_____:_____:_____happy

active_____:_____:_____:_____:_____:_____:_____passive

hard_____:_____:_____:_____:_____:_____:_____soft

good_____:_____:_____:_____:_____:_____:_____bad

slow_____:_____:_____:_____:_____:_____:_____fast

difficult_____:_____:_____:_____:_____:_____:_____easy

feminine_____:_____:_____:_____:_____:_____:_____masculine

heavenly_____:_____:_____:_____:_____:_____:_____hellish

cold_____:_____:_____:_____:_____:_____:_____hot

negative_____:_____:_____:_____:_____:_____:_____positive

awful_____:_____:_____:_____:_____:_____:_____nice

optimistic_____:_____:_____:_____:_____:_____:_____pessimistic

weak_____:_____:_____:_____:_____:_____:_____strong

TEACHER JUSTIFIES HIS OWN POSITION OR AUTHORITY

heavy_____:_____:_____:_____:_____:_____:_____light

sad_____:_____:_____:_____:_____:_____:_____happy

active_____:_____:_____:_____:_____:_____:_____passive

hard_____:_____:_____:_____:_____:_____:_____soft

good_____:_____:_____:_____:_____:_____:_____bad

slow_____:_____:_____:_____:_____:_____:_____fast

difficult_____:_____:_____:_____:_____:_____:_____easy

feminine_____:_____:_____:_____:_____:_____:_____masculine

heavenly_____:_____:_____:_____:_____:_____:_____hellish

cold_____:_____:_____:_____:_____:_____:_____hot

negative_____:_____:_____:_____:_____:_____:_____positive

awful_____:_____:_____:_____:_____:_____:_____nice

optimistic_____:_____:_____:_____:_____:_____:_____pessimistic

weak_____:_____:_____:_____:_____:_____:_____strong

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TITLE

Use of the Semantic Differential Technique to Measure ~~Prospective Elementary School Teacher Attitude toward~~ Mathematics and Other Subjects (Final Report)

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RETRIEVAL TERMS

Attitudes of prospective elementary teachers; Attitudes toward language arts, mathematics, science, social studies, teaching children, and teaching children in each of the above areas; Concept meaning and semantic space; congruity theory; predicting concept meaning; Semantic differential, Semantic differential factor structure with educational concepts; Semantic differential scale performance.

IDENTIFIERS

ABSTRACT

This project includes four studies. Factor analyses including orthognal rotations were performed on 34 14 X 14 correlation matrices. Each matrix stemmed from semantic differential (SD) data using 14 adjective scales. Concepts and Ss were associated with elementary education. Factor I was the evaluative dimension, Factor II was tagged as denoting intellectual or academic vigor, Factor III was an activity dimension. The polarity of the scale masculine-feminine switched from concept to concept. It seems unwise to assume an SD scale has a "known" factorial content or polarity. Each time an SD is used factor analysis should be done.

Attitudes toward four academic disciplines, together with teaching children in each field were measured by Factor I scores. Mean attitude toward each concept was higher than neutrality. No differences existed among attitudes toward the four disciplines. Teaching children evoked a higher attitude measure than any concept of the form teaching children X. Attitude toward mathematics was related to an achievement in mathematics variable.

The congruity principle was verified with these data although the prediction formula would have been improved by adding a constant between -0.3 and -0.2 scale units.

Connotative meanings and distances between concept meanings were derived under the assumption that the semantic space is Euclidean.