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AUTHOR Carifio, James; Kermis, William
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ABSTRACT

This study compared preparing science teachers' attitudes towards tests, evaluation and mathematics to those of preparing non-science teachers (N=76) in an upper division psychology course at a state college in eastern Massachusetts. These three attitudes were measured using semantic differentials that assessed both the cognitive and affective dimensions of these attitudes. Although preparing science teachers had better attitudes towards tests and mathematics than preparing non-science teachers, subject-matter area only accounted for 6% of the variance observed in these two attitudes, whereas aptitude accounted for 18% of the variance observed in these two attitudes. The variance accounted for by subject-matter area, moreover, was mostly attributable to aptitude. Preparing teachers attitude towards tests were negative in general (3.6 on a 1 to 7 scale), whereas their overall attitude towards mathematics was 4.3 and their overall attitude towards evaluation was 5.2. Tests, therefore, are a highly potent affective stimulus for preparing teachers. The mean level findings in this study were the same as our findings in our previous studies. Findings are discussed in terms of alternative theories and views of the data and the implications of these findings are discussed. (Author)

PREPARING SCIENCE TEACHERS' ATTITUDES TOWARDS TESTS

James Carifio, University of Massachusetts at Lowell
William Kermis, Southwest Oaklahoma State Univeristy

Abstract

This study compared preparing science teachers' attitudes towards tests, evalution and mathematics to those of preparing non-science teachers (N=76). These three attitudes were meaured using semantic differentials that assessed both the cognitive and affective dimensions of these attitudes.

Although preparing science teachers had better attitudes towards tests and mathematics than preparing non-science teachers, subject-matter area only accounted for 6% of the variance observed in these two attitudes, whereas aptitude accounted for 18% of the variance observed in these two attitudes. The variance accounted for by subject-matter area, moreover, was mostly attributable to aptitude.

Preparing teachers attitude towards tests were negative in general (3.6 on a 1 to 7 scale), whereas their overall attitude towards mathematics was 4.3 and their overall attitude towards evaluation was 5.2. Tests, therefore, are a highly potent affective stimulus for preparing teachers.

The mean level findings in this study were the same as our findings in our previous studies. Finding are discussed in terms of alternative theories and views of the data and the implications of these finding are discussed.

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Although lively discussions and subjective reports about teachers' and preparing teachers' atttitudes towards tests go back to before the turn of the century (see Kirland, 1971), little empirical research has been done on this topic other than a few seminal and very limited studies which collected unstructured interview data or responses to 5 or 6 Likert type opinion items about tests and the impact their uses in education (e.g., Osborne, 1933; Tyler, 1936; Noll, 1956; Mayo, 1967; Goslin, 1967; and Marsullio, 1971). As Evans (1983) has said, for a topic that that is stress so strongly by so many, and seems to concern professional educators so greatly, very little is actually known empirically, other than the general belief that teachers' and preparing teachers' attitudes towards tests and testing are in general very negative (see Mayo, 1967; Goslin, 1967; and Kirland, 1971).

One of the reasons that so little is known empirically about teachers' and preparing teachers' attitudes towards tests is the lack of appropriate instrumentation and flexible procedures for measuring these attitudes that could be used in a broad range of different research contexts and situation. Given this point, we developed, validated and then crosss-validated a 17 adjective-pair semantic differential (Osgood, 1964) for measuring teachers' attitudes towards tests (see Carifio and Kermis, 1990) that operationalized Peak's classical two factor theory of attitude (see Peak, 1955; McGuire,1968). This theory

predicates two underlying dimensions for an attitude which are (1) the cognitive (or evaluative) dimension and (2) the affective (or potency) dimension. The cognitive dimension in this view describes beliefs, opinions, and judgements, while the affective dimension describes emotions, feelings, drives, and approach-avoidance tendencies.

Instrument Development

The semantic differential development procedures we used were different from those reccomended by Osgood (1964). We followed the procedures recommended by Nunnally (1967) and Cronbach (1970) which seek to maximize the content and construct validity of the resulting scale relative to traditional theories of attitudes. Our development efforts were also guided by information processing theories of learning and behavior (Norman, 1981, Milligan, 1983).

In developing our semantic differential to measure attitudes towards tests, we used free association techniques with preparing and experienced teachers, Osgood's list of validated pairs (Snider and Osgood, 1969), and content analyses of the extant "pro and con" literature on tests and testing to generate a pool of 75 adjective pairs that were representative of attitudes towards tests. These 75 adjective pairs were the most frequently occuring pairs across all three sources (see Carifio and Kermis, 1990 for details). A panel of 3 judges then selected a set of 30 (15 congitive and 15 affective) adjective pairs from the 75 pairs

for subjects to respond to using the conventional Osgood 7 point responding format (Nunnally, 1967) and the stimulus term, "To me, tests are:". These 30 pairs were then reduced via factor analysis (N=291) to the 17 adjective-pairs in the final version scale, and the two factor structure (cognitive and affective) found for these 17 adjectives was confirmed in another sample of preparing teachers. In this sample (N=226), the cognitive factor (10 adjective pairs) accounted for 43% of the total variance and the affective factor (7 pairs) accounted for 27% of the variance. In all the two factors accounted for 70% the variance. This final semantic differential was also further validated in other ways and studies (see Carifio and Kermis, 1990).

Initial Findings

In our next study (see Carifio and Kermis, 1990), a sample of 163 preparing teachers were asked to respond to three semantic differentials. The first was the attitude towards tests semantic differential described above, the second was an attitude towards evaluation semantic differential using the same 17 adjective pairs, and the third was McCallon and Brown's (1971) attitude towards mathematics semantic differential.

In this study, preparing teachers were found to have more positive attitudes towards evaluation and mathematics (in this order) than towards tests at the .001 level of significance. No correlations were found between preparing

teachers' attitudes toward evaluation, which were positive, and their attitudes towards tests and mathematics, but moderately significant correlations were found between preparing teachers' attitudes towards tests and their attitudes towards mathematics.

In this study, high aptitude preparing teachers had significantly more positive attitudes towards mathematics and tests (in this order) that low aptitude preparing teachers, but the attitude levels of both high and low aptitude preparing teachers towards tests were in general negative, whereas for mathematics it was slightly positive. The locus of the differences observed were primarily on the affective dimensions of these two attitudes.

We have developed a tentative theory to explain the above findings and the attitude differences between high and low aptitude subjects in our data. This theory is based on House's (1966) view that aptitude is a surrogate variable for other more primary behavioral and metacognitive skills variables that are the causal variables in terms of observed differences. This essentially cognitive theory holds that "high aptitude" subjects behave in ways that are very different from "low aptitude" subjects and it is these convert behavioral differences that produce attitudinal differences between "high and low" aptitude subjects among other things. This theory will be elaborated more fully later in this paper.

The Present Study

A major question that emerged from our initial studies, and the fairly large data set we developed, was how similar the attitude towards tests of preparing science teachers were to other preparing teachers. The preliminary data we had for this question was somewhat inconclusive because we did not initially track preparing teachers by subject matter area or discipline in the early studies we did. This particular question emerged from our studies for a number of reasons.

First, several colleagues expressed the belief that our findings might be very different for preparing science teachers (as well as experienced science teachers) as objective and formal testing is a fundamental substantive component of all scientific disciplines. Consequently, people who have been socialized in the scientific tradition should in general be cognitively more positive and affectively less emotional towards tests. One's attitudes towards tests and testing, therefore, say something about one's scientific attitude and one's level of scientific socialization and acculturation.

In the main, the above view predicates that the schemas of those who have been strongly socialized in the scientific tradition should be different from the schemas of those who have not on key substantive items and issues. In the psychological literature, this view is often operationalized in terms of "expert/novice" comparisons and constrasts.

In terms of research design methodology, the above view

and position is inherently an instantiated version of Campbell and Fiske's discriminant (or key) groups design paradigm. This design paradigm essentially says that one should be able empirically to discriminate "units" that are different from each other by their behavior patterns if the units are in fact truly different.

Although we were of the opinion that there was some support and validity to the rival hypothesis and view expressed above, we believed that aptitude as a surrogate variable for generic metacognitive skills and knowledges was a stronger determining variable of a person's attitude towards tests than one's degree of socialization in the scientific tradition. The unanswered question, therefore, was really a question of which of the rival variables (and thus view) explained the most variance in the data.

Methodology

Data were collected from two classes of undergraduate education majors (N=76) in an upper division psychology course at a state college in eastern Massachusetts. Thirty four (34) of these students were preparing secondary education science teachers and 42 were preparing elementary and secondary English and social studies students. Five preparing secondary mathematics teachers were dropped from analysis for several reasons. The sample was 62% female and and 38% male. No differences between female and male attitude towards tests were found in our previous studies

(see Carifio and Kermis, 1990). At the beginning of the course, students were told that some of the data that would be collected from them in class periodically would be for research purposes and that they were required to participate in these data collections activities.

In the fourth week of the course, as an introductory exercise to a lecture on perception and memory, students were given the 17 adjective pairs semantic differential measuring attitudes towards tests followed by two "placebo" semantic differentials. The first "placebo" was an attitude towards evaluation semantic differential using the same 17 adjective pairs, and the second was McCallon and Brown's (1971) attitude towards mathematics semantic differential.

The semantic differentials administered were scored by summing responses to the cognitive items on the instrument and then dividing this simple sum score by the total number of cognitive items to put the responses on a 1 to 7 scale. This same scoring procedure was used for the affective items, and a total score for the instrument was obtained by repeating this procedures for all items on the sale. It should be noted that Richards (1972) found no significant differences between using simple sum, factor, difference, or regressed scores in the analysis of semantic differential data.

SAT scores were obtained from the college's records for the 76 student from whom complete data were obtained. The median total SAT score was used to divide the entire group

into high and low aptitude categories. The median SAT score for this group was 883. The mean SAT score was 894 with a standard deviation of 72.1.

The data were collected were analyzed in terms of the major research questions posed and the results presented here will be primarily in terms of these major research questions.

Results

The semantic differential collected were factor analyzed using principal components analyses with communalities in the diagonals and an eigen cut-off value of 1.00 to see if these the factor structures for this sample of preparing teachers were similar to those found in our previous studies. The two factor structure (cognitive and affective) found in previous studies was again found for attitudes towards tests in this sample (see Table 1) and attitude towards evaluation. The two factor structures for attitudes towards tests and evaluation accounted for 66% and 61% of the total variance respectively. The McCallon and Brown attitude towards math semantic differential again collapsed to one factor in this study (as opposed to the cognitive and affective factors found by Brown and McCallon) that accounted for 73% of the variance. Therefore, the attitudinal structures of preparing teachers in this sample were similar to those preparing teachers in our previous studies.

A point biserial correlation was computed between subject-matter area (science and non-science) and aptitude. A correlation of r=+.34 was found which means that aptitude and subject-matter area are moderately confounded in our data and this moderate confounding (correlation) will need to be taken into account in both analyzing and interpreting the data.

Table 2 presents the result of a subject matter area (science verus non-science) by aptitude (high versus low) 2x2 multivariate analysis of variance (MANOVA) on the 5 attitude scores obtained on each preparing teacher. As can be seen from Table 2, Significant main effects were found for both subject-matter area and aptitude on the affective dimension of attitude towards tests (F's of 4.3 and 8.5 respectively) and total attitude towards mathematics (F's of 6.6 and 17.4 respectively). No significant differences between preparing teachers were found on attitude towards evaluation, and preparing teachers in this sample in general had more positive attitudes towards evaluation and mathamatics (in that order) than they did towards tests (see Table 4). Preparing teachers attitude towards tests in this sample were negative in general (3.6 on a 1 to 7 scale), whereas their overall attitude towards mathematics was 4.3 and their overall attitude towards evaluation was 5.2. These mean level findings are the same as our findings in our previous studies.

Although preparing science teachers had better attitudes

towards tests and mathematics than preparing non-science teachers (see Table 4), Subject-matter area only accounted for 6% of the variance observed in these two attitudes, whereas aptitude accounted for 18% of the variance observed in these two attitudes. The variance account for by subject-matter area, moreover, is mostly attributable to aptitude as can be seen from the correlations between aptitude, subject-matter area, and attitudes towards tests, evaluation and mathematics presented in Table 3.

As may be computed from the intercorrelations given in Table 3, when the effects of aptitude are partialed out, the partial correlations observed between subject-matter area and these attitudes become insignificant (.04, .08 and .09 respectively), and the variance attributable to subject-matter area reduces from 6% to 1.7%. This same result was observed when the effects of aptitude were partialed out for preparing students attitudes towards mathematics. The effects of subject-matter area were reduced to marginal significance.

Discussion

People who have been socialized in the scientific tradition were in general only slightly more positive and affectively less emotional towards tests or mathematics. Aptitude was the variable that accounted for the greatest amount of variance in preparing teachers attitudes towards tests and mathematics. Overall, "aptitude" account for 17%

of preparing teachers' attitudes towards tests and mathematics which is a large of variance to be account for by a single variable.

As the mean levels and correlations observed in this study were the same as those that were observed in our previous studies, our original contention that "aptitude" is a more primary (causal) variable than "subject-matter," scientific (or other forms) of socialization is directly supported in the present study for (undergraduate) preparing teachers. It should be clearly noted, howerver that this finding might not hold for experienced science teachers, or people who have been more highly socialized in the scientific tradition that the preparing science teachers in the present study. Only further research can answer this particular question.

Our contention that that "aptitude" is a surrogate variable for other more primary behavioral and metacognitive skills that are the causal variables in terms of observed differences in attitudes is once again indirectly supported in the present study. The details of this view and cogntive theory of attitude as well its implications for instruction and remediation approaches are outlined more fully in our previous work (Carifio and Kermis, 1990), and the reader is referred to this work for a fuller explication of this view and the "good news" it contains. The point here is that

there is "bad news," and the bad news is that tests are currently a highly potent affective stimulus for preparing teachers (and most likely many, many others), and this is not a condition that can just be accepted as a fact and passively ignored, or we are going to be in extremely serious trouble competitively, and in terms of the world economy and global competition.

There is a developmental, adjustment, and very hard reality factor in tests and testing that simply must be addressed and faced across the board concerning teachers' "attitudes towards tests" and "comfortableness with tests and the testing situation" that simply cannot be passively ignored, if we really wish to be creatively and dynamically competitive in a healthy, constructive, and balanced way. Given the current state of affairs, and the rapidly emerging broad-based emphasis on international, national, and state level tests and testing programs, it would seem that empirically and systematically assessing, understanding and addressing teachers' and preparing teachers' attitudes toward tests might be quite helpful and beneficial to improving the state of American education and the performance of our students.

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Table 1: Factor Structure for the Attitude Towards Tests Semantic Differential (N=76)

ADJECTIVE PAIR	I	II	h2
meaningful: meaningless	.78	.36	.72
concealing: revealing	.74	.30	.65
necessary: unnecessary	.84	.18	.70
useful: useless	.82	.31	.81
oppressive: liberating	.38	.67	.59
effective: ineffective	.78	.37	.74
boring: interesting	.24	.70	.52
beneficial: harmful	.70	.36	.63
frustrating: stimulating	.23	.77	.64
valuable: worthless	.81	.27	.76
pleasant: unpleasant	.25	.79	.66
sinister: intriguing	.23	.75	.52
important: unimportant	.81	.23	.72
repugnant: likable	.21	.82	.70
needed: unneeded	.75	.29	.67
helpful: unhelpful	.72	.38	.6[illegible]
satisfying: unsatisfying	.48	.57	.57
N = 76 Variance	40%	28%	68%

I = Cognitive Dimension II = Affective Dimension

Table 2: F-Ratio Matrix for a Subject-Matter Area (SMA) by Aptitude Level (APT) MANOVA on Attitude Towards Tests, Evaluation and Mathmetics (N=76).

Variable	SMA	APT	SMA x APT
CDAT	2.5	2.6	0.4
ADAT	4.3*	8.5**	1.5
CDAE	1.1	0.6	0.7
ADAE	0.3	1.6	1.1
TAM	6.6*	17.4***	0.6
Mult-F (df=8,68)	2.52*	12.6***	0.8

*=p<.05 **=p<.01 ***=p<.001

KEY:

CDAT = cognitive dimension attitude towards tests
ADAT = affective dimension attitude towards tests
CDAE = cognitive dimension attitude towards evaluation
ADAE = affective dimension attitude towards evaluation
TAM = Total attitude towards mathematics

Table 3: Intercorrelations Between Aptitude, Subject-Matter Area, and Attitudes Towards Tests, Evaluation And Mathematics (N=76)

	SMA	CDATT	ADATT	TATT	CDATM	ADATM	TATM
APT	.34**	.11	.30**	.21*	.39**	.55**	.42*
SMA	1.0	.16	.20*	.18	.19	.29*	.26*
CDATT		1.0	.57**	.93**	.41**	.10	.33**
ADATT			1.0	.89**	.15	.42**	.30**
TATT				1.0	.23*	.29*	.32**
CDATM					1.0	.67**	.93**
TATM						1.0	.91**
CDATE	.06	.02	.06	.04	.02	-.03	.06
ADATE	.03	.06	.13	.02	-.06	.15	.12
TATE	.04	.11	.02	.07	.03	.09	.05

*=P<.05 **=P<.01

Table 4: Mean Response Levels for Total Attitude Towards Tests, Evaluation and Mathematics by Subject-Matter Area and Attitude Level(N=76).

Total Attitude Towards Tests

	Subject-Matter Area: Science			Non-Science		
	n	Mean	SD	n	Mean	SD
High Aptitude	25	4.2	1.1	15	3.8	0.9
Low Aptitude	13	3.4	1.2	23	3.1	0.7

Total Attitude Towards Evaluation

	Subject-Matter Area: Science			Non-Science		
	n	Mean	SD	n	Mean	SD
High Aptitude	25	5.1	0.6	15	5.2	0.7
Low Aptitude	13	5.2	0.5	23	5.3	0.4

Total Attitude Towards Mathematics

	Subject-Matter Area: Science			Non-Science		
	n	Mean	SD	n	Mean	SD
High Aptitude	25	4.9	0.8	15	4.4	0.7
Low Aptitude	13	4.2	0.9	23	3.7	0.5