

THE EFFECTIVENESS OF MODELING AND CONCEPT-LEARNING PROCEDURES IN TEACHING CHILDREN TO INDICATE UNCERTAINTY

JOAN E. SIEBER SUPPES, MARILYN EPSTEIN AND CHARLES PETTY
Stanford University

It has been observed that elementary school children tend not to identify problematic situations or to indicate uncertainty about such situations. To test two methods of teaching fifth-grade children to acknowledge warranted uncertainty, 32 boys and girls were divided into four groups. Group I received no training; Group II (concept learning) was taught to give examples of various types of problematic situations; Group III (observers of rewarded model) observed a well-liked student express warranted uncertainty about problematic issues in a class discussion, and receive praise for this behaviour; Group IV received both of the above treatments. In subsequent group discussions, students in Groups III and IV more frequently expressed warranted uncertainty than students in Groups I and II. On a written test, students in Groups II and IV (concept learners) indicated uncertainty more frequently in group discussions, and were better able to discriminate between problematic and nonproblematic statements than subjects in Groups I or III. A delayed posttest indicated that the skills learned in Groups II and IV were fully retained three weeks later. Results indicate that concept learning is required for accurate discrimination of problematic statements, but that norm learning is required for public expression of warranted uncertainty; there was no significant transfer of norm learning to written performance, or of concept learning to group behaviour. The data also show that children who are not trained to express warranted uncertainty tend to regard statements that seem not necessarily true as false, rather than as problematic.

Suppose that a child were involved in a situation that was partially familiar to him. How would he respond if shown or asked about some aspect of the situation that he could not explain? Studies indicate that middle class children and adults whose uncertainty is aroused in this way spend more time inspecting the situation (12, 13), ask more questions (5), learn more (3, 4, 11, 10), remember more (5), indicate that they wish to know more (4), and develop more higher-order concepts (6, 16) about the situation than individuals who are exposed to a comparable situation but whose uncertainty is not aroused. (Uncertainty, as the word is used here, refers to the state of having either no response or various plausible responses to a situation that one wishes to understand. Uncertainty about some matter does not mean total ignorance or evasion of it.)

What happens to a person when he becomes uncertain, and why may uncertainty lead to inquiry, learning and productive thinking? Uncertainty leads to a state of psychological and physiological disturbance. The uncertain individual feels in conflict about what he is to believe or do. Also, there is usually an increase in his heart rate (9), level of perspiration and muscle tension (3). These and other physiological changes are believed to produce increased vigilance and perceptiveness (3). Berlyne (3) has postulated that persons naturally seek to reduce such psychological and physiological disturbances by reducing their uncertainty. He argues that since the physiological concomitant of uncertainty facilitates information acquisition, persons who are given an opportunity to develop their innate exploratory tendencies may learn to reduce uncertainty by acquiring and processing relevant new information. There are, of course, other ways of reducing uncertainty and its accompanying disturbances. These include ignoring the problem, rationalizing one of its hypothetical solutions on insufficient grounds (3, 15, 8, 7), or failing to recognize that a relevant problem exists at all (14). Obviously, less productive thinking occurs if these latter ways of reducing uncertainty are used.

Most persons would probably agree that it is good pedagogy to create warranted uncertainty in students and then to help them obtain and organize the information they need in order to gain understanding. However, it is well known that few teachers provide such experience. For example, Bellack, Kliebard, Hyman, and Smith (1) observed that there is little questioning or expression of uncertainty by pupils or teachers in the classroom. The most common interaction pattern was one in which teachers asked questions to which students gave simple, factual answers. Teachers asked 80 per cent of all the questions, and of all teachers' questions only 19 per cent required students to give an explanation. Sixty-five per cent of all student responses were in the form of simple answers.

Now, since teachers rarely try to arouse uncertainty, it becomes especially important to inquire what students do when they encounter problematic situations. One may readily observe that students are frequently involved in social and academic matters that are problematic (e.g., how to deal with an injustice among students, or how to determine the difference between living and nonliving things). In such situations do they naturally experience uncertainty and engage in inquiry without assistance from the teacher? According to Bellack *et al.* (1) students show little spontaneous verbal indication of uncertainty. Ziller and Long (17) administered to 327 children in grades 2 to 7 a scale containing 30 state-

ments, none of which were known to be true or false, e.g., 'There is life on other planets.' For each item, the children were instructed to respond by circling 'yes,' 'no,' or 'don't know.' Most of the children answered at least 65 per cent of the items 'yes,' or 'no,' rather than 'don't know.' Sieber (15) observed that, when questioned orally about problematic matters, sixth graders offered many answers, but in no case indicated that they did not know. These data indicate that unassisted students usually do not recognize problematic situations as such.

This raises two related questions. Why do students respond with certainty when it is inappropriate to do so? And how can they be taught to identify and investigate problematic situations that they encounter? We have, as yet, little understanding of the cognitive processes involved in discriminating between problematic and nonproblematic situations. However, without being too specific about the nature of such processes, we may still ask why students fail to engage in them. One plausible explanation is that students fail to express warranted uncertainty because they have inadequate concepts of certainty and uncertainty. Given the infrequency of classroom discussions about problematic matters, students may have little opportunity to identify exemplars of problematic and nonproblematic statements. If this is the case, then expression of uncertainty and correct discrimination between nonproblematic and problematic statements should increase if concepts of certainty and uncertainty are learned. An alternative explanation is that concepts of uncertainty are rather well understood by students but that warranted uncertainty is rarely expressed in the classroom because it is socially unrewarding to do so. If this is the case, then expression of uncertainty and discrimination between nonproblematic and problematic situations should increase if students observe that such responses are socially rewarded. A third explanation is that both social motivation to express uncertainty and clear concepts of certainty and uncertainty are lacking in most students. Hence, relevant concept learning and social reward for expression of warranted uncertainty are complementary forms of training having additive effects in facilitating the expression of uncertainty and improving discrimination between problematic and nonproblematic situations.

The purpose of the present study was to evaluate the relative effectiveness of modeling and concept learning procedures as means of teaching fifth-grade students to discriminate between nonproblematic and five types of problematic questions in a written test, and to express uncertainty in a group discussion. Three experimental conditions were utilized. In Condition II, subjects were taught to give exemplars of each type of

problematic question In Condition III, subjects observed a well-liked student who modeled correct identification of problematic questions and was socially reinforced for this by the experimenter In Condition IV, subjects received both of the above treatments Subjects in Condition I, the control condition, received no training It was predicted that subjects in Conditions II, III, and IV, would more readily indicate uncertainty in a group discussion, and would more frequently express uncertainty and correctly discriminate between problematic and nonproblematic statements on a written test than control subjects Further, it was hypothesized that concept learning (Condition II) would facilitate written performance more than modeling (Condition III), that modeling would facilitate expression of uncertainty in a group discussion more than concept learning, and that students in Condition IV would perform better in both a group discussion and a written test than subjects in Conditions I, II, and III

METHOD

Subjects

Subjects were 16 boys and 16 girls ranging from middle to lower-middle class, attending fifth grade at a public elementary school in the Bay Area of California Their mean IQ, as measured by the California Test of Mental Maturity (CTMM) was 103.0, and the standard deviation was 12.7 These pupils were assigned to a control group and three experimental groups as follows All students from two fifth-grade classrooms were divided according to sex Students of each sex were then ranked according to IQ One of the four most capable boys and one of the four most capable girls were then randomly assigned to each of the four groups, followed by the next four of each sex, etc., until there were four boys and four girls assigned to each of the four groups

Procedure

The experimenters were introduced to the pupils by their teachers It was explained that the experimenters were Stanford students who would serve temporarily as teacher aides and would teach some interesting new things The experimenters spent two afternoons in the classrooms completing scheduling arrangements with the teachers and becoming acquainted with the pupils

The main aim of Condition II was to teach pupils to discriminate between the following six kinds of questions, the first of which is non-problematic, and the rest of which are problematic

(i) Questions that are not problematic to the person to whom they are addressed E g , What is your name? What is the name of your school? Who is your best friend?

(ii) Questions concerning things the respondent doesn't know, but someone else does E g , How old am I? How tall is the school flagpole? Who lives two blocks from here in the third house from the corner?

(iii) Questions concerning things no one knows, but for which there presently exist ways that one could discover the answer E g , How many leaves are on that tree? How many words are in today's paper? What kind of birds are nesting in this tree?

(iv) Questions concerning things no one knows, and for which no one knows how to discover the answer at this time E g , What is a sure cure for a common cold? How many stars are there in the sky? How many kinds of living things are there on the South Pole?

(v) Questions requiring answers that are value judgments and are therefore not necessarily true answers for all persons E g , What is the best tasting food in the world? Is summer or winter the nicest time of the year? What kind of person should one choose as a friend?

(vi) Questions concerning events that have not yet occurred, thus requiring answers that no one can presently give with total accuracy E g , When will the first man land on Saturn? What will we be doing this time next year? How tall will you be when you are fully grown?

Subjects in Condition II were taken individually by the experimenter to a pleasant place on the playground After establishing rapport, the experimenter said, 'We want to teach you and the rest of your class how to tell the difference between types of questions you can answer correctly and types of questions to which you can't be sure of the answer There are a lot of things no one knows very much about Also, some people know some things other people don't know Can you ask me a question that you can answer but I can't?' Whether or not the subject answered satisfactorily, the experimenter asked him two questions which the experimenter could answer but the subject could not The subject was then requested to ask a question he could answer but the experimenter could not The subject was coached until he could ask at least one such question

The subject was then told, 'There are other kinds of questions to which no one knows the answer but we could figure out a way to find the answers' Since this and the subsequent questions are more difficult than the initial question, the experimenter first gave an example of one such question, before asking the subject if he could generate such a question Whether or not the subject answered satisfactorily, the experimenter

asked two more questions of the same kind and explained how they were the same. The subject was then asked to give another example of the kind of question and was coached until he could give at least one such example. Identical procedures were used to teach each of the rest of the concepts.

Although the experimenters generally followed the above procedure, the details of each training session varied somewhat according to the ability and interest of the subject. The training criterion was reached when each subject was able to give at least one example of each of the five kinds of questions.

For Condition III, a bright, well-liked girl was chosen to serve as the model. She was trained as in Condition I and was then also trained to give the appropriate answers to 18 questions about a short film. The questions about the film included three of each of the six kinds of questions used in Condition I. The film was about a restaurant, some examples of the questions are 'What is the waiter going to do?' 'How many square feet of cloth are there in that tablecloth?' Subjects in Condition III and the model were then, as a group, shown the film. During the viewing, the film was stopped at various points and the experimenter asked the 18 questions. For each question, three subjects were called on to answer in a predetermined random order. If one or more of the three respondents answered the question with some appropriate indication of uncertainty, the next question was raised. Otherwise, the model was called on and reinforced for the appropriate response. The experimenter reinforced all instances of appropriate uncertainty but was not critical of other kinds of responses. This procedure continued until all 18 questions had been answered.

In Condition IV, subjects first received individual training identical to that given in Condition II. They then received group training identical to that given in Condition III.

Subjects in Condition I, the Control Condition, were chatted with individually by the experimenters and were shown the same movie that was shown in Condition III. They received no specific training, however.

About two hours after the training had been administered, subjects were again divided into the four groups. Each group was shown a film (that was different from the film shown during the training of groups III and IV). Subjects were asked 15 questions concerning the film. The questions included three of each of the five kinds of problematic questions listed above. Three subjects were called on (again in a predetermined random order) to respond to each question. The experimenter was equally cordial.

and encouraging to each respondent. Responses were recorded and later tabulated according to whether uncertainty had been expressed.

On the following day, subjects from all four conditions were gathered into one group. They were told they would see a film about an Egyptian boy and his camel and would then be asked to answer a questionnaire about the film. The questionnaire was handed out (A copy of the questionnaire is found in Appendix 1.) The questionnaire was preceded by directions including examples and explanations of the kinds of problematic and nonproblematic statements that appear on the questionnaire. These directions and explanations were carefully reviewed with the group. Students were then urged to read the questionnaire before viewing the film. The questionnaire consisted of 21 questions, three each of the five kinds of problematic statements, three false, and three true statements.

To test retention of whatever learning had resulted from the training, delayed posttests were planned. Due to conflicts with the school's schedule, a delayed posttest of group discussion behaviour was not possible. However, three weeks after the first written posttest, a different film was shown to all subjects and a similar written questionnaire about that film was administered.

From each questionnaire the following data were obtained: (a) the number of 'don't know' responses given, (b) the number of 'don't know' responses that were correct, i.e., that were given to a problematic question and were accompanied by a correct reason for not knowing, and (c) the number of problematic statements that were answered 'true,' or 'false.'

RESULTS

Tendency to indicate uncertainty in the posttraining group discussion varied with training, as predicted, but not all of the predicted differences were significant. As shown in Table 1, subjects who had observed a model receive praise for expressing warranted uncertainty in a group discussion expressed uncertainty more frequently in a subsequent group discussion than control subjects who had not observed the model ($\chi^2=13.27$, $df=1$, $p<.001$). Subjects who had received only individual concept training expressed uncertainty in the subsequent discussion insignificantly more often than control subjects, moreover, they expressed uncertainty significantly less often than subjects who had observed a model ($\chi^2=4.44$, $df=1$, $p<.05$). Subjects in Condition IV who had both received concept training and observed a model, performed about the same as subjects who had only observed a model.

TABLE 1
NUMBER OF RESPONSES IN WHICH UNCERTAINTY
WAS EXPRESSED IN GROUP DISCUSSIONS

Condition	Number of Responses in Which Uncertainty Was Expressed
I Control	10 ^a
II Concept training	17 ^a
III Modeling	27 ^b
IV Concept training and modeling	29 ^b

Note Cells with common superscripts are not significantly different at the .05 level

We turn now to the three measures of performance on the first written posttest. As predicted, on all three measures of performance, the most learning was evinced by subjects in Condition IV followed by subjects in Conditions II, III and I, in that order. Kruskal-Wallis one-way analyses of variance indicated that not all of these differences were significant, however. As Table 2 indicated, significantly fewer 'don't know' responses were given by subjects in Condition I than by subjects in Condition II ($\chi^2=3.86$, $df=1$, $p < .05$) or Condition IV ($\chi^2=4.27$, $df=1$, $p < .05$) but Conditions I and III did not differ significantly. With regard to the correctness of 'don't know' responses, we note that control subjects were significantly less often correct than subjects who had received concept training.

TABLE 2
MEANS FOR THREE MEASURES OF PERFORMANCE ON
FIRST WRITTEN POSTTEST

Measures	Condition				Means for All Training Conditions (N=22)
	I Control (N=7)	II Concept Training (N=8)	III Training by Model (N=7)	IV Combined Training (N=7)	
Don't know' responses	11.28 ^a	13.75 ^b	12.71 ^{ab}	14.86 ^b	13.77 ^b
Correct don't know' responses	6.43 ^a	9.00 ^b	7.85 ^{ab}	9.57 ^b	8.81 ^{ab}
Problematic statements answered 'true' or 'false'	4.43 ^a	1.63 ^b	2.57 ^{ab}	0.86 ^b	1.69 ^b

Note Within each row, cells with common superscripts are not significant at the .05 level

(for Condition I, $\chi^2=3.94, df=1, p<.05$; for Condition III, $\chi^2=4.28, df=1, p<.05$), but did not differ significantly from subjects in Condition II. Finally, subjects who had received concept training gave significantly fewer 'true' or 'false' responses to problematic statements than control subjects (comparing Condition I and II, $\chi^2=4.46, df=1, p<.05$, and comparing Condition I and IV, $\chi^2=8.52, df=1, p<.01$).

As indicated in Table 3, the observed differences between groups on the delayed written posttest paralleled almost exactly the differences that were

TABLE 3
MEANS FOR THREE MEASURES OF PERFORMANCE
ON DELAYED WRITTEN POSTTEST

Measures	Condition				Means for All Training Conditions (N=18)
	I Control (N=6)	II Concept Training (N=7)	III Training by Model (N=5)	IV Combined Training (N=6)	
'Don't know' responses	12.83 ^a	15.14 ^b	14.40 ^{ab}	14.80 ^b	14.78 ^b
Correct 'don't know' responses	6.33 ^a	9.86 ^b	9.40 ^{ab}	8.00 ^{ab}	9.09 ^{ab}
Problematic statements answered 'true' or 'false'	2.50 ^a	0.71 ^b	1.20 ^{ab}	1.00 ^b	0.97 ^b

Note: Within each row, cells with common superscripts are not significant at the .05 level.

observed in the first written posttest: control subjects gave fewer 'don't know' responses than subjects in Condition II ($\chi^2=6.17, df=1, p<.02$) or Condition IV ($\chi^2=7.24, df=1, p<.01$), but did not give significantly fewer 'don't know' responses than subjects in Condition III. However, only subjects in Condition II gave significantly more correct 'don't know' responses than control subjects ($\chi^2=6.17, df=1, p<.02$). Finally, the number of problematic statements answered 'true' and 'false' by control subjects was significantly greater than the number of such responses given by subjects in Condition II ($\chi^2=5.31, df=1, p<.05$) or Condition IV

($\chi^2=7.73$, $df=1$, $p < 01$), but did not differ significantly from the number of such responses given by subjects in Condition III

DISCUSSION

The results generally support our thesis that the expression of uncertainty by school children is influenced by observing that expression of uncertainty will be socially rewarded, and by understanding concepts of certainty and uncertainty. Subjects who had observed a model receiving praise for public expression of uncertainty expressed uncertainty during group discussion more frequently than control subjects who had not observed such a model. And, subjects who had been taught to discriminate between nonproblematic and five types of problematic statements more correctly discriminated between such statements and more frequently expressed uncertainty on a written test than subjects who had not learned these discriminations. What was surprising, however, was that there was no significant degree of transfer from social-norm learning (Condition III) to performance on the written test, nor from concept learning (Condition II) to performance in group discussions. These data imply that correct understanding of problematic matters does not necessarily predispose one to express uncertainty in group discussions. Likewise, knowledge that the expression of uncertainty is socially rewarded may increase neither the frequency nor the accuracy with which uncertainty is expressed privately in writing. Since the methods of teaching the norm of expressing uncertainty (Condition III) and the method of teaching concepts of certainty and uncertainty (Condition II) are not mutually exclusive (e.g., modeling included some discussion of the concepts of uncertainty, and concept training involved some reinforcement for expression of uncertainty), it would not have been surprising if Condition III training (modeling) had improved written performance and Condition I training (concept learning) had increased expression of uncertainty in group discussions.

We can only speculate as to why transfer did not occur. One hypothesis is that the skills required for successful transfer were not learned. In the case of Condition III subjects, perhaps all that was learned was that it was desirable to express uncertainty when at all in doubt in group discussions. They probably did not learn to make the distinctions that were explicitly taught in Condition II. Condition II subjects learned to discriminate between types of problematic issues in group discussions, students' responses in the group discussions were too incomplete to be

coded reliably according to the categories used by the model or in the written posttests. In the case of Condition II, subjects' transfer of the newly learned concept to the group discussion may have failed to occur because these subjects felt too unsure of their new knowledge to risk applying it before their peers. Indeed, Condition II subjects had good reason to doubt their new ability, they attained only 71 per cent and 77 per cent accuracy on the two respective posttests. However, whether transfer would have occurred if training had been more thorough remains an empirical question.

We have conjectured that subjects in Condition II learned, albeit imperfectly, some concepts about types of problematic statements and that subjects in Condition III learned to indicate uncertainty in group discussions when in doubt. An interesting question that remains is, how did they formerly regard problematic and nonproblematic statements?

To pursue this question, the first posttest data from Conditions I, II, and III were cast into confusion matrices which are shown in Table 4. Although data are too thin to permit elaborate analyses, some things are readily apparent: (i) Subjects in all three groups quite accurately identified true and false statements; (ii) Control subjects tended to consider untrue statements as false. A χ^2 test comparing the number of correct and incorrect 'false' responses by subjects in the control and concept training conditions indicated that groups differed significantly in this respect ($\chi^2=8.34$, $df=1$, $p=<0.01$); (iii) Trained subjects, especially Condition II subjects, were generally more willing to indicate uncertainty, and more accurate in doing so (cf. Table 2). Apparently, untrained subjects tend strongly to consider apparently true statements as true, and any other statements as false, while subjects who have been trained to categorize some statements as problematic are likely to test statements that are not obviously true against this third category.

We may conclude that, given the norms and training that prevail in most classrooms, specific training is required to enable pupils to develop warranted uncertainty, or, to use Bruner's terminology, 'problem-finding skills'. Modeling and concept training were effective enough to warrant their further use in the classroom. It would seem especially useful to develop for each curriculum area written tests similar in format to the written subtests used in this experiment. In some preliminary attempts to use such tests, teachers have found them stimulating to students. Devising such tests, however, is difficult, it forces teachers to sharpen their awareness of problematic matters. Parenthetically, we may hope that teachers who develop skill in writing tests like the ones used here (hence, skill in

TABLE 4
Types of Correct and Incorrect Responses Made by Subjects in Conditions I, II, and III on the First Posttest

Condition	Response Category Used by Subject	Correct Responses					Number of Responses by Category Used	Number of Errors by Category Used	Number of Correct by Category Responses			
		T		Don't Know								
		F	1	2	3	4						
I Control Group (N=7)	DK 5	0	0	0	1	1	0	8	8			
	DK 4	0	0	2	3	1	5	0	5			
	DK 3	2	0	1	1	9	2	1	9			
	DK 2	1	0	1	12	1	2	2	12			
	DK 1	0	2	6	3	3	2	4	6			
	False	0	19	9	2	4	9	3	19			
	True	18	0	3	0	2	1	1	18			

TABLE 4 (Continued)
Types of Correct and Incorrect Responses Made by Subjects in Conditions I, II, and III on the First Posttest

Condition	Response Category Used by Subject	Correct Responses					Number of Responses by Category Used	Number of Errors by Category Used	Number of Correct by Category Responses
		T	F	Don't Know	1	2			
II Concept Training (N=8)	DK 5	0	0	0	0	0	2	16	16
	DK 4	1	0	0	0	3	13	1	13
	DK 3	0	1	1	5	14	2	4	14
	DK 2	0	1	8	17	2	3	1	17
	DK 1	0	0	12	1	1	0	1	12
	False	1	22	0	1	2	3	1	22
	True	23	0	6	0	0	0	0	23

168

51

117

TABLE 4 (Continued)
Types of Correct and Incorrect Responses Made by Subjects in Conditions I, II, and III on the First Posttest

Condition	Response Category Used by Subject	Correct Responses					Number of Responses by Category Used	Number of Errors by Category Used	Number of Correct by Category Responses		
		T	F	Don't Know							
		1	2	3	4	5					
III Modeling (N=7)	DK 5	0	0	1	0	0	0	7	8	1	7
	DK 4	0	0	0	1	1	12	0	14	2	12
	DK 3	0	1	0	4	14	3	1	23	9	14
	DK 2	0	1	5	10	0	2	1	19	9	10
	DK 1	0	0	13	4	2	0	6	25	12	13
	False	1	19	2	1	3	3	4	33	14	19
	True	20	0	1	0	1	1	2	25	5	20

discriminating between nonproblematic and types of problematic situations) will also use those skills in classroom discussions of problematic matters. The teacher, rather than a well-rehearsed pupil, could serve as the initial model. He could express warranted uncertainty in class discussions and reinforce all pupils who did likewise.

But when such techniques as modeling and concept learning have been employed, and the expression of uncertainty becomes more frequent, what else happens? Do students learn more? Do habits of inquiry develop? How do teachers adapt to the new patterns of discussion? These complex and challenging problems remain for teachers and educational researchers to explore.

REFERENCES

- 1 BELLACK, A A, KLIBARD, H M, HYMAN, T R, and SMITH, F L *The language of the classroom* New York Teachers College Press, Columbia University, 1966
- 2 BERLYNE, D E Conditions of prequestioning and retention of meaningful material *Journal of Educational Psychology* 1966, 57, 128-132
- 3 BERLYNE, D E *Conflict, arousal and curiosity* New York McGraw-Hill, 1960
- 4 BERLYNE, D E An experimental study of human curiosity *British Journal of Psychology*, 1954, 45, 256-265
- 5 BERLYNE, D E, and FROMMER, F D Some determinants of the incidence of children's questions *Child Development*, 1966, 37, 177-189
- 6 BRUNER, J On the conservation of liquids In Bruner, J S, Olver, R R, and Greenfield, P M (Eds), *Studies in cognitive growth* New York Wiley, 1967 Pp 183-207
- 7 CALLOWAY, S, and DEMBO, D Narrowed attention *A M A Archives of Neurological Psychiatry*, 1958, 79, 74-90
- 8 JONES, A The efficiency of utilization of visual information and the effects of stress *Journal of Experimental Psychology*, 1959, 58, 428-432
- 9 LACEY, J I, KAGAN, J, LACEY, B C, and MOSS, H A The visceral level: Situational determinants and behavioral correlates of autonomic response patterns In Knapp, P H (Ed), *Expression of the emotions of man* New York International Universities Press, 1963
- 10 PARADOWSKI, W Effect of curiosity on incidental learning *Journal of Educational Psychology*, 1967, 58, 50-55
- 11 ROTHKOPF, E Z Learning from written instructive material An exploration of the control of inspection behavior by test like events *American Educational Research Journal*, 1966, 3, 241-250
- 12 ROTHKOPF, E Z Textual constraint as a function of repeated inspection *Journal of Educational Psychology*, 1968, 59, 20-25
- 13 ROTHKOPF, E Z, and BISBICOS, E E Selective facilitative effects of interspersed questions on learning from written materials *Journal of Educational Psychology*, 1967, 58, 56-61
- 14 SIEBER, J E Problem-solving behavior of teachers as a function of conceptual structure *Journal of Research in Science Teaching*, 1964, 2, 64-69
- 15 SIEBER, J E Lessons in uncertainty *Elementary School Journal*, 1969, 69, 304-312

16 SMEDSLUND, J The acquisition of conservation of substance and weight in children *Journal of Psychology* 1961, 2, 156-160

17 ZILLER, R C, and LONG, B H Some correlates of the don't know' response in opinion questionnaires *Journal of Social Psychology*, 1965, 67, 139 147

APPENDIX 1

FIRST WRITTEN POSTTEST

Directions Read the following statements Then circle True, False or Don't Know, depending on whether you think the statement is true or false or you don't know If you circle Don't Know, also circle one of the numbers that follow, to explain why you don't know The meanings of the numbers are

- 1 You don't know but you could find out from some other person in the world
- 2 No one knows but someone could find out
- 3 No one knows how to find out the answer to this question
- 4 This is a value statement It is just the way someone feels about something It is not true or false
- 5 No one knows because it hasn't happened yet

Examples

- | | |
|--|---|
| 1 One plus one equal two
(This mathematical equation is always true) | True False Don't Know 1 2 3 4 5 |
| 2 There are 25 hours in one day
(This statement is false, because there are always 24 hours in one day) | True False Don't Know 1 2 3 4 5 |
| 3 The population of Waterville, Ma is 53 120 (You don't know, but someone who works in Waterville's City Hall probably does) | True False Don't Know 1 2 3 4 5 |
| 4 There were 200,500 words printed in last night's paper (Nobody bothered to count, but if you wanted to find out, you could always count the words yourself) | True False Don't Know 1 2 3 4 5 |
| 5 Camels like rock and roll better than opera (This could be true, but since we cannot ask camels, we cannot know for sure) | True False Don't Know 1 2 3 4 5 |
| 6 Red is prettier than blue
(Though some people think so, others disagree It is really a matter of opinion, neither true nor false) | True False Don't Know 1 2 3 4 5 |
| 7 A man will land on Saturn in 1980
(Even if some people think that this is likely we cannot know for sure since it hasn't happened yet) | True False Don't Know 1 2 3 4 5 |

1 Camels are used in hot, dry places	True	False	Don't Know	1	2	3	4	5
2 All animals like hot climates	True	False	Don't Know	1	2	3	4	5
3 The basket over Mother Camel's nose is comfortable	True	False	Don't Know	1	2	3	4	5
4 Ali's turban is made of silk	True	False	Don't Know	1	2	3	4	5
5 Baby camel preferred to play with his little camel friend rather than with Ali	True	False	Don't Know	1	2	3	4	5
6 Ali has 63,474 hairs on his head	True	False	Don't Know	1	2	3	4	5
7 Ali's father is a very young man	True	False	Don't Know	1	2	3	4	5
8 The camel is the ugliest of all animals	True	False	Don't Know	1	2	3	4	5
9 Ali will be a farmer when he grows up	True	False	Don't Know	1	2	3	4	5
10 There are 10,243 gallons of water in the pond in front of the village	True	False	Don't Know	1	2	3	4	5
11 Baby camel often has pleasant dreams	True	False	Don't Know	1	2	3	4	5
12 Camels make the ugliest noise of all animals	True	False	Don't Know	1	2	3	4	5
13 Ali has his own bedroom at home	True	False	Don't Know	1	2	3	4	5
14 All camels in the market are healthy	True	False	Don't Know	1	2	3	4	5
15 Ali will always live in the desert	True	False	Don't Know	1	2	3	4	5
16 The desert is the best place in the world to live	True	False	Don't Know	1	2	3	4	5
17 Food is stored in a camel's hump	True	False	Don't Know	1	2	3	4	5
18 The length of the average step baby camel takes is three feet	True	False	Don't Know	1	2	3	4	5
19 Camels may be bought in camel markets	True	False	Don't Know	1	2	3	4	5
20 Ali was afraid of sand storms when he was young	True	False	Don't Know	1	2	3	4	5
21 Baby camel will never again get sick in a sand storm	True	False	Don't Know	1	2	3	4	5