DOCUMENT RESUME

ED 264 459 CG 018 687

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TITLE The Effects of Motivation and Emotion upon Problem Solving.
PUB DATE [Aug 84]
NOTE 23p.; Paper presented at the Annual Meeting of the Conference on Thinking (Cambridge, MA, August 19-23, 1984).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS College Students; *Emotional Response; Higher Education; *Motivation; Performance; Prediction; *Problem Solving
IDENTIFIERS *Emotions

ABSTRACT

Recent research has refuted the behaviorist approach by establishing a relationship between emotion and behavior. The data collection procedure, however, has often involved an inferred emotional state from a hypothetical situation. As partial fulfillment of a class requirement, 60 college students were asked to perform two problem solving tasks from the Wechsler Adult Intelligence Scale-Revised. Ten emotions were assessed by self-report on a 9-point scale. Subjects were asked before the tasks how well they though they would do and how much they would like it. Following the tasks the students were again asked in retrospect how well they thought they did and how much they liked the task. To assess the changes, pre-task scores were subtracted from the post-task scores. The results revealed that changes in emotional state from before to after the task were related to the subject's motivation toward the task. Altering the emotions of the subjects while engaged in problem solving altered the relationship between emotion and motivation. It was also found that motivation toward one type of problem solving could predict motivation toward other similar types. The self-report scales of emotions greatly enhanced the ability to predict. This relationship between motivation and emotional state can have an impact of the teaching of problem solving to children. (TW)

The Effects of Motivation and Emotion Upon Problem Solving

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Précis

Two studies are reported which correlate motivation and emotions with students' performance on problem solving tasks. Pre and post task self ratings of motivation, emotional state and perceived performance were obtained from subjects for two types of tasks. The results revealed that emotions are associated with motivation and task preference. Further, motivational level toward one kind of problem solving can be used to accurately predict motivational level toward a similar type of problem solving at a different time.

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Introduction

Research on the relationships among emotion, cognition, and motivation have travelled along various paths. At one time emotion wasn't even considered important enough to be studied (Cofer, 1972). According to behaviorists, the impetus to learn centered around stimulus, response and reinforcement. A turn in the road occurred with the cognitive psychologists. Not satisfied with the behavioristic viewpoint, they proceeded with research on the assumption that a person's behavior is based upon cognition that is an act of knowing or thinking about the situation in which the behavior occurs. Their preoccupation lies in the organization of knowledge, information processing and decision-making behavior--parts of the cognitive realm. The behavioristic and cognitive viewpoints fail to include for consideration an aspect basic to every human--emotions. The purpose of this study is to investigate the relationship of emotion to a person's motivation to problem solve.

Several researchers have approached the study of emotion and motivation in relation to cognition. Motivation theorists such as White (1959) and more recently Deci (1971, 1975, 1980) and Harter (1978, 1981) have acknowledged the contribution of emotions in reporting the results of their research; they tend, however, to regulate affect, particularly intrinsic pleasure, to an outcome which is always the product of

competence. The Berkeley Teaching-Learning Project begun in 1971, used attribution theory to formulate a model to link feelings of self-worth to perceived intellectual growth. Much of Covington and Beery's (1976) work with students' feelings of failure is grounded in this Project. Weiner, Kun & Benesh-Weiner (1980) have used attribution theory to suggest that causal attribution of a desired outcome to the self augment certain positive emotions such as feelings of pride, confidence and general self esteem. These emotions are presumed to increase the likelihood of future mastery-oriented activities. Rather than the acquisition of competence, emotion is central to the mastery process (Weiner et al., 1980).

The validity of the emotions studied in the above research is open to question. Emotion researchers have found a strong differentiation among feelings. Emotion theorists generally consider between six to ten feeling states to be true emotions (Ekman, Friesen & Ellsworth, 1972; Tomkins, 1962, 1963, 1981). These emotions include happiness, sadness, fear, disgust, contempt, surprise, shame, guilt, and interest. Whereas these emotion traits are found to be stable over time, other so called "emotions" tend to be affected by situations in time.

Another mien of the study of emotion is presented in the data collection. Oftentimes subjects are asked to infer their emotional state from a hypothetical situation (Weiner, Russell & Lerman, 1979). This procedure presents several complications. The accuracy of inference concerning hypothetical situating is questionable. A more viable solution would be to make a simultaneous assessment of emotional state at the time of engagement in an activity.

This study attempts to extend previous findings concerning emotions and the motivation to problem solve by addressing the issues outlined

above. A theory for a link between the affect and the intellect is found in the work of Piaget (1962), who discussed the theoretical aspects of the relationship of emotion and cognition. Hunt (1965) theorized an affective-cognitive connection in relation to motivation. The viewpoint of the study presented is that a symbiotic relationship exists between emotion and motivation in relation to cognition and that this relationship can be studied through motivation towards tasks. The study reported here investigates the influence of emotions and motivation for problem solving.

In order to address the issues of concern identified earlier, the following procedures were used. Each subject was presented with two performance tasks, thus insuring a concurrent evaluation of affective state. Subjects were then introduced to various manipulations during task involvement designed to influence their subjective feeling states. At specific intervals subjects were asked to complete self reports on a range of possible emotional states using the specific emotional terms. Finally, both a mastery oriented behavior index and a cognitive index of ability were obtained.

These procedures made it possible to examine (1) the systematic alterations in the changes in relationships between emotions and motivation toward problem solving; (2) the possibility that attempts to alter the emotional experience of the subjects during task performance changed the original systematic relationships that existed between the subjects' emotional states and the motivational levels; (3) the possibility that changes in subjects' perceived performance were related to changes in either motivation or emotion; (4) the possibility that

motivation ratings for one task have predictive qualities for other tasks.

Method

Subjects

The subjects included 60 college students participating in this study as partial fulfillment of class requirement. There were 28 males (mean age = 21.35 yrs.) and 32 females (mean age = 23.34 yrs.). No significant gender differences were found in any of the analyses made.

Materials

Subjects performed two problem solving tasks from the Wechler Adult Intelligence Scale, Revised (WAIS-R): Block Design and Picture Arrangement. These subtests were chosen over experimenter created tasks because the reliability across subjects has been standardized and widely used and because the use of a broad performance measure minimizes possible confounding effects due to sex, age, specific abilities, etc. Subjects completed all nine for Block Design and the first nine of ten trials for Picture Arrangement. The first trial for both tasks was used as a sample for all subjects. Actual performance scores were obtained by scoring according to the established criteria (Wechler, 1981).

Emotional state was assessed by means of a self-rating on a 9 point scale ranging from 0 (no emotion felt), to 8 (maximum intensity of emotion felt). Ten emotions were identified: anger, contempt, disgust, fear, guilt, happy, interest, sad, shame and surprise. These emotions were chosen because of the consensus of several emotion theorists that these emotions represent "true" emotions (e.g. Tomkins 1962, 1963).

Subjects were instructed to rate these emotions according to how they felt at the time they were completing the rating.

Indexes of mastery oriented behavior and perceived performance were also obtained. Before performing a task subjects rated (1) how well they thought they would do a task and (2) how much they would like to do the task. A nine point scale was employed ranging from 0 (not well/not much) to 8 (very well/very much). After completion of the tasks subjects were asked to rate (1) how well they thought they did the task and (2) how much they would like to do the task again.

Change scores for all emotion, motivation and perceived performance ratings were obtained by subtracting the pre-task score from the post-task score. The purpose of these measures of emotion, perceived performance and motivation was to provide a simple index for the simultaneous assessment of the interrelationships among the variables by obtaining information concerning each variable. The method used was self report.

Procedure

Each subject was tested individually. At the outset the experimenter explained that the purpose of the experiment was to examine the effects of emotional state on task performance. Subjects were told that they would be asked to engage in problem solving and that they may be asked to do some exercises during the session that might affect their own emotional state. Subjects were introduced to each of the two tasks by engaging in the first trial of each subset with the experimenter in order to insure comprehension of both types of tasks. After the orientation subjects rated both how well they thought they could do each task and how much they would like to do each task.

Before proceeding, the experimenter examined each subject's rating to determine which was the more intrinsically motivating task, that is, the task the subject indicated higher interest in doing. This procedure was included in order to determine task type preference. In cases of equal ratings the experimenter elicited a forced choice by asking which would be chosen if a choice had to be made. After the preferred task was determined, the subjects rated their emotional state on the emotion rating scale and engaged in the preferred task through the required eight trials.

Fifteen subjects were randomly assigned to each of four experimental conditions. The first two, smile and imagery, were designed to possible influence the subjects' emotional states. Subjects in Condition 1 (smile condition) were asked to raise up their lip corners (in a smile) and hold for 5 seconds after every other trial completion. Subjects in Condition 2 (imagery condition) were asked to imagine an event, memory or image from their past which made them happy or to think of something happy at the moment. After they attained a clear image, they were given 15 seconds to retain that image. This procedure was repeated twice, after the fourth and the last trial of the task. The last 2 conditions were control conditions, Condition 3 (face control) and Condition 4 (manipulation control). Subjects in Condition 3 were asked to make an innocuous expression (close eyes and lift eyebrows) and to hold for 5 seconds after every other trial. This condition was designed to serve as a basis for comparing the data for the smile condition. Subjects in Condition 4 completed the trials with no experimental manipulation.

After completion of the more intrinsically motivating trials, subjects again rated their emotional state. They also rated how well

they thought they did and how much they would like to do the task again. These entire procedures were repeated for the less intrinsically motivating task. Between tasks subjects in Condition 1 were reassigned to Condition 3 and visa versa. Subjects in Conditions 3 and 4 were not reassigned between tasks. The testing ended with the subjects rating their reactions as they had at the completion of the first task; they rated how well they thought they did and how much they'd like to do the task again.

Results

The data revealed low frequencies of the emotions anger, contempt, disgust, fear, guilt, sadness, and shame. For reporting purposes these ratings were combined into a single category, "Combined Negative." Thus the categories for emotions are happiness, interest, surprise and combined negative. The results are as follows:

Finding #1: Changes in emotional state from before problem solving to after problem solving were systematically related to changes in the subjects' motivation toward that type of problem solving. Further, these relationships were for the most part independent of the subjects' own personal indexes of task performance.

Changes in certain emotional states were highly related to changes in motivation ratings (see Table 1). For example, happiness and interest both correlated with high intrinsically motivating tasks. Moreover, when the variability in change in motivation ratings accounted for by change in perceived performance was controlled for by partial correlation techniques, each of the significant affect categories still correlated highly with change in motivation ratings.

Finding #2: Attempts to alter the emotional experience of the subjects while engaging in problem solving altered the systematic relationships that existed between their emotional states and their motivational levels.

Various emotions correlated highly with changes in motivation ratings (see Table 1). The correlation depended on the condition, the task order and whether or not the task was high or low intrinsically motivating. For example, within the high intrinsically motivating task change in happiness and interest were highly correlated with change in motivation ratings in Condition 4 (control). In Condition 3 (control face) changes in happiness, interest and surprise were correlated with changes in motivation ratings. In Condition 2 (imagery) change in interest was related to change in motivation ratings. In Condition 1 (smile) the combined negative was negatively correlated with changes in motivation ratings. In the low intrinsically motivating task, interest and surprise correlated highly with change in motivation ratings under various conditions. An Analysis of Variance was computed on the mean ratings for the changes in how well the subjects thought they did, how much they wanted to do the task again and the four emotion categories for both the high and low intrinsically motivating tasks. An ANOVA indicated there were no differences in these ratings between subjects in any of the four conditions. Thus, as indicated in Table 1 and 2, the relationships and not the mean ratings among emotion, performance and motivation change as a function of condition.

Finding #3: Changes in subjects' perceived performance level were related to changes in subjects' emotional states and motivational levels.

The relationships between how well the subjects thought they did and changes in their motivational ratings were also dependent upon the particular condition and task (see Table 2). For both high and low intrinsically motivating tasks these variables were correlated in both Conditions 3 and 4 but not Conditions 1 and 2.

The results in Table 2 and the findings from the ANOVA raised the possibility that introduction of the affect manipulations altered not only the relationships existing between changes in emotion and motivation (Table 1), but also some of the cognitive relationships that existed between changes in perceived competence and motivation ratings. To further substantiate this notion the correlations between how well subjects thought they did and changes in emotional state were calculated (Table 3). In every condition except one these two variables were highly correlated.

Finding #4: Knowledge of motivational level toward one kind of problem solving can be used to accurately predict motivational level toward a similar type of problem solving task .

Initial motivation level for the high intrinsically motivating task was highly correlated with initial motivation ratings for the low intrinsically motivating task (See Table 4). The product-moment correlations between the initial motivation ratings, the initial emotional state and performance for both tasks are also given. Multiple correlations predicting initial motivation for one task using initial motivation ratings for the other task and either simultaneous initial

interest or anticipated performance are included. A multiple correlation using all three sources of information concludes the table.

In order to predict the initial motivation ratings for the high intrinsically motivating task, the variables were (1) initial motivation for the low intrinsically motivating task and (2) simultaneous initial interest. For low intrinsically motivating tasks the variables used to predict initial motivation were (1) the initial motivation ratings for the high-intrinsically motivating task and (2) the anticipated performance ratings for the low-intrinsically motivating task.

Finding #5: Motivation ratings used in conjunction with simultaneous self-report of emotional state enhanced the power to accurately predict both initial levels of motivation and change in motivational level for problem solving for which subjects indicated preference.

Changes in motivation for both the high and low intrinsically motivating task for the total group as well as the smile, imagery and control conditions were correlated with change in motivations for the tasks which created the opposite intrinsic motivation. (See Table 5). For the high intrinsically motivating task change in motivation correlated with the other variables in all conditions except Condition 1 (smile). For the low intrinsically motivating task changes in both emotion ratings and performance ratings were correlated with change in motivation ratings for the total group. Unlike the results for the high intrinsically motivating task, change in performance was equally important to the prediction of change in motivation ratings. Use of all three change variables (motivation for the high intrinsically motivating task, emotion and performance for the low intrinsically motivating task)

produced multiple correlations which were consistently high across all four conditions as well as for the total group.

The variables used to predict change in motivation for this task were (1) change in motivation level for the low-intrinsically motivating task and (2) simultaneous change in emotion ratings. The addition of change in performance ratings in general did not contribute greatly to the multiple correlations. The pattern of results was similar for the smile condition although none of the Product-moment correlations or multiple correlations reached significance.

Discussion

Specifically, this study shows that there are relationships which exist between emotional state and changes in motivation toward problem solving. The results also indicate that motivation ratings can be used to accurately predict motivation for another similar problem solving task at a different time. Use of motivation ratings in conjunction with simultaneous self-report of emotional state enhanced the power to accurately predict both initial lack of motivation as well as change in motivation level for preferred problem solving tasks. For tasks which subjects were not as highly motivated to do, ratings of performance in addition to the above variables enhanced the power to accurately predict motivation level. These findings argue for the combined assessment of some types of stable characteristics subjects bring into the testing situation as well as of their cognitive and emotional reactions during task engagement.

The results of this study only begin to scratch the surface of a much needed area in educational research and application: the domains of

the intellect and affect. For too long those in the field of education have allowed the limiting dictates of behavioristic and cognitive psychologists to impose a narrow and unrealistic view of the learning process; that is a wholly cognitive approach. This research joins the budding flowers in a vast field of weeds and expands the notion that affect is a partner in the learning process. The fertilizer is motivation, and the bouquet is a greater understanding of the interrelationships which exist among affect, motivation and cognition.

The potential for use of manipulation to develop a positive inner "set" for learning and to encourage an inner drive (i.e. intrinsic motivation) to problem solve has fascinating implications. If manipulations can, in fact, influence a person's emotional response and motivation levels toward a task, educators have an exciting vehicle with which to advance student learning. Already, parallel experiments are being reported which demonstrate the influences of environment upon student learning (Lozanow, 1978; Ostrander and Schroeder, 1979). Why shouldn't the inner environment be just as influential?

As stated earlier, adequate assessment of motivational level towards tasks and changes in motivation should incorporate the simultaneous assessment of emotions and cognitions. The results of such an assessment could greatly assist the teacher in deciding upon an instructional strategy. For example, educators express great concern for students' motivation toward learning. By understanding the stability factor of motivation towards similar tasks, educators can better prescribe instructional methods for individual students. Additionally, the introduction of affective factors will give a fuller picture of the learning process and a way to adapt the process to fit individual

learning styles. Teachers could begin to keep records of these assessments and incorporate preferences into instructional methods just as they currently keep records of children's academic progress and use those records to ascertain academic developmental level.

Although the results of these studies await replication and extension using different target emotions, different affective manipulations and different tasks, they probably underestimate the potential contribution of the study of emotion to the understanding of intrinsic motivation to engage in problem solving tasks. Other measurement systems than self-report may afford researchers the tools necessary to make even larger steps in this direction.

In summary, these studies could have a strong impact in teaching problem solving to children. First, the findings argue for the combined assessment and use of information about stable characteristics subjects bring to problem solving situations as well as information on their cognitive and emotional reaction during task engagement. Second, they indicate that emotions are related to the cognitive aspects of problem solving and, in fact, heavily influence motivation for choosing a task. Teachers who are aware of this important area could approach problem solving through preferred tasks. The results would be higher student interest, stronger expectation of student success and more attunement toward learning. The findings of these studies indicate that future research is necessary in elucidating these roles in other aspects of learning such as decision-making.

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TABLE 1

Correlations Between Change in Affects and Change in Motivation Ratings
(Partial Correlations Control Change in Performance Ratings)

		High Intrinsically Motivating Task				Low Intrinsically Motivating Task			
		Happy	Interest	Combined Negative	Surprise	Happy	Interest	Combined Negative	Surprise
Smile	r	-.057	.260	.489*	-.056	-.024	-.056	.029	.038
(N=15)	pr	-.059	.289	.508*	-.054	.053	.103	.287	.105
Imagery	r	.291	.539*	.189	.350	.229	-.181	-.050	-.425*
(N=15)	pr	.274	.533*	.387	.369	.368	-.166	-.091	-.415
Control Face	r	.100	.575**	-.060	.557*	.420	.686***	-.174	.136
(N=15)	pr	.066	.429	.177	.509*	.274	.632**	-.086	.079
Control	r	.665***	.640***	.174	-.169	.475*	.386	-.371	.101
(N=15)	pr	.632**	.688***	.287	-.114	.526*	.517*	-.440	.132

* p .05
** p .01
*** p .005

TABLE 2

Correlations Between Change in Performance and Change in Motivation Levels

		High Intrinsically Motivating Task	Low Intrinsically Motivating Task
Smile (N=15)	r	.021	.312
Imagery (N=15)	r	.111	-.100
Control Face (N=15)	r	.436*	.446*
Control (N=15)	r	.307	.514*

* p .05

TABLE 3

Correlations Between Change in Affects and Change in Cognition Ratings

		High Intrinsically Motivating Task				Low Intrinsically Motivating Task			
		Happy	Interest	Combined Negative	Surprise	Happy	Interest	Combined Negative	Surprise
Smile (N=15)	r	.091	.509*	0.315	-.204	-.232	-.458*	-.603**	-.414
Imagery (N=15)	r	.505*	.294	-.716****	-.127	.610**	.180	-.333	.192
Control Face (N=15)	r	.028	.619***	-.415*	.277	.451*	.352	-.222	.149
Control (N=15)	r	.602**	-.047	.287	.207	.046	-.106	.014	-.024

* p .05
** p .01
*** p .005
**** p .001

TABLE 4

Correlations Predicting Initial Motivation Ratings

Independent Variables	Task	
	High Intrinsically Motivating Task	Low Intrinsically Motivating Task
Motivation	.768****	.768****
Interest	.449****	.414****
Performance	.168	.414****
Motivation+ Interest	.782****	.772****
Motivation+ Performance	.778****	.813****
Motivation+ Performance+ Interest	.788****	.815****

**** p = .001

TABLE 5

Specific Correlations Predicting Change in Motivation Ratings By Condition

	Task									
	High Intrinsically Motivating Task					Low Intrinsically Motivating Task				
Independent Variable	Total	Smile	Imagery	Control Face	Control	Total	Smile	Imagery	Control Face	Control
Motivation	.497****	.144	.666***	.725****	.653***	.497****	.144	.666***	.725****	.653***
Happy	.248*	-.057	.291	.100	.665***	.277*	.420	.229	-.024	.475*
Interest	.452****	.260	.539*	.575**	.640***	.332***	.686**	-.181	-.056	.386
Performance	.187	.021	.111	.436*	.307	.330***	.446*	-.100	.312	.514*
Motivation+ Performance	.550****	.158	.682*	.798***	.761***	.594****	.527	.677*	.734**	.723**
Motivation+ Happy+Interest	.619****	.347	.781*	.749*	.648***	.594****	.733*	.736*	.736*	.827***
Motivation+ Performance+ Happy+Interest	.627****	.368	.783*	.794*	.665***	.670****	.743	.740	.759*	.857**

* p .05
** p .01
*** p .005
**** p .001