

# Positive Affect Facilitates Creative Problem Solving

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Four experiments indicated that positive affect, induced by means of seeing a few minutes of a comedy film or by means of receiving a small bag of candy, improved performance on two tasks that are generally regarded as requiring creative ingenuity: Duncker's (1945) candle task and M. T. Mednick, S. A. Mednick, and E. V. Mednick's (1964) Remote Associates Test. One condition in which negative affect was induced and two in which subjects engaged in physical exercise (intended to represent affectless arousal) failed to produce comparable improvements in creative performance. The influence of positive affect on creativity was discussed in terms of a broader theory of the impact of positive affect on cognitive organization.

Recent research has suggested that positive affect can influence the way cognitive material is organized and thus may influence creativity. Studies using three types of tasks (typicality rating, sorting, and word association) indicated that persons in whom positive affect had been induced differed from those in control conditions in the associations that they gave to common, neutral words (Isen, Johnson, Mertz, & Robinson, 1985) and in the pattern and degree of relatedness that they depicted among stimulus elements (Isen & Daubman, 1984). It has been suggested that these differences are due to differences between the groups in the tendency to relate and integrate divergent material. This process of bringing together apparently disparate material in a useful or reasonable but unaccustomed way is central to most current conceptualizations of the creative process (e.g., Koestler, 1964; S. A. Mednick, 1962). Thus, it seems likely that positive affect may promote creativity.

In one of these series of studies, it was found that persons in whom positive affect had been induced (in any of three ways) tended to categorize stimuli more inclusively than did persons in the control conditions (Isen & Daubman, 1984). This tendency was reflected by performance on both a rating task and a sorting task. On the sorting task, positive-affect subjects tended to group more stimuli together than control subjects did, thus indicating that, for them, more of the items could be seen as related. On the rating task, persons in whom positive affect had been induced tended to rate nontypical exemplars of a category more as members of the category than control subjects did. For example, in a task similar to that used by Rosch (1975) in assessing the prototypicality of category exemplars, persons in whom positive affect had been induced—by refreshments at the experimental session, receipt of a small gift, or viewing 5 min of a comedy film—gave higher ratings to the atypical exemplars

*elevator, camel, and feet* as members of the category *vehicle* than did subjects in control conditions. That is, they gave evidence of being better able than control subjects to see the relatedness between these exemplars and the category or to see aspects of these exemplars that would make them like members of the category.

In a second series of studies, persons in whom positive affect had been induced—by having refreshments (juice and cookies) at the experimental session, giving word associations to positive words, receiving a small gift, or viewing 5 min of a comedy film—gave more unusual first associates to neutral words, according to the Palermo and Jenkins (1964) norms, than did persons in the control conditions (Isen et al., 1985).

Both of these effects have been interpreted as indicating an influence of positive affect on cognitive organization because they reflect the relatedness that people see among ideas or cognitive elements. One shows how persons organize stimuli set before them when they set out to do so; the other indicates the concepts that are cued for people by given stimulus words. In each type, there is evidence of greater integration or perception of interrelatedness of stimuli among people who are feeling happy.

Either of the effects of positive feelings on cognitive organization that has been observed thus far (atypical categorization and word association) might also be seen as reflective of an influence of affect on creativity. The categorization task involves either seeing nontypical yet plausible ways of relating items, or seeing aspects of the items that are real and useful but not usually focal in people's attention; these processes are central to creativity. Likewise, responding with related but nontypical word associations can be seen as creative, and in fact word association tasks have often been explicitly linked with creativity (e.g., Freedman, 1965; Maltzman, Simon, Raskin, & Licht, 1960; M. T. Mednick, S. A. Mednick, & E. V. Mednick, 1964; S. A. Mednick, 1962).

Moreover, S. A. Mednick's (1962) theory of creativity specifically relates word associations to cognitive representation and defines creativity in terms of the formation of new associa-

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tions or combinations of cognitive elements that are in some way useful. Thus, this theory of creativity is also compatible with the process suggested to result from positive affect, a process involving making new associations and combining cognitive elements in new ways.

Our studies are designed to test more directly the proposition that positive affect promotes creativity, and to extend the evidence beyond that available in the word association and categorization studies. In these experiments, we investigate whether the creativity promoted by positive affect includes problem-solving innovation.

The task that we used in the first two studies was the candle task used by Karl Duncker (1945) in his demonstrations of creative problem solving (actually, his demonstration of what he termed functional fixedness). In this task, the subject is presented with a box of tacks, a candle, and a book of matches and is asked to attach the candle to the wall (a corkboard) in such a way that it will burn without dripping wax on the table or floor. The task in Studies 3 and 4 was based on the Remote Associates Test used by M. T. Mednick et al. (1964) as a test of creativity. This task requires subjects to think of a word that is related to each of three other words presented.

## Experiment 1

### Method

**Subjects.** Subjects were 65 male and female students who participated in exchange for extra credit in their introductory psychology classes.

**Design.** Subjects were assigned randomly to one of four conditions. Two of the four involved manipulation of affect (positive and neutral) by means of films; the other two involved differences in the way materials for the task were displayed.

**Affect manipulation.** Positive affect was induced in Condition 1 of this study by having subjects view 5 min of a comedy film, *Gag Reel*, used previously in research and found to induce the desired state (e.g., Isen & Groggione, 1983). The segment shown consists of bloopers (i.e., errors that were cut from the film and not shown to the public) from two old television westerns (*Have Gun Will Travel* and *Gunsmoke*) and one from *The Red Skelton Show*. In Condition 2, a neutral-film control condition, subjects were shown a 5-min segment from a math film, *Area Under a Curve*, also used previously. In each case, subjects were told that the film was being pretested for use in another study to be held the following term and that our interest was in people's general reactions to it. They were instructed not to try to memorize anything from the film, but just to watch it.

**Display manipulation.** In the remaining conditions, no films were shown, and affect was not induced. Instead, differences between these two conditions were created by differences in the ways in which the items for the candle task were displayed. In Condition 3 (as in Conditions 1 and 2), the usual display was presented: a box filled with tacks, a candle, and a book of matches. In Condition 4, the same items were presented but in a facilitative display: The tacks were placed in a pile next to the empty box. Adamson (1952) found that arranging the items in this way facilitated performance on the task.

**Procedure.** Subjects were admitted to the laboratory in groups of 2 to 4. They were seated, each several seats away from the next person, and given a minute of introduction to the study. During this introduction they were asked not to speak to each other, interact with each other in any other way, or call out to the experimenter during the session. Then, in Conditions 1 and 2, subjects were shown one of the 5-min film

Table 1

*Study 1: Number and Percentage of Subjects Obtaining Correct Solution in Each Condition*

Condition	<i>n</i>	%
Positive film	9/12	75
Neutral film	3/15	20
Facilitative display	19/23	83
No manipulation	2/15	13

segments described earlier. Subjects in Conditions 3 and 4 proceeded directly to the next phase of the experiment.

After the films were shown but before the problem-solving task was presented, as a check on the manipulation of affect, subjects completed a word-rating scale in which they rated the pleasantness of unfamiliar words. Previous studies have shown effects of induced feelings on such measures (e.g., ratings of ambiguous slides) and in some cases have used them as indirect assessments of affect (e.g., Isen et al., 1985; Isen & Shaker, 1982).

Next, subjects were seated at individual tables in the four corners of the room, approximately 25 ft (7 m) apart, facing the corner so that they were unable to see each other. The materials for the candle task were on the table, in the appropriate display, but under a cover until the task was explained by the experimenter. The following instructions were read to subjects in Conditions 1, 2, and 3:

On the table are a book of matches, a box of tacks, and a candle. Above the table on the wall is a corkboard. Your task is to affix the candle to the corkboard in such a way that it will burn without dripping wax onto the table or the floor beneath. You will be given 10 minutes to work on the problem.

Subjects in Condition 4 heard the same instructions except that the box and the tacks were listed separately as items on the table. The problem as usually presented can be solved if the box is emptied, tacked to the wall, and used as a platform (candle holder) for the upright candle.

At the end of the session the purpose of the study was explained to the subjects, they were shown the solution to the problem, and the experimenter thanked the subjects for participating.

### Results and Discussion

Results of the manipulation check indicated that unfamiliar words were rated more positively by subjects in the positive-affect condition than by subjects in the neutral-film condition,  $t(25) = 2.00, p < .05$ . This suggests that the appropriate affective state was induced.

Table 1 presents the data showing the number and percentage of subjects obtaining the solution in each condition. Chi-square tests indicated that, as predicted, subjects in the positive-affect condition produced significantly more solutions than did subjects in the neutral-affect control condition,  $\chi^2(1, N = 27) = 8.19, p < .01$ , and subjects in the facilitative-display condition produced significantly more solutions than did subjects in the control-display condition  $\chi^2(1, N = 36) = 17.62, p < .01$ . The control conditions did not differ from each other on number of solutions produced, suggesting that the neutral-film condition may be considered comparable to a no-manipulation control in effect.

These results suggest that positive affect can facilitate creative problem solving. Duncker (1945) spoke of people's inability to

solve this task as stemming from functional fixedness, or their inability to consider alternative uses for the box. Adamson (1952) showed, and we have replicated his results, that displaying the items separately facilitates performance on this task. He reasoned that highlighting the independence of the box and tacks might allow each object to be utilized in its own right. Likewise, Glucksberg and Weisberg (1966) found that providing labels of all of the items in the display, including the box, also facilitated performance; and Higgins and Chaires (1980) found that giving subjects experience with unaccustomed linguistic structures that tended to emphasize the separateness of members of common pairs ("tray and tomatoes" instead of "tray of tomatoes") also facilitated performance on the candle task. In addition, Glucksberg and Danks (1967, 1968), in a series of studies using the electrical-circuit problem (another task requiring innovation to break set), demonstrated that procedures that increased the accessibility of semantic categories relevant to the solution of the problem facilitated seeing the required novel function and solving the problem.

All of these findings (except the present ones, that positive affect can facilitate performance on this task) can be interpreted as suggesting that calling attention to the box as an item in its own right, or calling attention specifically to the aspect of the box that might prove helpful, can facilitate seeing the crucial alternative function of the box. Subjects in our positive-affect condition were also able to break set and see the additional features of the box that would allow them to realize its potential for solving the problem, even though there was nothing in our procedure that specifically called their attention to the box, to the potential solution, or to the aspects of the box that might prove especially helpful in solving the task. Thus, there may be something about positive affect itself that facilitates either seeing more aspects of objects or in some other way seeing objects more fully, including their potential for combination with other objects and with the problem under consideration.

Possibly it is through creating a complex cognitive context that positive affect promotes creative problem solving. The importance of context in determining interpretation has been discussed recently by several cognitive psychologists (e.g., Bransford, 1979; Jenkins, 1974). Moreover, complexity of context has been specifically related to originality of word associations (Cramer, 1968). In addition, complexity of context is likely to result in a relaxing or broadening of focus of attention, a process that has also been related to the creative process (Martindale, 1981). Thus, it seems that increasing complexity of cognitive context might influence interpretation and organization of stimuli and promote creative responding.

For persons who are feeling happy, the complex context arises from the fact that positive feelings cue and facilitate access to positive material in memory (e.g., Isen, Shaker, Clark, & Karp, 1978; Teasdale & Fogarty, 1979) combined with the fact that positive material is more extensive and diverse than other material (e.g., Boucher & Osgood, 1969). Thus, a person who is feeling happy has more ready access to a large and diverse set of cognitive material, and this constitutes a complex cognitive context.

This elaborated and enriched context may influence cognitive organization by increasing the number of ways in which ideas or objects can be integrated or related to one another. This

may occur because of an increase in the number of aspects of ideas that are noticed, but there are other possible means by which context may influence organization as well, and the exact mechanism of the effect is as yet unknown. For example, as noted, the easy accessibility of many ideas simultaneously likely results in defocused attention, and this effect itself may influence cognitive organization. Thus, the presence of a complex cognitive context may cause many features of items and problems to become salient, so that more functions of the objects and more possibilities for solution can be seen. This interpretation is only speculative, however, and will have to be addressed specifically in future research. The studies that follow in this article focus on establishing the empirical link between positive feelings and creative problem solving.

## Experiment 2

Experiment 2 was conducted to replicate and extend the finding that one's affective state can influence creative problem solving. First, we wanted to explore the conditions of affect that might produce the same result, in order to learn more about the specific aspects of feeling states that might be responsible for the effect. We examined whether positive affect other than feelings of amusement might have the same effect, we included a negative-affect condition, to begin investigation of the impact of negative affect on creativity, and we included an arousal-control group, to get some idea about whether arousal, independent of affect, might influence performance on this task. The prediction that arousal alone might improve performance on tasks such as these has an intuitive appeal to many people, and it may also follow from a theory such as spreading activation, as described by, for example, Anderson (1983).

We predicted that the second means of positive-affect induction (a small gift) would facilitate solution of the candle problem, as would the humorous film. Because we conceptualized this effect as attributable to cognitive processes resulting from positive affect, rather than to a process of general activation, we expected the arousal condition to have no effect. We did not predict the deficit in performance due to arousal that some might have expected on this complex task requiring innovative responding, in part because success rates were already so low in the control conditions.

We did not expect negative affect to improve creative problem solving, because it has often been associated with constricted thinking and reduced cue utilization (e.g., Bruner, Matter, & Papanek, 1955; Easterbrook, 1959). At the same time, we did not expect impaired performance, because of the relatively low success rates in the control conditions. Moreover, recent research on the impact of negative affect on social behavior, memory, other cognitive processes, and performance has indicated complex effects, with negative affect sometimes facilitating, sometimes impairing, and sometimes leaving unaffected behaviors of interest (see, e.g., Isen, 1984, for discussion). Thus, the prediction regarding the impact of negative affect relative to the control group was difficult to make; we did, however, expect a difference between the negative-affect condition and the comparable positive-affect group.

Table 2  
Study 2: Manipulation Check and Mean Affect Ratings  
(Positive–Negative Scale) in Each Film Condition

Condition	<i>M</i>	<i>MS<sub>e</sub></i>	<i>n</i>
Comedy	3.11	1.29	11
Neutral	3.90	1.04	10
Negative	5.52	2.12	12

Note. Ratings were made on 7-point scales (1 = positive, 7 = negative).

## Method

**Subjects.** Subjects were 33 male and 83 female students who participated in this experiment for extra credit for their introductory psychology classes. Male–female composition was roughly equivalent in each of the conditions (between 26% and 32% men).

**Manipulations.** In one positive-affect condition, subjects each received a junior candy bar as an expression of thanks for their participation. In the other positive-affect condition, participants viewed the same segment of *Gag Reel* that was shown in Experiment 1. The negative-affect manipulation consisted of viewing 5 min of *Night and Fog*, a documentary film depicting Nazi concentration camps. To control for the effects of watching a film on performance, one control group watched the same segment of the math film (*Area Under a Curve*) that was shown in Experiment 1. Again, subjects were told that the films were being pretested for use in another study the following term and that our interest was in people's general reactions to them.

To control for the effect of simple arousal on performance, another control group exercised for 2 min by stepping up on and down from a cement block. This exercise is similar to that known as the Step Test and results in elevated heart rate. The third control group received no manipulation.

**Procedure.** Subjects assigned randomly to one of the conditions described (two positive-affect, one negative-affect, and three affect-control conditions) were admitted to the laboratory in groups of 1 to 3. The same instructions and procedures used in Experiment 1, including precautions against interaction among subjects, were used in this study.

After undergoing the assigned manipulation, some randomly selected subjects from each condition indicated their feelings on five 7-point Likert scales representing five affective dimensions. In the film conditions, subjects were asked to indicate how the film had made them feel; in the other affect-induction conditions, subjects were asked just to indicate their feelings. Thus, the manipulation check was slightly but meaningfully different in the two types of conditions (film vs. no film).

Four of the scales in the questionnaire were intended only as filler items (refreshed vs. tired, calm vs. anxious, alert vs. unaware, and amused vs. sober). The other scale (positive vs. negative) was included for the purpose of checking whether the appropriate affective states had been induced. We expected that subjects in the comedy-film condition would feel more positive, and subjects in the negative-film condition more negative, than subjects in the neutral-film condition and that subjects in the candy condition would feel more positive than subjects in the no-manipulation control condition; the exercise condition was not expected to differ from the control condition in rated affect.

Subjects, seated at individual tables approximately 20 ft (6 m) apart, with dividers positioned between them so that they could not see each other, were instructed about the task in a manner identical to that used in Conditions 1, 2, and 3 in Experiment 1. They were then given 10 min to complete the task. Whether they solved the problem successfully and, if so, time to solution were recorded. At the end of the session, subjects were debriefed as to the purpose of the study and were shown the solution to the problem if they had not solved it.

## Results and Discussion

**Manipulation check.** Tables 2 and 3 present the mean affect ratings (manipulation check) in each condition (film and no film separately). Two separate analyses of variance (ANOVAS), one including the film conditions and the other including the candy, exercise, and no-manipulation conditions, were performed on the data. Separate analyses were performed because the manipulation check question (as described in the Procedure) was different for the two types of conditions. The analysis contrasting the three film conditions indicated a significant effect,  $F(2, 30) = 11.44, p < .01$ . Subsequent *t* tests revealed that subjects in the comedy-film condition reported that they felt more positive,  $t(19) = 1.68, p = .056$ , one-tailed, and those in the negative-film condition more negative  $t(20) = 3.05, p < .01$ , one-tailed, than did subjects in the neutral-film condition. However, the analysis contrasting the candy, exercise, and no-manipulation conditions indicated no significant differences among these three groups,  $F(2, 45) = .60$ . Thus, contrary to expectation, subjects in the candy condition did not report that they felt more positive than subjects in their comparison group, the no-manipulation condition,  $t(34) = 1.17, p > .10$ . Subjects in these no-film conditions were not compared with subjects in any of the film conditions on the affect manipulation check because, as noted, the affect-rating tasks were differently focused in these two distinct contexts and therefore should be distinguished from one another.

The manipulation check data confirm the expected positive-affect and negative-affect induction in the film conditions but not in the gift (candy bar) condition. This suggests that our gift, a small (junior) candy bar in nothing but its commercial wrapper, was not successful in inducing pleasant feelings in subjects. Perhaps it was too small a gift or inappropriately packaged.

Moreover, in retrospect, it is clear to us that this type of manipulation check (self-reported mood) is especially inappropriate for persons who have received treatments such as a gift of candy. The measure is simply too reactive and may even cause subjects to be suspicious of the experimenter's intent in giving them the candy and resentful rather than elated in the remainder of the session. It is probably inappropriate also for treatments such as the exercise condition, in which, again, there is no apparent reason for the question and it is therefore too reactive. (In the film conditions, in contrast, the affect question is an integral part of the task of pretesting the film.)

**Problem solving.** Table 4 presents the percentage of subjects in each condition who solved the problem. We predicted that a higher proportion of subjects in the positive-affect conditions

Table 3  
Manipulation Check and Mean Affect Ratings (Positive–Negative Scales) in Each Nonfilm Condition

Condition	<i>M</i>	<i>MS<sub>e</sub></i>	<i>n</i>
Candy bar	2.69	1.27	18
No manipulation	3.18	2.07	18
Exercise	3.10	2.88	12

Note. Ratings were made on 7-point scales (1 = positive, 7 = negative).

than in their respective control conditions (neutral film and no manipulation) would solve the problem correctly. As expected, a  $\chi^2$  test indicated that a higher percentage of subjects who had viewed the comedy film solved the problem than of subjects who had viewed the control film,  $\chi^2(1, N = 38) = 9.46, p < .01$ ;<sup>1</sup> however, subjects who had received a candy bar did not perform better than subjects in the no-manipulation condition,  $\chi^2(1, N = 39) < 1$ . We did not expect any of the other conditions to facilitate solution of the problem, and in fact chi-squares comparing the exercise condition with its appropriate control (no manipulation) and the negative-affect condition with its control group (neutral film) revealed no significant difference,  $\chi^2(1, N = 38) < 1$  and  $\chi^2(1, N = 39) = 2.27, p > .1$ , respectively. Moreover, subjects in the positive-affect film condition performed significantly better than subjects in all of these comparison conditions, combined,  $\chi^2(1, N = 96) = 10.41, p < .01$ , or singly,  $\chi^2(1, N = 38) = 3.89, p < .05$ ;  $\chi^2(1, N = 39) = 3.09, p < .05$ ;<sup>2</sup> and  $\chi^2(1, N = 38) = 7.24, p < .01$ , for exercise, negative affect, and no-manipulation, respectively.

Although no specific prediction was made regarding time to reach a solution, we thought that positive affect might reduce solution time (among those solving the problem) as well as facilitate problem solution, as had been observed. Individual *t* tests revealed, however, that there were no significant differences among the conditions in the amount of time taken to solve the problem correctly (see Table 5 for means and variances). These results should be interpreted with caution, however, because of the extremely small sample sizes, especially in some of the conditions where only two or three persons solved the problem.

The results of this experiment support and extend those of the preceding one. Subjects in whom positive affect had been induced through viewing a comedy film were more likely to find a creative solution than were subjects who viewed a negative film or subjects in any one of three neutral-affect conditions (neutral film, no manipulation, and no-film arousal). Furthermore, this experiment suggests that the superior performance of subjects in the positive-affect condition is not due to a relatively high arousal level, as subjects in the exercise condition performed no better than subjects in the other control conditions and significantly worse than subjects in the comedy-film condition. We chose to represent arousal by means of exercise, even though this may seem questionable on some counts, because there is a growing body of literature that conceptualizes arousal in this way (e.g., Zillmann, 1979). If the meaning of arousal is taken to be better represented by the negative-affect condition than the exercise condition, then again there is no

Table 5

*Study 2: Mean Amount of Time in Minutes to Solve Problem in Each Condition*

Condition	<i>M</i>	<i>MS<sub>e</sub></i>	<i>n</i>
Comedy film	4.30	11.29	8 <sup>a</sup>
Neutral film	4.20	8.14	2
Negative film	4.29	7.27	6
Candy bar	5.81	14.44	5
No manipulation	3.06	9.01	3
Exercise	6.71	11.68	5

<sup>a</sup> Three data points were lost because of a malfunction of timing devices.

evidence that the effect of positive affect in our study is attributable only to arousal.

Contrary to expectation, subjects in the gift condition did not show improved performance as those in the comedy-film condition did. Thus, it may be specifically humor, and not positive affect more generally, that gives rise to improved creative problem solving. On the other hand, the manipulation check data suggest that positive affect may not have been induced in that condition. Moreover, as we have speculated, the rather heavy-handed technique of inexplicably inquiring about subjects' moods after giving them a gift may have ruined the lighthearted affect induction that was intended. Previous research has indicated that some affect inductions cannot withstand a manipulation check questionnaire (e.g., Frost & Greene, 1982; Isen & Gorgoglione, 1983), and this may be another instance of a similar phenomenon, if for a slightly different reason.

Thus, in subsequent studies, we retained the hypothesis that positive affect, induced in ways other than via humor, could facilitate creativity. However, we attempted to be more sophisticated in the way we went about giving the gift. First, we made the gift more believable and more charming by wrapping it, and second, we did not follow the gift with an obvious question about mood. (Later, in Study 4, we also considered again the effect of affectless arousal.)

Study 3, then, again examined the impact of a small gift on creativity. This time, however, a different measure of creative-

Table 4  
*Study 2: Number and Percentage of Subjects Obtaining Correct Solution in Each Condition*

Condition	<i>n</i>	%
Positive film	11/19	58
Neutral film	2/19	11
Negative film	6/20	30
Candy bar	5/20	25
No manipulation	3/19	16
Exercise	5/19	26

<sup>1</sup> Because some of the subjects in this experiment were run in pairs or in triads, it is important to address the issue of independence of subjects. To the extent that subjects who participate in the same session are allowed to interact with each other, independence of subjects is jeopardized. As indicated in the *Procedure* sections of the studies, we took great pains to make sure subjects did not interact with each other, and therefore the issue of independence is not likely to call the conclusions of this particular set of studies into question. One indication that this conclusion is correct is available in the data of 38 subjects who were run with no other subject present. Under this circumstance, subjects in the comedy-film condition were more likely to solve the problem than were subjects in the control conditions combined,  $\chi^2(1, N = 20) = 5.06, p < .05$ , whereas the comparable subjects in the negative-affect and exercise conditions were not more likely than control subjects to solve the problem,  $\chi^2(1, N = 21) < 1$ .

<sup>2</sup> This probability level reflects a one-tailed test, for which the probability levels of critical values in a two-tailed, standard chi-square table are halved (Siegel, 1956, p. 110).

problem-solving performance was used: items from the Remote Associates Test.<sup>3</sup> This test is an individual difference measure created by the Mednicks (M. T. Mednick et al., 1964) in accord with S. A. Mednick's (1962) theory of creativity. We used it as a dependent measure, assuming that performance on it reflects cognitive organization (which, in turn, we hypothesize to be malleable and responsive to affective state, despite the fact that people may differ in their typical style of cognitive organization). Before proceeding with Studies 3 and 4, we pretested the items for difficulty because we assumed that, given the relatively small sample sizes with which we had to work, differences between affect conditions might not be apparent on items of very great or very low difficulty.

### Pretest for Experiment 3

#### Method

**Subjects.** Fifty-one students from an introductory psychology class, fulfilling a class requirement, served as subjects in this pretest.

**Materials.** Seventy-eight Remote Associates Test items of differing difficulty levels were assembled into 78-page booklets containing one item per page. Each item consisted of three words followed by a blank space. Subjects were instructed to provide, in the blank space, a word that related to each of the three words given in the item. An example of a Remote Associates Test item (of moderate difficulty) is this:

MOWER ATOMIC FOREIGN \_\_\_\_.<sup>4</sup>

**Procedure.** Subjects were seated individually at tables and given a 78-page remote-associates booklet. Each page of the booklet contained three words and a blank, as illustrated in the display.

Subjects were told the instructions for the task and advised that no more than 1 or 2 min should be spent on any one item, as any additional time was not likely to produce an answer. In actuality, subjects spent about a half minute per item. After completion of the booklet, subjects were debriefed and given credit for their participation.

#### Results

For each item, the percentage of subjects obtaining the correct answer was calculated and used as the item's score. Scores ranged from 0 to 88.2. Items with scores between 0 and 22 (up to 22% of the sample answered them correctly) were designated difficult items (12 items). Those with scores between 66 and 88 were designated as easy items (11 items), and those with scores between 23 and 65 were considered of moderate difficulty (55 items).

Seven items were selected from each pool (difficult, easy, and moderate items) to create a test containing 21 items, of three difficulty levels, for use in our study. We attempted to select items representative of their range. The average difficulty scores of the three groups of items thus obtained were 4.2 (difficult items), 37.8 (moderate items), and 72.1 (easy items).

### Experiment 3

#### Method

**Subjects.** Subjects were 24 male and 22 female students enrolled in introductory psychology classes who participated as part of a course requirement. Approximately half the subjects in each condition were

Table 6

*Study 3: Mean Number of Remote Associates Test Items Correct in Each Condition*

Condition	High difficulty		Moderate difficulty		Low difficulty	
	<i>M</i>	<i>MS<sub>e</sub></i>	<i>M</i>	<i>MS<sub>e</sub></i>	<i>M</i>	<i>MS<sub>e</sub></i>
Candy	.50	.66	4.38	2.57	5.38	3.45
Control	.60	.36	3.45	3.00	5.10	3.04

*Note.* For the candy condition,  $n = 26$ . For the control condition,  $n = 20$ .

male (12 women and 14 men in the positive-affect condition; 10 women and 10 men in the control).

**Procedure.** Subjects were assigned randomly to either a positive-affect or a neutral-affect condition. In the positive-affect condition, the experimenter thanked the subjects for coming and gave them a decorated bag of candy (10 pieces of wrapped hard candy in a Glad Funtime sandwich bag), which has been used in other studies to induce affect (e.g., Isen et al., 1985). In the neutral-affect control condition, there was no attempt to manipulate affect.

Subjects, working independently at separate desks, were given a shortened version (the 21 items described) of the Remote Associates Test. On the basis of the pretest results, subjects were presented with seven easy, seven moderately difficult, and seven very difficult items. The items were presented in random order in a booklet, with one on each page, and subjects were given the usual instructions for the Remote Associates Test. Each subject was allowed to work on the test until he or she had finished or felt that additional time would be of no use in solving the problems. At the end of the session, subjects were debriefed and given credit for participation, as always.

#### Results and Discussion

Table 6 presents the mean number of each type of item correct, by condition. A mixed-design ANOVA, with affect as a between-subjects variable and item difficulty level as a within-subjects variable, was performed on the data. This analysis revealed a main effect of difficulty level,  $F(2, 88) = 174.48, p < .0001$ . Planned comparisons showed that, as might be expected, subjects performed significantly better on the moderately difficult items than on the very difficult items,  $t(88) = 13.52, p < .01$ , and significantly better on the easy items than on the moderately difficult items,  $t(88) = 5.05, p < .01$ .

We predicted that positive affect should facilitate performance on items of moderate difficulty. It was less clear, however, if positive affect would influence performance on easy or difficult items, because of restricted ranges of performance in these conditions (e.g., something like a ceiling effect with easy items and a floor effect with difficult items). An examination of the means indicates that a floor effect did occur on difficult items: Very few subjects could answer any of these items correctly. Also, scores on the easy items in every condition were fairly high, indicating that most subjects, regardless of affective state,

<sup>3</sup> We wish to thank Martha T. Mednick for making the Remote Associates Test items available to us.

<sup>4</sup> The correct answer to this item is *power*.

found these items quite easy. Therefore, it is not surprising that the main effect for affect was not significant,  $F(1, 44) = 1.32$ ,  $p < .26$ . Although the interaction between affect and difficulty level only approached but did not reach the customary significance level,  $F(2, 88) = 2.09$ ,  $p = .13$ , a planned comparison indicated that positive affect resulted in improved performance on the moderately difficult items, as predicted,  $t(110) = 2.13$ ,  $p < .025$ .<sup>5</sup>

Thus, Study 3 indicated that positive affect induced by means of a small gift could facilitate creativity as indicated by performance on the Remote Associates Test. This extends the previous findings by showing that affect-induction procedures other than humor can give rise to creative responding, and it demonstrates the impact of affect on creativity as measured by a task other than Duncker's candle task.

### Experiment 4

Experiment 4 was conducted to replicate conceptually the results of Experiment 3. In this experiment, the comedy film described earlier was used to induce affect and, as in Experiment 2, a control for the effect of arousal was added.

### Method

**Subjects.** Ninety-eight male and female college students participated in this experiment in exchange for extra credit toward their introductory psychology grade. A maximum of 5 subjects participated in any given session.

**Procedure.** Subjects who had been assigned randomly to one of three conditions—comedy film, exercise, or no manipulation—were told that they would be helping to develop procedures and materials for experiments to be run at a later time.

Subjects who had been assigned to the exercise condition were asked to perform the step exercise, described in conjunction with Study 2, for 2 min. All subjects complied, and pre-exercise and postexercise heart rate measures were taken. The average subject's heart rate increased 66%.

Subjects in the comedy-film condition were shown the same segment of *Gag Reel* described in Experiments 1 and 2. As before, they were instructed not to try to memorize anything from the film but just to watch it and get a general impression of it.

Next, all subjects were told that norms for an association task needed to be established. The seven Remote Associates Test items (each consisting of a set of three words) that had been determined to be of moderate difficulty (Study 3) were then read to subjects, who were asked to write them down as read. They were then given 15 min to complete the task.

### Results

The data from 6 subjects in the comedy-film condition, 5 in the no-manipulation condition, and 1 in the exercise condition were discarded because of failure of subjects to follow instructions or to hear or transcribe the items correctly.

Table 7 presents the number of items correct in each of the three conditions. A one-way ANOVA with three levels of the affect variable was performed. There was a significant main effect for affect,  $F(2, 83) = 5.96$ ,  $p < .01$ . Planned comparisons revealed a difference between the comedy-film and no-manipulation conditions,  $t(83) = 3.40$ ,  $p < .01$ , whereas the difference between the exercise and no-manipulation conditions was not

Table 7  
*Study 4: Mean Number of Remote Associates Test Items Correct in Each Condition*

Condition	<i>M</i>	<i>MS<sub>e</sub></i>	<i>n</i>
Comedy film	5.00	3.69	33
No manipulation	3.04	6.35	26
Exercise	3.81	4.84	27

significant,  $t(83) = 1.28$ ,  $p > .1$ . As in Experiment 2, a planned comparison revealed that the positive-affect and exercise conditions differed significantly also,  $t(83) = 2.08$ ,  $p < .025$ .

### General Discussion

Results of these four studies taken together show that positive affect, induced by a comedy film or a small gift of candy, can facilitate creative responding on tasks usually thought to reflect creativity. At the same time, a manipulation designed to induce negative affect (negative film) and one promotive of arousal devoid of any particular affective tone (exercise) had no effect on these measures. Thus, it appears that elation, if it involves arousal, is unlike some other aroused states in that it seems to lead to the kinds of thinking that enable people to solve problems that require ingenuity or innovation.

It has been proposed that a creative-problem-solving task is one involving the ability to see relatedness in diverse stimuli that normally seem unrelated. This is the essence of the definition of creativity provided by a number of theorists: S. A. Mednick (1962), for example, has proposed that creativity involves the combination of elements that are remotely associated; Koestler (1964) spoke of bisociation, the association and combination of two different frames of reference; and the mathematician Poincaré (cited in Martindale, 1981) suggested that creativity involves useful new combinations of associative elements. At the same time, a similar process—one of seeing relatedness in stimuli that are not usually seen as related to one another—has been proposed and demonstrated to result from the induction of a happy affective state (e.g., Isen, 1984, in press; Isen & Daubman, 1984; Isen et al., 1985). Thus, it makes sense that a person who is feeling good might be more creative than others (or than she or he might be at another time).

These results indicate that creativity, an important skill that is often thought of as a stable characteristic of persons, can be facilitated by a transient pleasant affective state. Moreover, the affective state sufficient to do this can be induced subtly, by small everyday events. This suggests that creativity can be fostered by appropriate modification of the physical or interpersonal environment.

Our findings have potential application to several domains.

<sup>5</sup> This contrast for a mixed design requires a combined error term based on both the between-subjects error term and the within-subjects error term. The degrees of freedom were computed by use of the formula found in Winer (1971, p. 545). The critical value was computed according to the formula found in Kirk (1982, p. 508) and described there as a conservative test. A value of 2.01 is needed for  $p = .025$ .

Their implications for the educational enterprise are clear: Teachers (and the students themselves) should regard everyone as potentially creative, and an effort should be made to provide the conditions that are conducive to creativity. One of those conditions is a happy feeling state. Although we induced this state by means of a small gift of candy and a comedy film in these experiments, it is likely that other inductions of good feeling might also be effective in facilitating creativity. We would suggest, for the educational context, that an atmosphere of interpersonal respect conducive to good self-esteem might be the kind of condition that would promote creativity.

These results are also potentially relevant to other settings, including other organizational settings such as businesses, in which leaders seek to promote creativity or innovative problem solving. Once again, the most important way of inducing good feelings may be by allowing workers to achieve a sense of competence, self-worth, and respect. Pleasant surprises may also be effective, but if used too frequently, they will become expected and may lose their ability to induce happy feelings.

Finally, our findings may bear on interpersonal problem solving more generally. A recent study has reported that persons in whom positive affect was induced negotiated more effectively and obtained higher joint benefits on an integrative bargaining task that required finding an innovative solution (Carnevale & Isen, 1986). The creation and maintenance of good interpersonal relationships often involves finding ways of resolving disputes or negotiating arrangements of various kinds. When these would benefit from a creative approach, positive feelings might facilitate the interpersonal process. Thus, it may be possible to extend our findings regarding the facilitative effect of good feelings on creative problem solving to many organizational and interpersonal domains.

### *Arousal*

In these studies we have attempted to address a possible alternative interpretation of the effect observed in Study 1, namely that positive affect constitutes an aroused state and therefore the effects on creativity are attributable to arousal rather than to positive affect. For this reason, we included groups engaging in exercise (to represent arousal with no affective tone), and the negative-affect induction can be seen as representing the kind of arousal associated with upset, anxiety, or anger. Neither of these types of conditions produced any significant increase in creativity over that displayed by control groups; moreover, each was found to be significantly below comparison positive-affect conditions. Thus, it does not appear that arousal alone is sufficient to result in creativity, even though such a hypothesis might follow from spreading-activation theory (e.g., Anderson, 1983). Moreover, it does not seem appropriate to attribute the observed effect of positive feelings on creativity to increased arousal.

Indeed, it is not clear whether positive affect does in fact create an aroused state, although many people assume so. (See Isen et al., 1985, for a fuller discussion of this issue.) Recently Mandler, long a proponent of the role of arousal in emotion, suggested that arousal is not a central component in the type of affect state (pervasive affect, or mood) involved in these studies (Mandler, 1984, p. 277).

Although it is not possible to say for certain that positive affect of the kind used in these studies (mild elation) involves no arousal, it does seem clear that feeling good has effects different from those commonly associated with or produced by arousal. For example, it is not clear that arousal should be expected to facilitate creativity. Arousal of at least some types has been shown to increase a person's likelihood of giving dominant or usual responses (e.g., Matlin & Zajonc, 1968) and, compatibly with that finding, to improve performance on simple tasks but to impair performance on complex tasks or tasks requiring innovation (e.g., Martindale, 1981; Yerkes & Dodson, 1908). In contrast with effects that have been observed for arousal, positive affect has been shown to facilitate unusual responding rather than typical responding in several kinds of tasks (e.g., Isen & Daubman, 1984; Isen et al., 1985). This is in addition to the results obtained in the present studies that demonstrate a facilitative effect of positive feelings, but none of arousal, on creative problem solving.

Thus, in sum, there seems to be reason that we should not think of elation as involving arousal. Yet the mere use of the term *elation*, rather than *positive affect*, in the preceding sentence makes clear how difficult it will be to think of positive affect as devoid of arousal. Thus, let us conclude by saying that even if positive affect does have an arousal component or does result in increased arousal, it also has other effects: it has been demonstrated to have influences on cognition and behavior that mere arousal does not.

### *Negative Affect and Creativity*

Study 2 included one group in which negative affect was induced; this group failed to differ from the relevant control group and scored significantly lower than those in the comparable positive-affect condition. We interpreted this result as suggesting that negative affect neither facilitates nor impairs creativity. However, a few words of caution are warranted here.

First, negative affect was induced in only one study, by only one means. The film that we showed for the purpose (*Night and Fog*) undoubtedly does induce unpleasant feelings in most persons, and our manipulation check confirmed this expectation. However, there may be something specific to this particular means of affect induction that produced the observed outcome. In particular, this film is about a very disturbing chapter in the history of the world, and it depicts suffering with great impact. Therefore, its intensity level may be incomparable to those of the other affect inductions used. Moreover, conversations with persons who have seen the film suggest that it may induce more than one negative affect at once (disgust, sadness, anger, shame, regret, fear, and despair have been reported by students viewing the film in classes). This complexity could complicate interpretation of the effects of the film. Finally, as noted, the film is about something relatively specific, and this specificity of content may influence cognitive processes in ways independent of the affect induced. Thus, before conclusions can be drawn regarding the impact of negative affect on creativity, studies inducing negative affect in more than one way (and perhaps differentiating among negative affects such as sadness, fear, and anger) should be conducted. It is still possible that negative



affect may be found to influence creative problem solving in some way.

More specifically regarding negative affect, it should be noted that our negative-affect induction did not result in impaired creativity. Sometimes it is inviting to think of positive and negative affect as, if not the same thing (arousal, as discussed earlier; Duffy, 1934, 1941), then opposite poles of a single dimension and therefore likely to produce opposite effects. Thus, some might interpret our finding regarding the impact of positive affect on creativity as suggestive that negative affect should impair creativity. This may yet be true, when appropriate levels and types of negative affect are investigated; however, on the basis of the information now available, such a conclusion or prediction would seem unwarranted. Rather, positive and negative affect may be seen as distinct states, influencing behavior in accord with the thoughts that each brings to mind and the processes that each fosters.

Moreover, this view would suggest that individuals may differ in the impact that affect states may have on them, depending on the cognitive patterns available to them and the coping strategies that they typically use. One may expect commonalities among people, and indeed results of our studies do indicate predictable effects of positive-affect inductions in general; however, individuals may differ, possibly in identifiable ways having to do with cognitive structure. Thus, although negative affect may not typically facilitate creativity for most people, the case of Edgar Allan Poe or Vincent van Gogh can be understood as exceptions.

Mention of these two creative geniuses not only points out the possibility of individual differences but also underscores the potential distinction with regard to the creative process between normal persons and those clinically depressed or otherwise emotionally disturbed. It may be that for clinical depressives, compared with normal persons, more cognitive material is accessed by sadness; and it may also be that for such persons sadness cues more material than other affective states do. If so, the process proposed to occur with happiness for normal persons (i.e., increased access to a large range and amount of material) may occur in response to sadness for these persons. The asymmetry between the cuing effects of happiness and sadness in normal persons has been discussed recently (e.g., Isen, 1984, 1985), and this kind of cognitive difference between depressives and normals has been hypothesized. However, at present it remains to be investigated.

### Cognitive Capacity

The results of the four studies presented in this article suggest that it would be unwise to think of positive affect as reducing cognitive capacity or as, for some other reason, leading to lazy and inefficient problem solving. Earlier research reported effects—such as increased use of heuristics, more rapid decision making, and broadened categorization among positive-affect subjects (e.g., Isen & Daubman, 1984; Isen & Means, 1983; Isen, Means, Patrick, & Nowicki, 1982)—that might have been seen as evidence of lowered cognitive capacity. Most of those effects provided stronger evidence for changes in process than for changes in available cognitive capacity as a result of positive affect; however, the alternative interpretation remained

possible. Our findings suggest that that alternative is not appropriate, because they show *improved* performance on the part of persons in positive-affect states and, in fact, improved performance on tasks usually considered very difficult and demanding of cognitive capacity. Thus, it seems that positive affect should be viewed as influencing the way in which material is processed, rather than just the amount of capacity present.

In conclusion, the interpretation that we have suggested for the impact of positive affect on creative problem solving is that good feelings increase the tendency to combine material in new ways and to see relatedness between divergent stimuli. We hypothesize that this occurs because the large amount of cognitive material cued by the positive affective state results in defocused attention, and the more complex cognitive context thus experienced by persons who are feeling happy allows them a greater number and range of interpretations. This increased range of interpretations results in awareness of more aspects of stimuli and more possible ways of relating and combining them.

One question that remains regarding this process is whether persons in positive states notice more features of stimuli because of the increased number of interpretations of them (thus rendering more of their features useful, functional, and therefore salient). Another question arising from the formulation presented here is whether these processes also promote schematic functioning and whether, therefore, persons who are feeling happy may also be likely to structure material in schematic or functional ways. These two kinds of processes, although different, would not seem to be mutually exclusive. Moreover, together they would account for the very distinct kinds of cognitive processing shown by persons in whom positive affect has been induced. Thus, these seem particularly good questions for further study.

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