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Effects of Arousal on Judgments of Others' Emotions

Margaret S. Clark, Sandra Milberg, and Ralph Erber
Carnegie-Mellon University

Based on evidence that arousal cues information from memory associated with a similar level of arousal (Clark, Milberg, & Ross, 1983) and on evidence that people will base judgments on the information that is most available to them (Tversky & Kahneman, 1974), it was hypothesized that (a) increases in arousal would increase the likelihood that subjects would interpret positive statements and positive facial expressions as indicating a positive emotion associated with high arousal (joy) rather than a positive emotion associated with low arousal (serenity), and (b) increases in arousal would increase the likelihood that subjects would interpret negative statements and negative expressions as indicating a negative emotion associated with high arousal (anger) rather than a negative emotion associated with low arousal (sadness or depression). Two studies are reported, each of which support the first hypothesis but not the second. Explanations for why arousal had the predicted effects on positive but not on negative stimuli are offered.

Recently there has been considerable work demonstrating that a perceiver's positive or negative mood state may bias evaluations of stimuli in his or her environment to reflect that mood (e.g., Gouaux, 1971; Isen & Shalker, 1982; Isen, Shalker, Clark, & Karp, 1978). In addition, evidence that perceivers' specific emotions (e.g., fear, disgust) influence judgments about other people's emotional states, such that those judgments become more consistent with the perceiver's own emotional state has been reported (Feshbach & Feshbach, 1963; Feshbach & Singer, 1957; Hornberger, 1960; Murray, 1933; Schiffenbauer, 1974a, 1974b). An explanation for such findings offered by Isen (1975; Isen et al., 1978) and Bower (1981) is that feeling states increase the accessibility of similarly toned material from memory. Thus, if one is evaluating an object while in a positive mood, positive thoughts about the object ought to be more likely to come to mind than usual. On the other hand, if one is in a negative mood, negative thoughts about the object ought to be more likely to come to mind than usual. Then, because these thoughts are more available than other thoughts, they may in turn influence judgments about the objects being evaluated (cf. Tversky & Kahneman, 1974).

Thus far the literature on the influence of mood states on judgments has focused primarily on the positive–negative dimension of moods, whereas the literature on the effects of specific emotions on judgments has tended not to break those emotions down into underlying dimensions. A potentially important dimension of affective states that has been neglected in this work is the level of autonomic arousal associated with a particular emotional state.

Different emotional states do intuitively involve different levels of arousal (e.g., serenity vs. joy, sadness vs. anger). Furthermore research supports the idea that emotional states vary not only in terms of positivity–negativity but also in terms of the level of associated arousal (e.g., Bush, 1973; Russell, 1980; Schwartz, Weinberger, & Singer, 1981). Russell (1980), for instance, had four groups of subjects scale affect stimulus words, each using a different technique: a multidimensional scaling procedure based on the perceived similarity of the terms, a unidimensional scaling of the terms on pleasure–displeasure and arousal dimensions, a principal-components factor

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Requests for reprints should be sent to Margaret S. Clark, Department of Psychology, Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213.

analysis of subjects' self-reports of their current affective states, or a category sort technique developed by Ross (1938). Russell's work provided evidence that these adjectives could be represented well as a circle in a two-dimensional bipolar space, the dimensions being pleasure–displeasure and degree of arousal. Schwartz et al. had subjects imagine themselves experiencing happiness, sadness, anger, and fear, and then measured diastolic and systolic blood pressure as well as heart rate. They found that imagining certain emotions (e.g., anger) was associated with higher overall increases on these cardiovascular measures than was imagining other emotions (e.g., sadness).[1]

Given such evidence that emotional states are associated with different levels of arousal, it is reasonable to hypothesize that the level of arousal one is experiencing may influence one's judgments regarding the emotional states being experienced by others. Specifically, people experiencing high levels of arousal may be more likely than usual to perceive others as experiencing high-arousal emotions (e.g., joy or anger). Similarly, people experiencing low levels of arousal may be more likely than usual to perceive others as experiencing low-arousal emotions (e.g., serenity, depression, or sadness). The remainder of the introduction and the two studies reported thereafter are devoted to making a detailed case for this hypothesis.

The case that arousal may bias judgments of others' affective states begins with a recent finding that autonomic arousal cues material from memory associated with a similar level of arousal. Clark, Milberg, and Ross (1983, Studies 1 and 2) conducted two studies in which subjects learned one list of word phrases when experiencing high arousal and a second list when experiencing low arousal. Later, while experiencing either high or low arousal, each subject was unexpectedly asked to recall as many phrases as possible from both lists. In both studies, subjects recalled material best when their level of arousal at recall approximately matched their level of arousal at learning. These effects held even when the manipulations of arousal at learning (exercise for high arousal and relaxation for low arousal) were very different from the manipulations of arousal at recall (viewing a sexually explicit film for high arousal and viewing an educational film for low arousal).

This finding, together with evidence that people base decisions on the information that is most readily available to them (Tversky & Kahneman, 1974), suggests that when people are themselves aroused, they may be more likely to judge others as feeling emotions associated with high arousal than usual. Such biased judgments might result from a two-stage process analogous to the process through which Isen et al. (1978) have suggested that moods may influence judgments. First, when a highly aroused person focuses attention on a stimulus in the environment, the arousal should cue arousal-related information stored in memory and the stimulus should cue stimulus-related information. Consequently, arousal-related thoughts about the stimulus ought to be more likely than usual to come to mind. Second, the increased availability of this information should make it more likely than usual to influence judgments about the stimulus.

Consider the following example of how judgments concerning the emotion being experienced by a smiling person might be influenced by the perceiver's own state of arousal. First, recall that some feelings are associated with higher arousal than are others (Russell, 1980; Schwartz et al., 1981). Joy, for instance, is a high-arousal, positive emotion, whereas serenity is a low-arousal, positive emotion. Next, note that both joy and serenity are associated with some of the same stimuli in the environment (e.g., with smiles). Now think about what should happen when a perceiver sees a smiling person and is asked to judge what emotion that person is experiencing. If the perceiver is highly aroused, arousal combined with the other's smile may bring thoughts of joy to the perceiver's mind, while at the same time the high arousal may block thoughts of serenity. On the other hand, if the

[1] The Schwartz et al. (1981) study also provided clear evidence that different emotional states are associated with different *patterns* of autonomic system arousal, as have many other studies (e.g., Ax, 1953; Sternbach, 1962). Although the variable of primary interest in the present study is the overall level or intensity of arousal rather than the patterning of specific arousal states, the idea that level of arousal can influence psychological judgments does not preclude the possibility that specific patterns of arousal might have effects similar to those we will describe for levels of arousal.

perceiver is experiencing low arousal, the low arousal combined with the smile may bring thoughts of serenity to the perceiver's mind and may simultaneously block thoughts of joy from coming to mind. If the perceiver is then asked to judge what the smiling person is feeling, the highly aroused perceiver may be more likely than usual to say "joy," whereas the perceiver experiencing low arousal may be more likely than usual to say "serenity."

Analogous reasoning yields the prediction that the degree of arousal may bias perception of *negative* stimuli. For example, anger is associated with high levels of arousal; depression and sadness are associated with lower levels of arousal (Russell, 1980; Schwartz et al., 1981). Consequently, a person experiencing high arousal may be more likely than usual to interpret a negative appearance as anger, whereas a person experiencing low arousal may be more likely than usual to interpret the same appearance as indicating depression.

Given this reasoning, we conducted the present studies to test the following specific hypotheses:

1. People experiencing high arousal will be more likely than people experiencing low arousal to interpret positive statements and positive facial expressions as indicating joy rather than serenity.

2. People experiencing high arousal will be more likely than people experiencing low arousal to interpret negative statements and negative facial expressions as indicating anger rather than sadness or depression.

These hypotheses were examined in two studies (a field study and a laboratory study). The first study examined whether arousal would bias interpretations of the emotions indicated by things another might say; the second examined whether arousal would bias interpretations of the emotions indicated by another's physical appearance.

Study 1

Method

Subjects

Subjects were 37 adult tennis players, 23 males and 14 females. They were initially identified while waiting to play tennis at a city park. All were recruited by an experimenter who, either before or after their game, asked them to volunteer for a short project. No person refused.

Stimulus Materials

Phrases. For use in the study, we selected a set of five positive phrases that a person who was feeling either serene or joyous might say and a set of five negative phrases that a person who was feeling either depressed or angry might say. The positive phrases were (a) "Just look at that sunset," (b) "I should have more days like today," (c) "For the most part, people are pretty nice," (d) "Life is going well," and (e) "I really like my work." On scales ranging from 1 (indicating serenity) to 7 (indicating joy), 10 pretest judges gave these positive phrases a mean rating of 2.8. The negative phrases were (a) "I'm tired of this," (b) "I'd like to be left alone," (c) "I'm so dumb," (d) "I can't do this," and (e) "Why did that happen?" On scales from 1 (indicating depression) to 7 (indicating anger), 10 pretest judges gave these negative phrases a mean rating of 3.0.[2]

In selecting stimuli, we intentionally selected positive phrases with a slight bias toward serenity and negative phrases with a slight bias toward depression. These biases were sought because if the results did support our hypotheses, they would rule out a Hull-Spence alternative explanation (Hull, 1943, 1952; Spence, 1956). In other words, if arousal biased judgments toward joy or anger, the bias could not be explained by arguing that arousal increased subjects' tendencies to give their dominant response.

Ratings of terms anchoring the endpoints of scales. In this research we used scales anchored by the terms *serenity* and *joy* or by the terms *depression* and *anger.* To check our assumptions that people consider serenity and joy to differ in arousal but to be equally positive and that they consider depression and anger to differ in arousal but to be equally negative, we had judges rate these terms for arousal and positivity or negativity. As expected, judges' arousal ratings for serenity on a 7-point scale from low (1) to high (7) arousal ($M = 2.2$) were significantly lower than their arousal ratings for joy ($M = 4.3$), $t(20) = -6.38$, $p < .001$, whereas their positivity ratings of these terms on similar scales (4.6 and 4.9, respectively) did not differ significantly. Also as expected, judges' arousal ratings for depression ($M = 2.2$) were significantly lower than their arousal ratings for anger ($M = 4.7$), $t(16) = 5.63$, $p < .001$, whereas negativity ratings of these terms (4.6 and 3.8, respectively) did not differ significantly.

Procedure

To conduct the study, the experimenter went to a city park with many tennis courts. Alongside these courts are benches on which people wait until a court becomes free. The experimenter randomly assigned each waiting person

[2] Additional pretesting involving separate ratings of each positive phrase for joy and for serenity and of each negative phrase for depression and for anger indicated that these phrases were not given ratings near the middle of the original scale because judges saw them as indicative of *neither* of the emotions anchoring the ends of the scales.

to either a high- or a low-arousal condition. Those subjects assigned to the low-arousal condition were approached before they played and were asked to participate in a short psychology experiment. Subjects assigned to the high-arousal condition were approached with the same request immediately after having played. Subjects were also randomly assigned to rate either the five positive phrases or the five negative phrases. A total of 17 subjects filled out a questionnaire before playing tennis. Nine (6 males and 3 females) rated the positive statements, and 8 (4 males and 4 females) rated the negative statements. A total of 20 subjects filled out a questionnaire after playing tennis. Ten (6 males and 4 females) rated the positive statements, and 10 (7 males and 3 females) rated the negative statements.

After agreeing to participate, each subject was handed a sheet with five positive or negative phrases. The phrases appeared in the same order on each sheet. Each phrase was followed by a single 7-point scale with 1 indicating serenity or depression and 7 indicating joy or anger. After completing the scales each subject was thanked and debriefed.

Results

The dependent measure was the sum of each subject's ratings of the five phrases. For subjects in the positive conditions, the higher the sum, the greater the tendency to perceive joy rather than serenity. For subjects in the negative conditions, the higher the sum, the greater the tendency to perceive anger rather than depression. Results on each of these measures were examined separately.

Judgments About Positive Statements

The mean sum of the five ratings for subjects who read the positive statements *before* playing tennis was 15.22, whereas the mean sum for subjects who rated the same statements *after* having played tennis was 27.50. Indeed, among these subjects there was no overlap between scores in the low- and high-arousal conditions. The highest sum in the low-arousal condition was 19 and the lowest sum in the high-arousal condition was 25. Not surprisingly, a two-tailed t test indicated a significant difference between the scores in the pre- and posttennis conditions, $t(17) = 12.9$, $p < .0001$.

Judgments About Negative Statements

Having played tennis also biased the judgments of people who read the negative statements as predicted. The mean sum of the three ratings for subjects who read the negative statements before playing tennis was 19.50, whereas the mean sum for subjects who rated the same statements after having played tennis was 23.40. A two-tailed t test indicated the expected significant difference between these scores, $t(16) = 3.4$, $p < .004$.

Discussion

The results of the first study are clearly consistent with the hypotheses. High arousal seems to have biased the judgments of positive stimuli toward joy and the judgments of negative stimuli toward anger. However, the results of this study must be interpreted with caution. There is a plausible alternative explanation for these results. Specifically, there is no reason to suspect that before playing tennis, our subjects were feeling either particularly joyous or angry, rather than particularly serene or depressed. After playing, however, subjects who won may have been feeling joyous while subjects who lost may have been feeling angry. Thus the joy of a subset of our posttennis subjects (rather than arousal per se) may have biased our high-arousal, positive group's scores toward joy rather than serenity. Similarly, the anger of a subset of our posttennis subjects (rather than arousal per se) may have biased our high-arousal, negative group's scores toward anger rather than depression.

We did not ask subjects whether they had won or lost, so it was difficult to rule out this alternative explanation. However, recall that in the case of the results obtained for ratings of the positive statements there was no overlap in the scores between the high- and low-arousal subjects. Thus, an alternative explanation involving the assumption that some subset of our subjects were experiencing joy as a result of winning (perhaps as many as half) cannot entirely explain this result. To examine this argument, we eliminated half the data in the high-arousal, positive statements condition, specifically the five *highest* ratings of joy (i.e., the data most favorable to our hypothesis). Then we performed a second two-tailed t test using the data from the five remaining high-arousal subjects and from all the subjects in the low-arousal condition. In this analysis, the mean in the high-arousal condition became 26.2, whereas the mean in the low-arousal condition remained at 15.2. The new test still indicated a significant difference between conditions, $t(12) = 9.61$, $p < .0001$. Thus, despite the potential alternative explanation, the re-

sults still support the hypothesis that arousal biases the perception of positive stimuli.

We performed a similar reanalysis to see whether the hypothesis that arousal would bias perception of negative statements would be supported after eliminating the alternative explanation for that result. The five highest scores in the high-arousal condition (i.e., those indicating greatest anger) were eliminated. Then we repeated the analysis using the remaining subjects in that condition and all subjects in the low-arousal condition. The mean in the high-arousal condition became 21.6, whereas the mean in the low-arousal condition remained at 19.5. Although the difference between the means was still in the expected direction, it was no longer significant. Thus the first study did not provide clear evidence that arousal biases perception of negative stimuli.

Despite the results of this first study, however, we were unwilling to conclude that arousal would bias perception of positive but not of negative stimuli. Although we did control for the alternative explanation, only 4 subjects remained in the high-arousal, negative condition. This was not a sufficient number to provide for an adequate test of our hypothesis. Thus it seemed wise to conduct another experiment.

In designing the second experiment we chose an arousal manipulation that was not associated with winning or losing. In addition, several other design improvements were also made. First, the study was designed in such a way that the experimenter collecting the dependent variable was unaware of the subject's arousal condition. Second, the term anchoring the low arousal end of the negative scale, *depressed,* was replaced with the term *sad* because it seemed remotely possible that subjects considered the term *depressed* to mean *clinically depressed,* a state with which the majority probably had had no personal experience. Given that, the absence of any arousal effects on negative judgments might have been due to subjects' feeling forced to make negative judgments on bases other than their personal memories. Finally, instead of using single scales anchored by low- and high-arousal terms for rating stimuli, we rated each positive stimulus on two scales, one for the degree of joy depicted and one for the degree of serenity depicted. Each negative stimulus was also rated on two scales, one for sadness and one for anger. This would allow us to detect whether the effect of arousal observed in the first study was due to an increased tendency to perceive high-arousal emotions, a decreased tendency to perceive low-arousal emotions, or—as we suspected—both tendencies.

Study 2

Method

Subjects

Subjects were 38 students (21 males and 17 females) who partly fulfilled a course requirement by participating. The data from three potential subjects were eliminated. One, who was run in the low-arousal, positive condition, clearly indicated to the experimenter that he did not know what "serenity" meant. The remaining two, both in the high-arousal, negative condition were suspicious. They believed that two parts of our study that were presented as being unrelated really were related.

Stimulus Materials

Photos. For use in the study, we selected a set of six positive photographs depicting a person who might be feeling either serenity or joy and a set of six negative photographs depicting a person who might be feeling either sad or angry. The positive photographs included five photographs of women and one of a man. On separate scales ranging from 1 (low) to 5 (high), one for how serene the person was and one for how joyous the person was, 16 pretest judges gave these six positive photographs a mean serenity rating of 3.9 and a mean joy rating of 2.8. The negative photographs included three photographs of women and three of men. On two separate 5-point scales for sadness and anger, 12 to 16 pretest judges (the number varied depending on the particular photograph) gave these photographs mean sadness and anger ratings of 3.1 and 2.7, respectively. As in Study 1, stimuli slightly biased toward the low-arousal ends of the scales were favored. Again, this was done to guard against a Hull-Spence alternative explanation for the results should the results confirm our hypotheses.

Separate rating of the term sad. In this study negative scales were anchored by the terms *sadness* and *anger,* which we assumed differed in the degree of associated arousal but not in negativity. Nine judges rated these terms for arousal and positivity/negativity. As expected, judges' arousal ratings for sadness ($M = 2.3$) were significantly lower than their arousal ratings for anger ($M = 4.7$), $t(16) = 6.26$, $p < .0001$. Also as expected, judges' negativity ratings of sadness ($M = 3.8$) and anger ($M = 3.8$) did not differ significantly.

Procedure

Before arrival, each subject was randomly assigned to one of the following four conditions: (a) high-arousal, positive photos (5 males and 3 females), (b) low-arousal, positive photos (7 males, 3 females), (c) high-arousal, negative photos (5 males, 5 females), or (d) low-arousal, negative photos (4 males, 6 females). Upon arrival, each subject

was greeted by the first experimenter, who said the research session would include two short studies—pretests for later studies. She would conduct the first session; another person would conduct the second. The two pretests were presented as unrelated projects that were being run together for one credit because each only took 15 minutes.

The first experimenter then explained her pretest. She was interested in how various amounts of exercise and relaxation affected people's pulse rates. Therefore she was going to ask the subject to do some mild exercise as well as to relax in a lounge chair. The subject's pulse rate would be taken before and after each task. All subjects were asked at this point if there was any reason why they should not exercise; they were assured that if there was, they would not have to exercise but they would still receive credit. No subject indicated that he or she should not exercise.

Next, subjects were told they would do one of the first experimenter's two tasks, then participate in the second experimenter's study, and finally return to the first experimenter for the second task. This plan was supposedly being followed to allow the subject's pulse following the first task to return to normal before the start of the second task.[3] Half the subjects (those in the high-arousal condition) began with the exercise task; the other half (those in the low-arousal condition) began with the relaxation task. Subjects in the high-arousal (exercise) condition had their pulse taken, stepped up and down on a cinder block for 7 min and finally had their pulse taken a second time. Subjects in the low-arousal (relaxation) condition had their pulse taken, relaxed in a lounge chair for 7 min, then had their pulse taken a second time.[4]

After completing the first experimenter's first task, all subjects were taken to the second experimenter's room. The first experimenter introduced the subject to the second experimenter, who was unaware of the subjects' arousal condition. The first experimenter then asked the second experimenter to send the subject back when the "second pretest" was over, and finally she left the room.

The second experimenter said he was interested in moods. He wanted to know if it was possible to infer a person's moods from photographs. To study this, he wanted the subject to look at some photographs and to judge the emotion depicted by the people in those photographs. Half the subjects looked at the six positive photos and rated each person's serenity on a scale from 1 (not at all serene) to 7 (very serene). These subjects also rated the joyousness of the people in same photographs on a second scale from 1 (not at all joyous) to 7 (very joyous). The remaining half of the subjects looked at the six negative photos and rated each on two similar 7-point scales, in terms of how angry and in terms of how sad the person seemed to be. The order of presentation of the six photographs was randomized for each subject. Subjects who rated positive photos always rated them in terms of serenity first, then in terms of joy. Subjects who rated negative photos always rated them in terms of sadness first, then in terms of anger. Finally subjects were probed for suspicion and were fully debriefed by the second experimenter.

Results

The dependent measure for the positive stimuli was the difference between the sum of each subject's ratings of the five positive photographs on serenity and the sum of his or her ratings of the same photographs on joy (scores on the serenity scale were subtracted from scores on the joy scale). Higher scores on this measure indicate a greater tendency to judge the photographs as indicating joy than serenity. The dependent measure for the negative stimuli was the difference between the sum of each subject's ratings of the five negative photographs on sadness and the sum of his or her ratings of the same photographs on anger (the sadness score was subtracted from the anger score). Higher scores on this measure indicate a greater tendency to judge the photographs as indicating anger than sadness.

As in Study 1 the effect of arousal on judgments about the positive stimuli was as predicted. The difference scores from the high-arousal subjects indicated a significantly greater tendency to perceive joy relative to serenity ($M = 2.1$) than that shown by the low-arousal subjects ($M = -4.9$), $t(16) = -2.72$, $p < .02$. In contrast, once again analogous evidence was not obtained for negative stimuli. The mean rating of these stimuli by the high-arousal subjects (−1.5) did not differ significantly from the mean rating by the low-arousal subjects (0.2), $t(18) = 0.56$, *ns*.

It is also worth noting the impact of arousal on ratings of joy and on ratings of serenity separately. On the index of joy, the mean for subjects in the high-arousal condition was 27.6,

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[3] In fact, as will become evident shortly, at the conclusion of the study, subjects in the high-arousal condition had performed only the exercise task, and subjects in the low-arousal condition had performed only the relaxation task. However, all subjects were led to believe they would do both because we believed that simply being told that one was expected to perform the relaxation or the exercise task might produce an emotional reaction. Given this, we told subjects in both arousal conditions that they would be performing the same two tasks to keep such reactions comparable.

[4] Because it takes some time to locate and count a person's pulse—time during which arousal would be dropping—and because previous research had clearly indicated the effectiveness of these manipulations (Clark et al., 1983), the experimenter actually did not measure pulse rates. She simply pretended to efficiently do so for purposes of the cover story. In the Clark et al. (1983) study a check on the identical manipulations revealed that stepping up and down on the cinder block for 7 min produced significantly greater increases in pulse from pre- to posttask (mean change = 45) than did the relaxation task (mean change = −0.15), $t(4) = 8.1$, $p < .001$.

and the mean for subjects in the low-arousal condition was 25.10. This difference, although it was in the expected direction, was not, by itself, significant. On the index of serenity, the mean for subjects in the high-arousal condition was 25.5 and the mean for subjects in the low-arousal condition was 30.0. This difference, although also in the expected direction, was not by itself significant.

General Discussion

These two studies taken together provide clear and consistent evidence for increases in arousal biasing judgments of positive stimuli in such a way as to be seen as indicating joy (a positive high-arousal emotion), rather than serenity (a positive low-arousal emotion). These results support our reasoning that this should have occurred because (a) the positive stimuli and arousal would combine to cue positive high-arousal thoughts, increasing the probability that they, rather than positive low-arousal thoughts (which might actually be blocked by the high arousal), would come to mind, and (b) these thoughts, being more available than others, would then bias judgments of others' emotions. The results of the second study not only replicated those of the first study but also extended their generalizability by demonstrating that arousal can bias not only judgments about the emotion indicated by what a person says but also judgments about the emotion indicated by a person's appearance.[5]

Explanations for the Lack of an Effect of Arousal on Negative Judgments

In contrast with the results for positive stimuli, increases in arousal did not bias judgments of negative stimuli as expected.[6] However, concluding that arousal cannot bias judgments of others' negative emotions would be premature. After all, the studies reported here used only one negative emotion term to anchor the high-arousal end of our negative scales and only two to anchor the low-arousal end. Furthermore, only moderate levels of exercise were used to manipulate arousal. Thus our failure to observe an effect of arousal on judgments of negative emotions may be due to the particular pairs of emotional terms used to anchor our scales and/or due to our particular manipulations of arousal. In this regard, consider three possible specific explanations for our failure to observe an effect of arousal on judgments of negative emotions.

The first explanation is suggested by a study by Schwartz et al. (1981), in which subjects who imagined anger experienced greater increases in mean arterial blood pressure and heart rate than did subjects who imagined happiness. This suggests that moderate levels of arousal may be associated with joyful thoughts in memory, whereas high levels of arousal may be associated with angry thoughts in memory. If this is true, then arousal would have to be moderately high to induce joyful thoughts but very high to induce angry thoughts. The arousal in our studies may have been moderate, thus inducing joyful but not angry thoughts.

A second explanation is that the pattern of physiological responses produced by moderate exercise (or more specifically those parts of the pattern that are represented in memory) matches that produced by joy better than that produced by anger. The fact that patterns of sympathetic arousal (as well as of other physiological responses accompanying exercise and various emotional states) differ is well established (e.g., Ax, 1953; Schwartz et al., 1981). Although there is evidence that such patterns do not have to be the same for one to prime another (Clark, Milberg, & Ross, 1983), it is still possible that the more similar two patterns of physiological responses are, the more likely they are to prime one another. Thus moderate exercise may be more likely to prime joy rather than anger. Unfortunately, we do not know enough about the particular patterns of arousal produced by our manipulations of arousal and

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[5] Clark, Milberg, and Erber (1983, study 2) replicated a third time the finding that arousal increases people's tendency to judge positive stimuli as indicating joy rather than serenity. In this third study, soccer players rated photographs of smiling others either before or after practicing soccer. Those who rated the photos after practice were significantly more likely than those who rated them before to rate the pictures as indicating joy rather than serenity. This third study is described in a paper (Clark, Milberg, & Erber, 1983, Study 2) that is available from the first author.

[6] This lack of an effect of arousal on judgments of negative photographs in terms of sadness versus anger was also replicated a third time by Clark et al. (1983, Study 2).

that produced by joy and anger to assess the likelihood of this explanation.

A final explanation involves the assumption that serenity and joy differ from one another primarily in terms of the amount of arousal associated with each, whereas depression or sadness and anger differ in more complex ways. For example, a large body of research reveals that angry and sad facial expressions are clearly differentiated, whereas serene and joyous expressions are not (e.g., Izard, 1977; Plutchik, 1962; Schwartz, Fair, Salt, Mandel, & Klerman, 1976; Tomkins & McCarter, 1964; also see Ekman, Friesen, & Ellsworth, 1982, for a review). Given such evidence, it is reasonable to speculate that people's judgments of whether a person is feeling serenity versus joy may be based primarily on their own arousal state, whereas their judgments of whether a person is feeling sadness or depression versus anger may be based primarily on other factors such as facial expressions or the person's particular choice of words.

This last explanation suggests that arousal might bias judgments of negative stimuli if the stimuli were judged in terms of the degree to which they indicated each of two states more qualitatively similar in all respects except the degree of associated arousal than are depression (or sadness) and anger. According to some theorists, terms such as (a) *apprehension, fear,* and *terror;* or (b) *annoyance, anger,* and *rage* describe the same primary emotions experienced at different levels of intensity (Izard, 1977; Plutchik, 1962, p. 138). Thus increased arousal might be capable of biasing people's choice of labels for "fearful" phrases or appearances away from apprehension and toward terror, or of biasing their choice of labels for "angry" phrases or appearances away from annoyance and toward rage.

In any case, all of these possibilities suggest that future work examining the ideas set forth in this article should incorporate not only a variety of materials to be judged, as was the case in the present studies, but also (a) a variety of positive and negative response pairs (e.g., serene vs. joyous; pleased vs. delighted; glad vs. ecstatic; sad vs. distressed; annoyed vs. angry; apprehensive vs. terrified), (b) a variety of levels of arousal (e.g., reduction in arousal, no manipulation, moderate elevation, high elevation) and, finally, (c) a variety of types of arousal manipulations (e.g., for high arousal, exercise vs. caffeine vs. viewing an erotic movie). Work in which such changes are made is needed to detect whether arousal may sometimes bias judgments of negative emotions and specifically when it will, as well as to determine whether the effects of arousal on positive judgments generalize to judgments involving other pairs of positive terms and to arousal produced in ways other than exercise.

Importance of Evidence That Arousal Biases Judgments About Positive Emotions

The finding that arousal can bias at least judgments of positive emotions is important for a number of reasons. First, although early work has already shown that perceivers' specific emotions may bias judgments of the emotions felt by others in such a way as to be consistent with one's own emotion (e.g., Feshbach & Feshbach, 1963; Feshbach & Singer, 1957; Hornberger, 1960; Murray, 1933; Schiffenbauer, 1974a, 1974b), the present work shows that more general states of an observer (states of high or low arousal) may also influence such judgments.

Second, the present work suggests that mood states, at least positive ones, involve more than just a negativity–positivity dimension. They also involve a sympathetic arousal dimension. Thus recent discussions of and research about moods in which moods are referred to primarily in terms of their negativity or positivity may have presented an oversimplified picture of mood states. It may prove profitable in future research to investigate effects of the level of arousal associated with moods as well as effects caused by the evaluative tone of the mood.

Third, our results suggest that the role of arousal in emotion is more complex than previous research has implied. Consider the fact that after reviewing much of the existing literature on arousal and emotion, Eysenck (1982, p. 95) has recently suggested that increases in arousal serve to enhance the degree of negativity or positivity that a person experiences. The present research suggests that the effects of arousal are not always that simple. Although arousal may indeed increase the positivity or probability (or both) of certain *types* of positive feelings (e.g., joy) by cuing

joyful thoughts, it may actually decrease the positivity or probability of other types of positive feelings (e.g., serenity) by blocking access to low-arousal thoughts.[7] Of course, since our subjects' *own* emotions were not measured, these ideas remain speculative.

Although we do believe our evidence suggests that the effects of arousal involve more than simply increasing the positivity or negativity of emotions, as Eysenck (1982) suggests, our evidence is not necessarily in conflict with claims that arousal determines the intensity of felt emotion (e.g., Mandler, 1975, p. 67). Joyous thoughts may well be experienced as more intense than serene thoughts. This may occur because of people's awareness of the arousal that accompanies joy, because arousal increases the duration of joy (Clark, 1982), and/or because arousal makes emotions difficult to control. We also believe that these results are not in conflict with Schachter and Singer's (1962) claim that "an individual will react emotionally or describe his feelings as emotions only to the extent that he experiences a state of physiological arousal" (p. 382). One can *experience* low or high arousal, so that does not imply that the higher the arousal the more of any given emotion one will experience. However, the present results do go beyond Schachter and Singer's work to suggest that a person's level of arousal may influence the cognitive label applied to stimuli in the environment, in addition to stimuli in the environment influencing what cognitive label is applied to one's state of arousal.

Finally, the present results, together with past results showing that emotional states influence perception of others' emotions, may shed light on problems of communication in interpersonal relationships. Specifically, such results suggest that people who are "moody" and/or who are especially subject to shifts in their own arousal state for any reason, may experience difficulty in understanding or empathizing with others' emotional states because their own states may bias their perception of those states. Of course, in connection with this last point, when other cues to emotion such as tone of voice (Bugental & Moore, 1979) and context information (Knudsen & Muzekari, in press; Mann, 1940; Muzekari, Knudsen, & Evans, 1983) are present, observers' moods and arousal states may not have as great an impact on their perception of others' emotions as they have been shown to have in laboratory studies.

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[7] In connection with this point, it is interesting to note that Reilly & Morris (1983) have very recently reported that exercise-induced arousal *inhibits* the effectiveness of inductions of sadness, a low-arousal emotion.

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