

# PSYCHOLOGICAL REVIEW

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## COGNITIVE, SOCIAL, AND PHYSIOLOGICAL DETERMINANTS OF EMOTIONAL STATE<sup>1</sup>

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The problem of which cues, internal or external, permit a person to label and identify his own emotional state has been with us since the days that James (1890) first tendered his doctrine that "the bodily changes follow directly the perception of the exciting fact, and that our feeling of the same changes as they occur *is* the emotion" (p. 449). Since we are aware of a variety of feeling and emotion states, it should follow from James' proposition that the various emotions will be accompanied by a variety of differentiable bodily states. Following James' pronouncement, a formidable number of studies were undertaken in search of the physiological differentiators of the emotions. The results, in these early days, were almost uniformly negative. All of the emotional states experi-

mentally manipulated were characterized by a general pattern of excitation of the sympathetic nervous system but there appeared to be no clear-cut physiological discriminators of the various emotions. This pattern of results was so consistent from experiment to experiment that Cannon (1929) offered, as one of the crucial criticisms of the James-Lange theory, the fact that "the same visceral changes occur in very different emotional states and in non-emotional states" (p. 351).

More recent work, however, has given some indication that there may be differentiators. Ax (1953) and Schachter (1957) studied fear and anger. On a large number of indices both of these states were characterized by a similarly high level of autonomic activation but on several indices they did differ in the degree of activation. Wolf and Wolff (1947) studied a subject with a gastric fistula and were able to distinguish two patterns in the physiological responses of the stomach wall. It should be noted, though, that for many months they studied their subject during and following a great variety of moods and emotions and were able to distinguish only two patterns.

Whether or not there are physiological distinctions among the various emotional states must be considered an open

<sup>1</sup> This experiment is part of a program of research on cognitive and physiological determinants of emotional state which is being conducted at the Department of Social Psychology at Columbia University under PHS Research Grant M-2584 from the National Institute of Mental Health, United States Public Health Service. This experiment was conducted at the Laboratory for Research in Social Relations at the University of Minnesota.

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question. Recent work might be taken to indicate that such differences are at best rather subtle and that the variety of emotion, mood, and feeling states are by no means matched by an equal variety of visceral patterns.

This rather ambiguous situation has led Ruckmick (1936), Hunt, Cole, and Reis (1958), Schachter (1959) and others to suggest that cognitive factors may be major determinants of emotional states. Granted a general pattern of sympathetic excitation as characteristic of emotional states, granted that there may be some differences in pattern from state to state, it is suggested that one labels, interprets, and identifies this stirred-up state in terms of the characteristics of the precipitating situation and one's apperceptive mass. This suggests, then, that an emotional state may be considered a function of a state of physiological arousal<sup>2</sup> and of a cognition appropriate to this state of arousal. The cognition, in a sense, exerts a steering function. Cognitions arising from the immediate situation as interpreted by past experience provide the framework within which one understands and labels his feelings. It is the cognition which determines whether the state of physiological arousal will be labeled as "anger," "joy," "fear," or whatever.

In order to examine the implications of this formulation let us consider the fashion in which these two elements, a state of physiological arousal and cognitive factors, would interact in a variety of situations. In most emotion inducing situations, of course, the two

<sup>2</sup> Though our experiments are concerned exclusively with the physiological changes produced by the injection of adrenalin, which appear to be primarily the result of sympathetic excitation, the term physiological arousal is used in preference to the more specific "excitation of the sympathetic nervous system" because there are indications, to be discussed later, that this formulation is applicable to a variety of bodily states.

factors are completely interrelated. Imagine a man walking alone down a dark alley, a figure with a gun suddenly appears. The perception-cognition "figure with a gun" in some fashion initiates a state of physiological arousal; this state of arousal is interpreted in terms of knowledge about dark alleys and guns and the state of arousal is labeled "fear." Similarly a student who unexpectedly learns that he has made Phi Beta Kappa may experience a state of arousal which he will label "joy."

Let us now consider circumstances in which these two elements, the physiological and the cognitive, are, to some extent, independent. First, is the state of physiological arousal alone sufficient to induce an emotion? Best evidence indicates that it is not. Marañon<sup>3</sup> (1924), in a fascinating study, (which was replicated by Cantril & Hunt, 1932, and Landis & Hunt, 1932) injected 210 of his patients with the sympathomimetic agent adrenalin and then simply asked them to introspect. Seventy-one percent of his subjects simply reported their physical symptoms with no emotional overtones; 29% of the subjects responded in an apparently emotional fashion. Of these the great majority described their feelings in a fashion that Marañon labeled "cold" or "as if" emotions, that is, they made statements such as "I feel *as if* I were afraid" or "*as if* I were awaiting a great happiness." This is a sort of emotional "déjà vu" experience; these subjects are neither happy nor afraid, they feel "as if" they were. Finally a very few cases apparently reported a genuine emotional experience. However, in order to produce this reaction in most of these few cases, Marañon (1924) points out:

<sup>3</sup> Translated copies of Marañon's (1924) paper may be obtained by writing to the senior author.

One must suggest a memory with strong affective force but not so strong as to produce an emotion in the normal state. For example, in several cases we spoke to our patients before the injection of their sick children or dead parents and they responded calmly to this topic. The same topic presented later, during the adrenal commotion, was sufficient to trigger emotion. This adrenal commotion places the subject in a situation of 'affective imminence' (pp. 307-308).

Apparently, then, to produce a genuinely emotional reaction to adrenalin, Marañon was forced to provide such subjects with an appropriate cognition.

Though Marañon (1924) is not explicit on his procedure, it is clear that his subjects knew that they were receiving an injection and in all likelihood knew that they were receiving adrenalin and probably had some order of familiarity with its effects. In short, though they underwent the pattern of sympathetic discharge common to strong emotional states, at the same time they had a completely appropriate cognition or explanation as to why they felt this way. This, we would suggest, is the reason so few of Marañon's subjects reported any emotional experience.

Consider now a person in a state of physiological arousal for which no immediately explanatory or appropriate cognitions are available. Such a state could result were one covertly to inject a subject with adrenalin or, unknown to him, feed the subject a sympathomimetic drug such as ephedrine. Under such conditions a subject would be aware of palpitations, tremor, face flushing, and most of the battery of symptoms associated with a discharge of the sympathetic nervous system. In contrast to Marañon's (1924) subjects he would, at the same time, be utterly unaware of why he felt this way. What would be the consequence of such a state?

Schachter (1959) has suggested that

precisely such a state would lead to the arousal of "evaluative needs" (Festinger, 1954), that is, pressures would act on an individual in such a state to understand and label his bodily feelings. His bodily state grossly resembles the condition in which it has been at times of emotional excitement. How would he label his present feelings? It is suggested, of course, that he will label his feelings in terms of his knowledge of the immediate situation.<sup>4</sup> Should he at the time be with a beautiful woman he might decide that he was wildly in love or sexually excited. Should he be at a gay party, he might, by comparing himself to others, decide that he was extremely happy and euphoric. Should he be arguing with his wife, he might explode in fury and hatred. Or, should the situation be completely inappropriate he could decide that he was excited about something that had recently happened to him or, simply, that he was sick. In any case, it is our basic assumption that emotional states are a function of the interaction of such cognitive factors with a state of physiological arousal.

This line of thought, then, leads to the following propositions:

1. Given a state of physiological arousal for which an individual has no immediate explanation, he will "label" this state and describe his feelings in terms of the cognitions available to him. To the extent that cognitive factors are potent determiners of emotional states, it could be anticipated that precisely the same state of physiological arousal could be labeled "joy" or "fury" or "jealousy" or any of a great diversity

<sup>4</sup> This suggestion is not new for several psychologists have suggested that situational factors should be considered the chief differentiators of the emotions. Hunt, Cole, and Reis (1958) probably make this point most explicitly in their study distinguishing among fear, anger, and sorrow in terms of situational characteristics.

of emotional labels depending on the cognitive aspects of the situation.

2. Given a state of physiological arousal for which an individual has a completely appropriate explanation (e.g., "I feel this way because I have just received an injection of adrenalin") no evaluative needs will arise and the individual is unlikely to label his feelings in terms of the alternative cognitions available.

Finally, consider a condition in which emotion inducing cognitions are present but there is no state of physiological arousal. For example, an individual might be completely aware that he is in great danger but for some reason (drug or surgical) remain in a state of physiological quiescence. Does he experience the emotion "fear"? Our formulation of emotion as a joint function of a state of physiological arousal and an appropriate cognition, would, of course, suggest that he does not, which leads to our final proposition.

3. Given the same cognitive circumstances, the individual will react emotionally or describe his feelings as emotions only to the extent that he experiences a state of physiological arousal.<sup>5</sup>

#### PROCEDURE

The experimental test of these propositions requires (a) the experimental manipulation of a state of physiological arousal, (b) the manipulation of the extent to which the subject has an appropriate or proper explanation of his bodily state, and (c) the creation of situations from which explanatory cognitions may be derived.

In order to satisfy the first two experimental requirements, the experiment was cast

<sup>5</sup> In his critique of the James-Lange theory of emotion, Cannon (1929) also makes the point that sympathectomized animals and patients do seem to manifest emotional behavior. This criticism is, of course, as applicable to the above proposition as it was to the James-Lange formulation. We shall discuss the issues involved in later papers.

in the framework of a study of the effects of vitamin supplements on vision. As soon as a subject arrived, he was taken to a private room and told by the experimenter:

In this experiment we would like to make various tests of your vision. We are particularly interested in how certain vitamin compounds and vitamin supplements affect the visual skills. In particular, we want to find out how the vitamin compound called 'Suproxin' affects your vision.

What we would like to do, then, if we can get your permission, is to give you a small injection of Suproxin. The injection itself is mild and harmless; however, since some people do object to being injected we don't want to talk you into anything. Would you mind receiving a Suproxin injection?

If the subject agrees to the injection (and all but 1 of 185 subjects did) the experimenter continues with instructions we shall describe shortly, then leaves the room. In a few minutes a physician enters the room, briefly repeats the experimenter's instructions, takes the subject's pulse and then injects him with Suproxin.

Depending upon condition, the subject receives one of two forms of Suproxin—epinephrine or a placebo.

Epinephrine or adrenalin is a sympathomimetic drug whose effects, with minor exceptions, are almost a perfect mimicry of a discharge of the sympathetic nervous system. Shortly after injection systolic blood pressure increases markedly, heart rate increases somewhat, cutaneous blood flow decreases, while muscle and cerebral blood flow increase, blood sugar and lactic acid concentration increase, and respiration rate increases slightly. As far as the subject is concerned the major subjective symptoms are palpitation, tremor, and sometimes a feeling of flushing and accelerated breathing. With a subcutaneous injection (in the dosage administered to our subjects), such effects usually begin within 3-5 minutes of injection and last anywhere from 10 minutes to an hour. For most subjects these effects are dissipated within 15-20 minutes after injection.

Subjects receiving epinephrine received a subcutaneous injection of  $\frac{1}{2}$  cubic centimeter of a 1 : 1000 solution of Winthrop Laboratory's Suprarenin, a saline solution of epinephrine bitartrate.

Subjects in the placebo condition received a subcutaneous injection of  $\frac{1}{2}$  cubic centimeter of saline solution. This is, of course, com-

pletely neutral material with no side effects at all.

### *Manipulating an Appropriate Explanation*

By "appropriate" we refer to the extent to which the subject has an authoritative, unequivocal explanation of his bodily condition. Thus, a subject who had been informed by the physician that as a direct consequence of the injection he would feel palpitations, tremor, etc. would be considered to have a completely appropriate explanation. A subject who had been informed only that the injection would have no side effects would have no appropriate explanation of his state. This dimension of appropriateness was manipulated in three experimental conditions which shall be called: Epinephrine Informed (Epi Inf), Epinephrine Ignorant (Epi Ign), and Epinephrine Misinformed (Epi Mis).

Immediately after the subject had agreed to the injection and before the physician entered the room, the experimenter's spiel in each of these conditions went as follows:

*Epinephrine Informed.* I should also tell you that some of our subjects have experienced side effects from the Suproxin. These side effects are transitory, that is, they will only last for about 15 or 20 minutes. What will probably happen is that your hand will start to shake, your heart will start to pound, and your face may get warm and flushed. Again these are side effects lasting about 15 or 20 minutes.

While the physician was giving the injection, she told the subject that the injection was mild and harmless and repeated this description of the symptoms that the subject could expect as a consequence of the shot. In this condition, then, subjects have a completely appropriate explanation of their bodily state. They know precisely what they will feel and why.

*Epinephrine Ignorant.* In this condition, when the subject agreed to the injection, the experimenter said nothing more relevant to side effects and simply left the room. While the physician was giving the injection, she told the subject that the injection was mild and harmless and would have no side effects. In this condition, then, the subject has no experimentally provided explanation for his bodily state.

*Epinephrine Misinformed.* I should also tell you that some of our subjects have experienced side effects from the Suproxin.

These side effects are transitory, that is, they will only last for about 15 or 20 minutes. What will probably happen is that your feet will feel numb, you will have an itching sensation over parts of your body, and you may get a slight headache. Again these are side effects lasting 15 or 20 minutes.

And again, the physician repeated these symptoms while injecting the subject.

None of these symptoms, of course, are consequences of an injection of epinephrine and, in effect, these instructions provide the subject with a completely inappropriate explanation of his bodily feelings. This condition was introduced as a control condition of sorts. It seemed possible that the description of side effects in the Epi Inf condition might turn the subject introspective, self-examining, possibly slightly troubled. Differences on the dependent variable between the Epi Inf and Epi Ign conditions might, then, be due to such factors rather than to differences in appropriateness. The false symptoms in the Epi Mis condition should similarly turn the subject introspective, etc., but the instructions in this condition do not provide an appropriate explanation of the subject's state.

Subjects in all of the above conditions were injected with epinephrine. Finally, there was a placebo condition in which subjects, who were injected with saline solution, were given precisely the same treatment as subjects in the Epi Ign condition.

### *Producing an Emotion Inducing Cognition*

Our initial hypothesis has suggested that given a state of physiological arousal for which the individual has no adequate explanation, cognitive factors can lead the individual to describe his feelings with any of a diversity of emotional labels. In order to test this hypothesis, it was decided to manipulate emotional states which can be considered quite different—euphoria and anger.

There are, of course, many ways to induce such states. In our own program of research, we have concentrated on social determinants of emotional states and have been able to demonstrate in other studies that people do evaluate their own feelings by comparing themselves with others around them (Schachter 1959; Wrightsman 1960). In this experiment we have attempted again to manipulate emotional state by social means. In one set of conditions, the subject is placed together with a stooge who has been trained

to act euphorically. In a second set of conditions the subject is with a stooge trained to act in an angry fashion.

### *Euphoria*

Immediately<sup>6</sup> after the subject had been injected, the physician left the room and the experimenter returned with a stooge whom he introduced as another subject, then said:

Both of you have had the Suproxin shot and you'll both be taking the same tests of vision. What I ask you to do now is just wait for 20 minutes. The reason for this is simply that we have to allow 20 minutes for the Suproxin to get from the injection site into the bloodstream. At the end of 20 minutes when we are certain that most of the Suproxin has been absorbed into the bloodstream, we'll begin the tests of vision.

The room in which this was said had been deliberately put into a state of mild disarray. As he was leaving, the experimenter apologetically added:

The only other thing I should do is to apologize for the condition of the room. I just didn't have time to clean it up. So, if you need any scratch paper or rubber bands or pencils, help yourself. I'll be back in 20 minutes to begin the vision tests.

As soon as the experimenter had left, the stooge introduced himself again, made a series of standard icebreaker comments, and then launched his routine. For observation purposes, the stooge's act was broken into a series of standard units, demarcated by a change in activity or a standard comment. In sequence, the units of the stooge's routine were the following:

1. Stooge reaches for a piece of paper and starts doodling saying, "They said we could use this for scratch, didn't they?" He doodles a fish for some 30 seconds, then says:

<sup>6</sup> It was, of course, imperative that the sequence with the stooge begin before the subject felt his first symptoms for otherwise the subject would be virtually forced to interpret his feelings in terms of events preceding the stooge's entrance. Pretests had indicated that, for most subjects, epinphrine-caused symptoms began within 3-5 minutes after injection. A deliberate attempt was made then to bring in the stooge within 1 minute after the subject's injection.

2. "This scrap paper isn't even much good for doodling" and crumples paper and attempts to throw it into wastebasket in far corner of the room. He misses but this leads him into a "basketball game." He crumples up other sheets of paper, shoots a few baskets, says "Two points" occasionally. He gets up and does a jump shot saying, "The old jump shot is really on today."

3. If the subject has not joined in, the stooge throws a paper basketball to the subject saying, "Here, you try it."

4. Stooge continues his game saying, "The trouble with paper basketballs is that you don't really have any control."

5. Stooge continues basketball, then gives it up saying, "This is one of my good days. I feel like a kid again. I think I'll make a plane." He makes a paper airplane saying, "I guess I'll make one of the longer ones."

6. Stooge flies plane. Gets up and retrieves plane. Flies again, etc.

7. Stooge throws plane at subject.

8. Stooge, flying plane, says, "Even when I was a kid, I was never much good at this."

9. Stooge tears off part of plane saying, "Maybe this plane can't fly but at least it's good for something." He wads up paper and making a slingshot of a rubber band begins to shoot the paper.

10. Shooting, the stooge says, "They [paper ammunition] really go better if you make them long. They don't work right if you wad them up."

11. While shooting, stooge notices a sloppy pile of manila folders on a table. He builds a tower of these folders, then goes to the opposite end of the room to shoot at the tower.

12. He misses several times, then hits and cheers as the tower falls. He goes over to pick up the folders.

13. While picking up, he notices, behind a portable blackboard, a pair of hula hoops which have been covered with black tape with a few wires sticking out of the tape. He reaches for these, taking one for himself and putting the other aside but within reaching distance of the subject. The stooge tries the hula hoop, saying, "This isn't as easy as it looks."

14. Stooge twirls hoop wildly on arm, saying, "Hey, look at this—this is great."

15. Stooge replaces the hula hoop and sits down with his feet on the table. Shortly thereafter the experimenter returns to the room.

This routine was completely standard, though its pace, of course, varied depending upon the subject's reaction, the extent to which he entered into this bedlam and the extent to which he initiated activities of his own. The only variations from this standard routine were those forced by the subject. Should the subject originate some nonsense of his own and request the stooge to join in, he would do so. And, he would, of course, respond to any comments initiated by the subject.

Subjects in each of the three "appropriateness" conditions and in the placebo condition were submitted to this setup. The stooge, of course, never knew in which condition any particular subject fell.

### *Anger*

Immediately after the injection, the experimenter brought a stooge into the subject's room, introduced the two and after explaining the necessity for a 20 minute delay for "the Suproxin to get from the injection site into the bloodstream" he continued, "We would like you to use these 20 minutes to answer these questionnaires." Then handing out the questionnaires, he concludes with, "I'll be back in 20 minutes to pick up the questionnaires and begin the tests of vision."

Before looking at the questionnaire, the stooge says to the subject,

I really wanted to come for an experiment today, but I think it's unfair for them to give you shots. At least, they should have told us about the shots when they called us; you hate to refuse, once you're here already.

The questionnaires, five pages long, start off innocently requesting face sheet information and then grow increasingly personal and insulting. The stooge, sitting directly opposite the subject, paces his own answers so that at all times subject and stooge are working on the same question. At regular points in the questionnaire, the stooge makes a series of standardized comments about the questions. His comments start off innocently enough, grow increasingly querulous, and finally he ends up in a rage. In sequence, he makes the following comments.

1. Before answering any items, he leafs quickly through the questionnaire saying, "Boy, this is a long one."

2. Question 7 on the questionnaire requests, "List the foods that you would eat in a typical day." The stooge comments,

"Oh for Pete's sake, what did I have for breakfast this morning?"

3. Question 9 asks, "Do you ever hear bells? \_\_\_\_\_ . How often? \_\_\_\_\_ ." The stooge remarks, "Look at Question 9. How ridiculous can you get? I hear bells every time I change classes."

4. Question 13 requests, "List the childhood diseases you have had and the age at which you had them" to which the stooge remarks, "I get annoyed at this childhood disease question. I can't remember what childhood diseases I had, and especially at what age. Can you?"

5. Question 17 asks "What is your father's average annual income?" and the stooge says, "This really irritates me. It's none of their business what my father makes. I'm leaving that blank."

6. Question 25 presents a long series of items such as "Does not bathe or wash regularly," "Seems to need psychiatric care," etc. and requests the respondent to write down for which member of his immediate family each item seems most applicable. The question specifically prohibits the answer "None" and each item must be answered. The stooge says, "I'll be damned if I'll fill out Number 25. 'Does not bathe or wash regularly'—that's a real insult." He then angrily crosses out the entire item.

7. Question 28 reads:

"How many times each week do you have sexual intercourse?" 0-1 \_\_\_\_\_ 2-3 \_\_\_\_\_ 4-6 \_\_\_\_\_ 7 and over \_\_\_\_\_ . The stooge bites out, "The hell with it! I don't have to tell them all this."

8. The stooge sits sullenly for a few moments then he rips up his questionnaire, crumples the pieces and hurls them to the floor, saying, "I'm not wasting any more time. I'm getting my books and leaving" and he stamps out of the room.

9. The questionnaire continues for eight more questions ending with: "With how many men (other than your father) has your mother had extramarital relationships?"

4 and under \_\_\_\_\_ : 5-9 \_\_\_\_\_ : 10 and over \_\_\_\_\_ .

Subjects in the Epi Ign, Epi Inf and Placebo conditions were run through this "anger" inducing sequence. The stooge, again, did not know to which condition the subject had been assigned.

In summary, this is a seven condition experiment which, for two different emotional states, allows us (a) to evaluate the effects of "appropriateness" on emotional inducibility

and (b) to begin to evaluate the effects of sympathetic activation on emotional inducibility. In schematic form the conditions are the following:

EUPHORIA	ANGER
Epi Inf	Epi Inf
Epi Ign	Epi Ign
Epi Mis	Placebo
Placebo	

The Epi Mis condition was not run in the Anger sequence. This was originally conceived as a control condition and it was felt that its inclusion in the Euphoria conditions alone would suffice as a means of evaluating the possible artifactual effect of the Epi Inf instructions.

### Measurement

Two types of measures of emotional state were obtained. Standardized observation through a one-way mirror was the technique used to assess the subject's behavior. To what extent did he act euphoric or angry? Such behavior can be considered in a way as a "semiprivate" index of mood for as far as the subject was concerned, his emotional behavior could be known only to the other person in the room—presumably another student. The second type of measure was self-report in which, on a variety of scales, the subject indicated his mood of the moment. Such measures can be considered "public" indices of mood for they would, of course, be available to the experimenter and his associates.

### Observation

*Euphoria.* For each of the first 14 units of the stooge's standardized routine an observer kept a running chronicle of what the subject did and said. For each unit the observer coded the subject's behavior in one or more of the following categories:

Category 1: Joins in activity. If the subject entered into the stooge's activities, e.g., if he made or flew airplanes, threw paper basketballs, hula hooped, etc., his behavior was coded in this category.

Category 2: Initiates new activity. A subject was so coded if he gave indications of creative euphoria, that is, if, on his own, he initiated behavior outside of the stooge's routine. Instances of such behavior would be the subject who threw open the window and, laughing, hurled paper basketballs at passersby; or, the subject who jumped on a table and spun one hula hoop on his leg and the other on his neck.

Categories 3 and 4: Ignores or watches

stooge. Subjects who paid flatly no attention to the stooge or who, with or without comment, simply watched the stooge without joining in his activity were coded in these categories.

For any particular unit of behavior, the subject's behavior was coded in one or more of these categories. To test reliability of coding two observers independently coded two experimental sessions. The observers agreed completely on the coding of 88% of the units.

*Anger.* For each of the units of stooge behavior, an observer recorded the subject's responses and coded them according to the following category scheme:

Category 1: Agrees. In response to the stooge the subject makes a comment indicating that he agrees with the stooge's standardized comment or that he, too, is irked by a particular item on the questionnaire. For example, a subject who responded to the stooge's comment on the "father's income" question by saying, "I don't like that kind of personal question either" would be so coded (scored +2).

Category 2: Disagrees. In response to the stooge's comment, the subject makes a comment which indicates that he disagrees with the stooge's meaning or mood; e.g., in response to the stooge's comment on the "father's income" question, such a subject might say, "Take it easy, they probably have a good reason for wanting the information" (scored -2).

Category 3: Neutral. A noncommittal or irrelevant response to the stooge's remark (scored 0).

Category 4: Initiates agreement or disagreement. With no instigation by the stooge, a subject, so coded, would have volunteered a remark indicating that he felt the same way or, alternatively, quite differently than the stooge. Examples would be "Boy I hate this kind of thing" or "I'm enjoying this" (scored +2 or -2).

Category 5: Watches. The subject makes no verbal response to the stooge's comment but simply looks directly at him (scored 0).

Category 6: Ignores. The subject makes no verbal response to the stooge's comment nor does he look at him; the subject, paying no attention at all to the stooge, simply works at his own questionnaire (scored -1).

A subject was scored in one or more of these categories for each unit of stooge behavior. To test reliability, two observers independently coded three experimental sessions. In order to get a behavioral index of anger, observation protocol was scored according to the values presented in parentheses

after each of the above definitions of categories. In a unit-by-unit comparison, the two observers agreed completely on the scoring of 71% of the units jointly observed. The scores of the two observers differed by a value of 1 or less for 88% of the units coded and in not a single case did the two observers differ in the direction of their scoring of a unit.

*Self Report of Mood and Physical Condition*

When the subject's session with the stooge was completed, the experimenter returned to the room, took pulses and said:

Before we proceed with the vision tests, there is one other kind of information which we must have. We have found, as you can probably imagine, that there are many things beside Suproxin that affect how well you see in our tests. How hungry you are, how tired you are, and even the mood you're in at the time—whether you feel happy or irritated at the time of testing will affect how well you see. To understand the data we collect on you, then, we must be able to figure out which effects are due to causes such as these and which are caused by Suproxin.

The only way we can get such information about your physical and emotional state is to have you tell us. I'll hand out these questionnaires and ask you to answer them as accurately as possible. Obviously, our data on the vision tests will only be as accurate as your description of your mental and physical state.

In keeping with this spiel, the questionnaire that the experimenter passed out contained a number of mock questions about hunger, fatigue, etc., as well as questions of more immediate relevance to the experiment. To measure mood or emotional state the following two were the crucial questions:

1. How irritated, angry or annoyed would you say you feel at present?

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I don't feel at all irritated or angry (0)	I feel a little irritated and angry (1)	I feel quite irritated and angry (2)	I feel very irritated and angry (3)	I feel extremely irritated and angry (4)

2. How good or happy would you say you feel at present?

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I don't feel at all happy or good (0)	I feel a little happy and good (1)	I feel quite happy and good (2)	I feel very happy and good (3)	I feel extremely happy and good (4)

To measure the physical effects of epinephrine and determine whether or not the injection had been successful in producing the necessary bodily state, the following questions were asked:

1. Have you experienced any palpitation (consciousness of your own heart beat)?

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Not at all (0)	A slight amount (1)	A moderate amount (2)	An intense amount (3)

2. Did you feel any tremor (involuntary shaking of the hands, arms or legs)?

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Not at all (0)	A slight amount (1)	A moderate amount (2)	An intense amount (3)

To measure possible effects of the instructions in the Epi Mis condition, the following questions were asked:

1. Did you feel any numbness in your feet?
2. Did you feel any itching sensation?
3. Did you experience any feeling of headache?

To all three of these questions was attached a four-point scale running from "Not at all" to "An intense amount."

In addition to these scales, the subjects were asked to answer two open-end questions on other physical or emotional sensations they may have experienced during the experimental session. A final measure of bodily state was pulse rate which was taken by the physician or the experimenter at two times—immediately before the injection and immediately after the session with the stooge.

When the subjects had completed these questionnaires, the experimenter announced that the experiment was over, explained the deception and its necessity in detail, answered any questions, and swore the subjects to secrecy. Finally, the subjects answered a brief questionnaire about their experiences, if any, with adrenalin and their previous knowledge or suspicion of the experimental setup. There was no indication that any of the subjects had known about the experiment beforehand but 11 subjects were so extremely suspicious of some crucial feature of the experiment that their data were automatically discarded.

*Subjects*

The subjects were all male, college students taking classes in introductory psychology at the University of Minnesota. Some 90% of the students in these classes volunteer for a subject pool for which they receive two extra points on their final exam for every

hour that they serve as experimental subjects. For this study the records of all potential subjects were cleared with the Student Health Service in order to insure that no harmful effects would result from the injections.

### *Evaluation of the Experimental Design*

The ideal test of our propositions would require circumstances which our experiment is far from realizing. First, the proposition that: "A state of physiological arousal for which an individual has no immediate explanation will lead him to label this state in terms of the cognitions available to him" obviously requires conditions under which the subject does not and cannot have a proper explanation of his bodily state. Though we toyed with such fantasies as ventilating the experimental room with vaporized adrenalin, reality forced us to rely on the disguised injection of Suproxin—a technique which was far from ideal for no matter what the experimenter told them, some subjects would inevitably attribute their feelings to the injection. To the extent that subjects did so, differences between the several appropriateness conditions should be attenuated.

Second, the proposition that: "Given the same cognitive circumstances the individual will react emotionally only to the extent that he experiences a state of physiological arousal" requires for its ideal test the manipulation of states of physiological arousal and of physiological quiescence. Though there is no question that epinephrine effectively produces a state of arousal, there is also no question that a placebo does not prevent physiological arousal. To the extent

that the experimental situation effectively produces sympathetic stimulation in placebo subjects, the proposition is difficult to test, for such a factor would attenuate differences between epinephrine and placebo subjects.

Both of these factors, then, can be expected to interfere with the test of our several propositions. In presenting the results of this study, we shall first present condition by condition results and then evaluate the effect of these two factors on experimental differences.

## RESULTS

### *Effects of the Injections on Bodily State*

Let us examine first the success of the injections at producing the bodily state required to examine the propositions at test. Does the injection of epinephrine produce symptoms of sympathetic discharge as compared with the placebo injection? Relevant data are presented in Table 1 where it can be immediately seen that on all items subjects who were in epinephrine conditions show considerably more evidence of sympathetic activation than do subjects in placebo conditions. In all epinephrine conditions pulse rate increases significantly when compared with the decrease characteristic of the placebo conditions. On the scales it is clear that epinephrine subjects experi-

TABLE 1  
THE EFFECTS OF THE INJECTIONS ON BODILY STATE

Condition	N	Pulse		Self-rating of				
		Pre	Post	Palpitation	Tremor	Numbness	Itching	Headache
Euphoria								
Epi Inf	27	85.7	88.6	1.20	1.43	0	0.16	0.32
Epi Ign	26	84.6	85.6	1.83	1.76	0.15	0	0.55
Epi Mis	26	82.9	86.0	1.27	2.00	0.06	0.08	0.23
Placebo	26	80.4	77.1	0.29	0.21	0.09	0	0.27
Anger								
Epi Inf	23	85.9	92.4	1.26	1.41	0.17	0	0.11
Epi Ign	23	85.0	96.8	1.44	1.78	0	0.06	0.21
Placebo	23	84.5	79.6	0.59	0.24	0.14	0.06	0.06

ence considerably more palpitation and tremor than do placebo subjects. In all possible comparisons on these symptoms, the mean scores of subjects in any of the epinephrine conditions are greater than the corresponding scores in the placebo conditions at better than the .001 level of significance. Examination of the absolute values of these scores makes it quite clear that subjects in epinephrine conditions were, indeed, in a state of physiological arousal, while most subjects in placebo conditions were in a relative state of physiological quiescence.

The epinephrine injection, of course, did not work with equal effectiveness for all subjects; indeed for a few subjects it did not work at all. Such subjects reported almost no palpitation or tremor, showed no increase in pulse and described no other relevant physical symptoms. Since for such subjects the necessary experimental conditions were not established, they were automatically excluded from the data and all further tabular presentations will not include such subjects. Table 1, however, does include the data of these subjects. There were four such subjects in euphoria conditions and one of them in anger conditions.

In order to evaluate further data on Epi Mis subjects it is necessary to note the results of the "numbness," "itching," and "headache" scales also presented in Table 1. Clearly the subjects in the Epi Mis condition do not differ on these scales from subjects in any of the other experimental conditions.

#### *Effects of the Manipulations on Emotional State*

*Euphoria:* Self-report. The effects of the several manipulations on emotional state in the euphoria conditions are presented in Table 2. The scores recorded in this table are derived, for each subject, by subtracting the value

of the point he checks on the irritation scale from the value of the point he checks on the happiness scale. Thus, if a subject were to check the point "I feel a little irritated and angry" on the irritation scale and the point "I feel very happy and good" on the happiness scale, his score would be +2. The higher the positive value, the happier and better the subject reports himself as feeling. Though we employ an index for expositional simplicity, it should be noted that the two components of the index each yield results completely consistent with those obtained by use of this index.

Let us examine first the effects of the appropriateness instructions. Comparison of the scores for the Epi Mis and Epi Inf conditions makes it immediately clear that the experimental differences are not due to artifacts resulting from the informed instructions. In both conditions the subject was warned to expect a variety of symptoms as a consequence of the injection. In the Epi Mis condition, where the symptoms were inappropriate to the subject's bodily state the self-report score is almost twice that in the Epi Inf condition where the symptoms were completely appropriate to the subject's bodily state. It is reasonable, then, to attribute differences between informed subjects and those in other conditions to differences in manipulated appropriateness rather than to artifacts such as introspectiveness or self-examination.

It is clear that, consistent with expectations, subjects were more susceptible to the stooge's mood and consequently more euphoric when they had no explanation of their own bodily states than when they did. The means of both the Epi Ign and Epi Mis conditions are considerably greater than the mean of the Epi Inf condition.

It is of interest to note that Epi Mis subjects are somewhat more euphoric

TABLE 2  
SELF-REPORT OF EMOTIONAL STATE IN  
THE EUPHORIA CONDITIONS

Condition	N	Self-Report scales	Comparison	$p^a$
Epi Inf	25	0.98	Epi Inf vs. Epi Mis	<.01
Epi Ign	25	1.78	Epi Inf vs. Epi Ign	.02
Epi Mis	25	1.90	Placebo vs. Epi Mis, Ign, or Inf	<i>ns</i>
Placebo	26	1.61		

All  $p$  values reported throughout paper are two-tailed.

than are Epi Ign subjects. This pattern repeats itself in other data shortly to be presented. We would attribute this difference to differences in the appropriateness dimension. Though, as in the Epi Ign condition, a subject is not provided with an explanation of his bodily state, it is, of course, possible that he will provide one for himself which is not derived from his interaction with the stooge. Most reasonably he could decide for himself that he feels this way because of the injection. To the extent that he does so he should be less susceptible to the stooge. It seems probable that he would be less likely to hit on such an explanation in the Epi Mis condition than in the Epi Ign condition for in the Epi Mis condition both the experimenter and the doctor have told him that the effects of the injection would be quite different from what he actually feels. The effect of such instructions is probably to make it more difficult for the subject himself to hit on the alternative explanation described above. There is some evidence to support this analysis. In open-ended questions in which subjects described their own mood and state, 28% of the subjects in the Epi Ign condition made some connection between the injection and their bodily state compared with the 16% of subjects in the Epi Mis condition who did so. It could be considered, then, that these three conditions fall along a dimension of appropri-

ateness, with the Epi Inf condition at one extreme and the Epi Mis condition at the other.

Comparing the placebo to the epinephrine conditions, we note a pattern which will repeat itself throughout the data. Placebo subjects are less euphoric than either Epi Mis or Epi Ign subjects but somewhat more euphoric than Epi Inf subjects. These differences are not, however, statistically significant. We shall consider the epinephrine-placebo comparisons in detail in a later section of this paper following the presentation of additional relevant data. For the moment, it is clear that, by self-report manipulating appropriateness has had a very strong effect on euphoria.

Behavior. Let us next examine the extent to which the subject's behavior was affected by the experimental manipulations. To the extent that his mood has been affected, one should expect that the subject will join in the stooge's whirl of manic activity and initiate similar activities of his own. The relevant data are presented in Table 3. The column labeled "Activity

TABLE 3  
BEHAVIORAL INDICATIONS OF EMOTIONAL  
STATE IN THE EUPHORIA CONDITIONS

Condition	N	Activity index	Mean number of acts initiated
Epi Inf	25	12.72	.20
Epi Ign	25	18.28	.56
Epi Mis	25	22.56	.84
Placebo	26	16.00	.54

$p$  value

Comparison	Activity index	Initiates
Epi Inf vs. Epi Mis	.05	.03
Epi Inf vs. Epi Ign	<i>ns</i>	.08
Plac vs. Epi Mis, Ign, or Inf	<i>ns</i>	<i>ns</i>

<sup>a</sup> Tested by  $X^2$  comparison of the proportion of subjects in each condition initiating new acts.

index" presents summary figures on the extent to which the subject joined in the stooge's activity. This is a weighted index which reflects both the nature of the activities in which the subject engaged and the amount of time he was active. The index was devised by assigning the following weights to the subject's activities: 5—hula hooping; 4—shooting with slingshot; 3—paper airplanes; 2—paper basketballs; 1—doodling; 0—does nothing. Pretest scaling on 15 college students ordered these activities with respect to the degree of euphoria they represented. Arbitrary weights were assigned so that the wilder the activity, the heavier the weight. These weights are multiplied by an estimate of the amount of time the subject spent in each activity and the summed products make up the activity index for each subject. This index may be considered a measure of behavioral euphoria. It should be noted that the same between-condition relationships hold for the two components of this index as for the index itself.

The column labeled "Mean number of acts initiated" presents the data on the extent to which the subject deviates from the stooge's routine and initiates euphoric activities of his own.

On both behavioral indices, we find precisely the same pattern of relationships as those obtained with self-reports. Epi Mis subjects behave somewhat more euphorically than do Epi Ign subjects who in turn behave more euphorically than do Epi Inf subjects. On all measures, then, there is consistent evidence that a subject will take over the stooge's euphoric mood to the extent that he has no other explanation of his bodily state.

Again it should be noted that on these behavioral indices, Epi Ign and Epi Mis subjects are somewhat more

euphoric than placebo subjects but not significantly so.

*Anger: Self-report.* Before presenting data for the anger conditions, one point must be made about the anger manipulation. In the situation devised, anger, if manifested, is most likely to be directed at the experimenter and his annoyingly personal questionnaire. As we subsequently discovered, this was rather unfortunate, for the subjects, who had volunteered for the experiment for extra points on their final exam, simply refused to endanger these points by publicly blowing up, admitting their irritation to the experimenter's face or spoiling the questionnaire. Though as the reader will see, the subjects were quite willing to manifest anger when they were alone with the stooge, they hesitated to do so on material (self-ratings of mood and questionnaire) that the experimenter might see and only after the purposes of the experiment had been revealed were many of these subjects willing to admit to the experimenter that they had been irked or irritated.

This experimentally unfortunate situation pretty much forces us to rely on the behavioral indices derived from observation of the subject's presumably private interaction with the stooge. We do, however, present data on the self-report scales in Table 4. These figures are derived in the same way as the figures presented in Table 2 for the euphoria conditions, that is, the value checked on the irritation scale is subtracted from the value checked on the happiness scale. Though, for the reasons stated above, the absolute magnitude of these figures (all positive) is relatively meaningless, we can, of course, compare condition means within the set of anger conditions. With the happiness-irritation index employed, we should, of course, anticipate precisely the reverse results from those ob-

TABLE 4  
SELF-REPORT OF EMOTIONAL STATE IN  
THE ANGER CONDITIONS

Condition	N	Self-Report scales	Comparison	<i>p</i>
Epi Inf	22	1.91	Epi Inf vs. Epi Ign	.08
Epi Ign	23	1.39	Placebo vs. Epi Ign or Inf	<i>ns</i>
Placebo	23	1.63		

tained in the euphoria conditions; that is, the Epi Inf subjects in the anger conditions should again be less susceptible to the stooge's mood and should, therefore, describe themselves as in a somewhat happier frame of mind than subjects in the Epi Ign condition. This is the case; the Epi Inf subjects average 1.91 on the self-report scales while the Epi Ign subjects average 1.39.

Evaluating the effects of the injections, we note again that, as anticipated, Epi Ign subjects are somewhat less happy than Placebo subjects but, once more, this is not a significant difference.

Behavior. The subject's responses to the stooge, during the period when both were filling out their questionnaires, were systematically coded to provide a behavioral index of anger. The coding scheme and the numerical values attached to each of the categories have been described in the methodology section. To arrive at an "Anger index" the numerical value assigned to a subject's responses to the stooge is summed together for the several units of stooge behavior. In the coding scheme used, a positive value to this index indicates that the subject agrees with the stooge's comment and is growing angry. A negative value indicates that the subject either disagrees with the stooge or ignores him.

The relevant data are presented in

Table 5. For this analysis, the stooge's routine has been divided into two phases—the first two units of his behavior (the "long" questionnaire and "What did I have for breakfast?") are considered essentially neutral revealing nothing of the stooge's mood; all of the following units are considered "angry" units for they begin with an irritated remark about the "bells" question and end with the stooge's fury as he rips up his questionnaire and stomps out of the room. For the neutral units, agreement or disagreement with the stooge's remarks is, of course, meaningless as an index of mood and we should anticipate no difference between conditions. As can be seen in Table 5, this is the case.

For the angry units, we must, of course, anticipate that subjects in the Epi Ign condition will be angrier than subjects in the Epi Inf condition. This is indeed the case. The Anger index for the Epi Ign condition is positive and large, indicating that these subjects have become angry, while in the Epi Inf condition the Anger index is slightly negative in value indicating that these subjects have failed to catch the stooge's mood at all. It seems clear that providing the subject with an ap-

TABLE 5  
BEHAVIORAL INDICATIONS OF EMOTIONAL  
STATE IN THE ANGER CONDITIONS

Condition	N	Neutral units	Anger units
Epi Inf	22	+0.07	-0.18
Epi Ign	23	+0.30	+2.28
Placebo	22 <sup>a</sup>	-0.09	+0.79
Comparison for anger units			<i>p</i>
Epi Inf vs. Epi Ign			<.01
Epi Ign vs. Placebo			<.05
Placebo vs. Epi Inf			<i>ns</i>

<sup>a</sup> For one subject in this condition the sound system went dead and the observer could not, of course, code his reactions.

propriate explanation of his bodily state greatly reduces his tendency to interpret his state in terms of the cognitions provided by the stooge's angry behavior.

Finally, on this behavioral index, it can be seen that subjects in the Epi Ign condition are significantly angrier than subjects in the Placebo condition. Behaviorally, at least, the injection of epinephrine appears to have led subjects to an angrier state than comparable subjects who received placebo shots.

#### *Conformation of Data to Theoretical Expectations*

Now that the basic data of this study have been presented, let us examine closely the extent to which they conform to theoretical expectations. If our hypotheses are correct and if this experimental design provided a perfect test for these hypotheses, it should be anticipated that in the euphoria conditions the degree of experimentally produced euphoria should vary in the following fashion:

Epi Mis  $\cong$  Epi Ign  $>$  Epi Inf = Placebo

And in the anger conditions, anger should conform to the following pattern:

Epi Ign  $>$  Epi Inf = Placebo

In both sets of conditions, it is the case that emotional level in the Epi Mis and Epi Ign conditions is considerably greater than that achieved in the corresponding Epi Inf conditions. The results for the Placebo condition, however, are ambiguous for consistently the Placebo subjects fall between the Epi Ign and the Epi Inf subjects. This is a particularly troubling pattern for it makes it impossible to evaluate unequivocally the effects of the state of physiological arousal and indeed raises serious questions about our entire theoretical structure. Though the emo-

tional level is consistently greater in the Epi Mis and Epi Ign conditions than in the Placebo condition, this difference is significant at acceptable probability levels only in the anger conditions.

In order to explore the problem further, let us examine the experimental factors identified earlier, which might have acted to restrain the emotional level in the Epi Ign and Epi Mis conditions. As was pointed out earlier, the ideal test of our first two hypotheses requires an experimental setup in which the subject has flatly no way of evaluating his state of physiological arousal other than by means of the experimentally provided cognitions. Had it been possible to physiologically produce a state of sympathetic activation by means other than injection, one could have approached this experimental ideal more closely than in the present setup. As it stands, however, there is always a reasonable alternative cognition available to the aroused subject—he feels the way he does because of the injection. To the extent that the subject seizes on such an explanation of his bodily state, we should expect that he will be uninfluenced by the stooge. Evidence presented in Table 6 for the anger condition and in Table 7 for the euphoria conditions indicates that this is, indeed, the case.

As mentioned earlier, some of the Epi Ign and Epi Mis subjects in their answers to the open-end questions clearly attributed their physical state to the injection, e.g., "the shot gave me the shivers." In Tables 6 and 7 such subjects are labeled "Self-informed." In Table 6 it can be seen that the self-informed subjects are considerably less angry than are the remaining subjects; indeed, they are not angry at all. With these self-informed subjects eliminated the difference between the Epi Ign and the Placebo

TABLE 6

THE EFFECTS OF ATTRIBUTING BODILY STATE  
TO THE INJECTION ON ANGER IN THE  
ANGER EPI IGN CONDITION

Condition	N	Anger index	p
Self-informed subjects	3	-1.67	<i>ns</i>
Others	20	+2.88	<i>ns</i>
Self-informed vs. Others			.05

conditions is significant at the .01 level of significance.

Precisely the same pattern is evident in Table 7 for the euphoria conditions. In both the Epi Mis and the Epi Ign conditions, the self-informed subjects have considerably lower activity indices than do the remaining subjects. Eliminating self-informed subjects, comparison of both of these conditions with the Placebo condition yields a difference significant at the .03 level of significance. It should be noted, too, that the self-informed subjects have much the same score on the activity index as do the experimental Epi Inf subjects (Table 3).

It would appear, then, that the experimental procedure of injecting the subjects, by providing an alternative cognition, has, to some extent, obscured the effects of epinephrine. When account is taken of this artifact, the evidence is good that the state of physiological arousal is a necessary component of an emotional experience for when self-informed subjects are removed, epinephrine subjects give consistent indications of greater emotionality than do placebo subjects.

Let us examine next the fact that consistently the emotional level, both reported and behavioral, in Placebo conditions is greater than that in the Epi Inf conditions. Theoretically, of course, it should be expected that the two conditions will be equally low, for

by assuming that emotional state is a joint function of a state of physiological arousal and of the appropriateness of a cognition we are, in effect, assuming a multiplicative function, so that if either component is at zero, emotional level is at zero. As noted earlier this expectation should hold if we can be sure that there is no sympathetic activation in the Placebo conditions. This assumption, of course, is completely unrealistic for the injection of placebo does not prevent sympathetic activation. The experimental situations were fairly dramatic and certainly some of the placebo subjects gave indications of physiological arousal. If our general line of reasoning is correct, it should be anticipated that the emotional level of subjects who give indications of sympathetic activity will be greater than that of subjects who do not. The relevant evidence is presented in Tables 8 and 9.

As an index of sympathetic activation we shall use the most direct and unequivocal measure available—change

TABLE 7

THE EFFECTS OF ATTRIBUTING BODILY STATE  
TO THE INJECTION ON EUPHORIA IN  
THE EUPHORIA EPI IGN AND  
EPI MIS CONDITIONS

Epi Ign			
	N	Activity Index	p
Self-informed subjects	8	11.63	<i>ns</i>
Others	17	21.14	<i>ns</i>
Self-informed vs. Others			.05
Epi Mis			
	N	Activity Index	p
Self-informed subjects	5	12.40	<i>ns</i>
Others	20	25.10	<i>ns</i>
Self-informed vs. Others			.10

TABLE 8  
SYMPATHETIC ACTIVATION AND EUPHORIA  
IN THE EUPHORIA PLACEBO CONDITION

Subjects whose:	<i>N</i>	Activity index	<i>p</i>
Pulse decreased	14	10.67	<i>ns</i>
Pulse increased or remained same	12	23.17	<i>ns</i>
Pulse decrease vs. pulse increase or same			.02

in pulse rate. It can be seen in Table 1 that the predominant pattern in the Placebo condition is a decrease in pulse rate. We shall assume, therefore, that those subjects whose pulse increases or remains the same give indications of sympathetic activity while those subjects whose pulse decreases do not. In Table 8, for the euphoria condition, it is immediately clear that subjects who give indications of sympathetic activity are considerably more euphoric than are subjects who show no sympathetic activity. This relationship is, of course, confounded by the fact that euphoric subjects are considerably more active than noneuphoric subjects—a factor which independent of mood could elevate pulse rate. However, no such factor operates in the anger condition where angry subjects are neither more active nor talkative than calm subjects. It can be seen in Table 9 that Placebo subjects who show signs of sympathetic

TABLE 9  
SYMPATHETIC ACTIVATION AND ANGER IN  
ANGER PLACEBO CONDITION

Subjects whose:	<i>N</i> <sup>a</sup>	Anger index	<i>p</i>
Pulse decreased	13	+0.15	<i>ns</i>
Pulse increased or remained same	8	+1.69	<i>ns</i>
Pulse decrease vs. pulse increase or same			.01

<sup>a</sup>*N* reduced by two cases owing to failure of sound system in one case and experimenter's failure to take pulse in another.

activation give indications of considerably more anger than do subjects who show no such signs. Conforming to expectations, sympathetic activation accompanies an increase in emotional level.

It should be noted, too, that the emotional levels of subjects showing no signs of sympathetic activity are quite comparable to the emotional level of subjects in the parallel Epi Inf conditions (see Tables 3 and 5). The similarity of these sets of scores and their uniformly low level of indicated emotionality would certainly make it appear that both factors are essential to an emotional state. When either the level of sympathetic arousal is low or a completely appropriate cognition is available, the level of emotionality is low.

#### DISCUSSION

Let us summarize the major findings of this experiment and examine the extent to which they support the propositions offered in the introduction of this paper. It has been suggested, first, that given a state of physiological arousal for which an individual has no explanation, he will label this state in terms of the cognitions available to him. This implies, of course, that by manipulating the cognitions of an individual in such a state we can manipulate his feelings in diverse directions. Experimental results support this proposition for following the injection of epinephrine, those subjects who had no explanation for the bodily state thus produced, gave behavioral and self-report indications that they had been readily manipulable into the disparate feeling states of euphoria and anger.

From this first proposition, it must follow that given a state of physiological arousal for which the individual has a completely satisfactory explanation, he will not label this state in terms of

the alternative cognitions available. Experimental evidence strongly supports this expectation. In those conditions in which subjects were injected with epinephrine and told precisely what they would feel and why, they proved relatively immune to any effects of the manipulated cognitions. In the anger condition, such subjects did not report or show anger; in the euphoria condition, such subjects reported themselves as far less happy than subjects with an identical bodily state but no adequate knowledge of why they felt the way they did.

Finally, it has been suggested that given constant cognitive circumstances, an individual will react emotionally only to the extent that he experiences a state of physiological arousal. Without taking account of experimental artifacts, the evidence in support of this proposition is consistent but tentative. When the effects of "self-informing" tendencies in epinephrine subjects and of "self-arousing" tendencies in placebo subjects are partialled out, the evidence strongly supports the proposition.

The pattern of data, then, falls neatly in line with theoretical expectations. However, the fact that we were forced, to some extent, to rely on internal analyses in order to partial out the effects of experimental artifacts inevitably makes our conclusions somewhat tentative. In order to further test these propositions on the interaction of cognitive and physiological determinants of emotional state, a series of additional experiments, published elsewhere, was designed to rule out or overcome the operation of these artifacts. In the first of these, Schachter and Wheeler (1962) extended the range of manipulated sympathetic activation by employing three experimental groups—epinephrine, placebo, and a group injected with the sympatholytic agent,

chlorpromazine. Laughter at a slapstick movie was the dependent variable and the evidence is good that amusement is a direct function of manipulated sympathetic activation.

In order to make the epinephrine-placebo comparison under conditions which would rule out the operation of any self-informing tendency, two experiments were conducted on rats. In one of these Singer (1961) demonstrated that under fear inducing conditions, manipulated by the simultaneous presentation of a loud bell, a buzzer, and a bright flashing light, rats injected with epinephrine were considerably more frightened than rats injected with a placebo. Epinephrine-injected rats defecated, urinated, and trembled more than did placebo-injected rats. In nonfear control conditions, there were no differences between epinephrine and placebo groups, neither group giving any indication of fear. In another study, Latané and Schachter (1962) demonstrated that rats injected with epinephrine were notably more capable of avoidance learning than were rats injected with a placebo. Using a modified Miller-Mowrer shuttlebox, these investigators found that during an experimental period involving 200 massed trials, 15 rats injected with epinephrine avoided shock an average of 101.2 trials while 15 placebo-injected rats averaged only 37.3 avoidances.

Taken together, this body of studies does give strong support to the propositions which generated these experimental tests. Given a state of sympathetic activation, for which no immediately appropriate explanation is available, human subjects can be readily manipulated into states of euphoria, anger, and amusement. Varying the intensity of sympathetic activation serves to vary the intensity of a variety of emotional states in both rats and human subjects.

Let us examine the implications of these findings and of this line of thought for problems in the general area of the physiology of the emotions. We have noted in the introduction that the numerous studies on physiological differentiators of emotional states have, viewed en masse, yielded quite inconclusive results. Most, though not all, of these studies have indicated no differences among the various emotional states. Since as human beings, rather than as scientists, we have no difficulty identifying, labeling, and distinguishing among our feelings, the results of these studies have long seemed rather puzzling and paradoxical. Perhaps because of this, there has been a persistent tendency to discount such results as due to ignorance or methodological inadequacy and to pay far more attention to the very few studies which demonstrate *some* sort of physiological differences among emotional states than to the very many studies which indicate no differences at all. It is conceivable, however, that these results should be taken at face value and that emotional states may, indeed, be generally characterized by a high level of sympathetic activation with few if any physiological distinguishers among the many emotional states. If this is correct, the findings of the present study may help to resolve the problem. Obviously this study does *not* rule out the possibility of physiological differences among the emotional states. It is the case, however, that given precisely the same state of epinephrine-induced sympathetic activation, we have, by means of cognitive manipulations, been able to produce in our subjects the very disparate states of euphoria and anger. It may indeed be the case that cognitive factors are major determiners of the emotional labels we apply to a common state of sympathetic arousal.

Let us ask next whether our results

are specific to the state of sympathetic activation or if they are generalizable to other states of physiological arousal. It is clear that from our experiments proper, it is impossible to answer the question for our studies have been concerned largely with the effects of an epinephrine created state of sympathetic arousal. We would suggest, however, that our conclusions are generalizable to almost any pronounced internal state for which no appropriate explanation is available. This suggestion receives some support from the experiences of Nowlis and Nowlis (1956) in their program of research on the effects of drugs on mood. In their work the Nowlises typically administer a drug to groups of four subjects who are physically in one another's presence and free to interact. The Nowlises describe some of their results with these groups as follows:

At first we used the same drug for all 4 men. In those sessions seconal, when compared with placebo, increased the checking of such words as expansive, forceful, courageous, daring, elated, and impulsive. In our first statistical analysis we were confronted with the stubborn fact that when the same drug is given to all 4 men in a group, the *N* that has to be entered into the analysis is 1, not 4. This increases the cost of an already expensive experiment by a considerable factor, but it cannot be denied that the effects of these drugs may be and often are quite contagious. Our first attempted solution was to run tests on groups in which each man had a different drug during the same session, such as 1 on seconal, 1 on benzedrine, 1 on dramamine, and 1 on placebo. What does seconal do? Cooped up with, say, the egotistical benzedrine partner, the withdrawn, indifferent dramamine partner, and the slightly bored lactose man, the seconal subject reports that he is distractible, dizzy, drifting, glum, defiant, languid, sluggish, discouraged, dull, gloomy, lazy, and slow! This is not the report of mood that we got when all 4 men were on seconal. It thus appears that the moods of the partners do definitely influence the effect of seconal (p. 350).

It is not completely clear from this description whether this "contagion"

of mood is more marked in drug than in placebo groups, but should this be the case, these results would certainly support the suggestion that our findings are generalizable to internal states other than that produced by an injection of epinephrine.

Finally, let us consider the implications of our formulation and data for alternative conceptualizations of emotion. Perhaps the most popular current conception of emotion is in terms of "activation theory" in the sense employed by Lindsley (1951) and Woodworth and Schlosberg (1958). As we understand this theory, it suggests that emotional states should be considered as at one end of a continuum of activation which is defined in terms of degree of autonomic arousal and of electroencephalographic measures of activation. The results of the experiment described in this paper do, of course, suggest that such a formulation is not completely adequate. It is possible to have very high degrees of activation without a subject either appearing to be or describing himself as "emotional." Cognitive factors appear to be indispensable elements in any formulation of emotion.

#### SUMMARY

It is suggested that emotional states may be considered a function of a state of physiological arousal and of a cognition appropriate to this state of arousal. From this follows these propositions:

1. Given a state of physiological arousal for which an individual has no immediate explanation, he will label this state and describe his feelings in terms of the cognitions available to him. To the extent that cognitive factors are potent determiners of emotional states, it should be anticipated that precisely the same state of physiological arousal could be labeled "joy" or "fury" or "jealousy" or any of a great diversity

of emotional labels depending on the cognitive aspects of the situation.

2. Given a state of physiological arousal for which an individual has a completely appropriate explanation, no evaluative needs will arise and the individual is unlikely to label his feelings in terms of the alternative cognitions available.

3. Given the same cognitive circumstances, the individual will react emotionally or describe his feelings as emotions only to the extent that he experiences a state of physiological arousal.

An experiment is described which, together with the results of other studies, supports these propositions.

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