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THE EFFECT OF BENZEDRINE SULFATE (AMPHETAMINE SULFATE) ON SATIATION

In a recent paper, satiation was defined by Barmack as "a state of conflict between the tendency to continue and the tendency to get away from a situation which has become unpleasant, principally because of inadequate motivation resulting in inadequate physiological adjustments to it. Accordingly a state of boredom is initiated by *inadequate motivation* during the operation of a task set and results in a tendency to revert back to the *sleep level*."¹ In the attempt to substantiate this hypothesis, Barmack administered 10 mg. of Benzedrine Sulfate (amphetamine sulfate) and equated blank pills to 36 Ss in order to determine the effect on the rate and accuracy of adding 6-place numbers for 2 hr.² He found that the drug retarded a drop in the rate of addition, and also retarded the development of boredom, sleepiness, and fatigue. Since the accuracy of the performance was not affected, and since the differences in the rate of work were increased with the increased duration of the work period, Barmack believes that the action of Benzedrine (amphetamine) was on the inclination, rather than on the ability to perform repetitive work. It was concluded that the experimental facts substantiate the hypothetical definition of satiation.

The findings were confirmed, in a later experiment,³ with a dose of 15 mg. of Benzedrine (amphetamine) and 120 min. of activity on the Poffenberger pursuit-meter.

This note attempts to indicate some difficulties inherent in the Barmack definition of satiation, and in the experiment which apparently confirms the hypothesis.

When it is observed that an individual is highly motivated, then with continued activity becomes disinterested, and finally rejects the activity entirely, it is plausible to consider that the motivation has somehow disappeared; that in some way the tissue needs, states of agitation, or other conditions which are the basis of motivation (drive), have become appeased, and then saturated to the point of aversion. This is certainly true in certain forms of satiation which we consider primitive; where the satisfaction of a basic need is involved, and is well illustrated by the work of Katz on hunger and appetite.⁴ Barmack adopts just this point, but errs when he generalizes this restricted view to all satiation. He does not consider satiation in the wider sense of a dynamic reaction in the behavioral field. He ignores the findings of Lewin and Karsten who showed that satiation may arise suddenly and leave suddenly, *i.e.* S may be satiated at one moment and not in the next.⁵ This frequently occurs when the stimulus-field undergoes even a slight reorganization. Under these circumstances it does not seem probable that these motivational states could be resolved, or that a transformation from desire to aversion could be accomplished, in so short a period. In an operational sense, it is known that animals require a relatively long period—within a particular sphere of activity—to satiate a basic need

¹ J. E. Barmack, The effect of benzedrine sulphate (benzyl methyl carbinamine) upon the report of boredom and other factors, *J. Psychol.*, 5, 1938, 125. (Italics ours.)

² *Ibid.*

³ Unpublished experiment by Dr. Barmack. Personal letter to the writer.

⁴ D. Katz, *Animals and Men*, 1937, 1-263.

⁵ K. Lewin and A. Karsten, Untersuchungen zur Handlungs- und Affektpsychologie: V. Psychische Sättigung, *Psychol. Forsch.*, 10, 1928, 142-254.

(*e.g.* hunger) and if this satiation were to occur in an instant, it would probably be due to mediating factors and not to the physiological, organic, or vital activities which we think of as the basis of motivation. These mediating factors, which in part determine the continuation or rejection of the activity, seem to involve a higher level of behavior than the physiological, and are of great importance to a theory of satiation. By this we mean to indicate that satiation involves more than a reduction of motivation during the task. There seems to exist a confusion between the recognition of the subjective aspects of fatigue and that of satiation. It is fundamental that a one-to-one correspondence between these basic states and satiation does not seem to hold. Katz has made this the basis of his two component theory for he finds that hunger, and the satisfaction of that hunger, is to a surprisingly great extent independent of the physical state of the organism and largely dependent upon the external circumstances of the event.⁶

If we deny a strict correspondence between motivational states and satiation, then we cannot accept the hypothesis that satiation is a "tendency to revert back to the *sleep level* arising through a *loss of motivation*."⁷ The evidence to support this contention seems insufficient—in addition to that presented—on the following grounds.

(1) The criterion of 'sleepiness' was *S*'s report on a 10-point scale, ranging from 1 and 2 (very sleepy), 3 (sleepy), 4, 5, 6 (indifferent), to 7 and 8 (wide awake), and 9 and 10 (very wide awake). We doubt whether any *S* has the ability to discriminate accurately over a 10-point scale. It was found in one of our experiments that responses to a 5-point scale were not sufficiently reliable to be the sole criterion of satiation. Barmack's data seem to indicate that the greatest difference between the two groups on the sleep-wake scale was no more than 1 point on a 10-point scale. The probable error of the scale is such that the small obtained differences might easily be overcome or reversed. A criterion of satiation should involve—in addition to a subjective report—non-resumption of activity, characteristic variability in performance, and the presence of "creative substitution," *e.g.* day-dreaming.

(2) As is well known, the requisite for sleep, or a sleep-like state, is the exclusion of sensory stimulation.⁸ An abundance of stimuli in the field, as would be required to satiate an individual, would reduce the tendency to go to sleep.

In certain instances where *S* becomes adapted to identical repeated stimuli, he may restrict the field of attention (as in hypnosis), and where the initial tendency is towards a drowsy state, this may facilitate sleep. Satiation is, however, not restricted to repetitive stimuli—and heterogeneous stimulus-fields tend to a waking state. We have no evidence that those individuals who tend to sleep during repetitive activity, would not do likewise in activities upon which they do not become satiated.

(3) Postulating a 'sleep-level' adds nothing to the explanation of satiation beyond the already apparent fact of the conflict between staying at the task and its rejection; that variegated accompaniments of this conflict appear which may in certain instances be postural, attentive, psychical, visceral, and fantastic.

The pharmaceutical action of Benzedrine Sulfate (amphetamine sulfate) as a relief

⁶ Katz, *op. cit.*, 159 ff.

⁷ Barmack, *op. cit.*, 125. (Italics ours.)

⁸ Katz, *op. cit.*, 34.

for exhaustion and for an increased capacity for work,⁹ as a vaso-constrictor,¹⁰ as a general activator of behavior,¹¹ has been demonstrated clinically and experimentally. It may be said in general to produce a restless hyperactive state with increased tensions and tendencies to activities. Skinner and Heron report that "the effect of either drug [Benzedrine or caffeine] is to cause the organism to release energy at a higher than normal rate whether in a state of inhibition or not. The surplus energy is used by the animal in doing what it is accustomed to doing in the situation."¹² It would seem, then, that the action of Benzedrine (or caffeine, ephedrine,¹³ and even a stimulus which elicits an intense emotional response—*e.g.* fright) serves to increase the available energy and the extensity and intensity of the tension systems. It is thus possible for *S* to persist longer at the task because of the greater potentiality of these systems. Any drug or stimulus of sympatho-mimetic character thus performs this function to a greater or less degree. This, of course, does not mean that the previously discussed motivational states are necessarily increased under such stimulation, for it is easily shown that such stimuli do not actually increase the desire for activity. In addition, it may be that an increased "vitality" of these *Ss* also introduces a reorganization of the attitude toward the rapidly declining "demand value" of the task.

In his earlier studies,¹⁴ Barmack seems to recognize the more than motivational character of satiation by recognizing a "feeling of boredom" and an "attitude of boredom," although the distinction is not strictly maintained throughout the paper. No evidence of more than the primitive aspects of satiation is apparent in the later work.

This note is in part directed to just this recognition of the confusion between the motivational and physiological aspects of satiation on the one hand, and the psychical on the other. It does not posit a strict dualism between motivation and satiation (for this is obviously incorrect), but attempts to indicate that all aspects of satiation cannot be explained on the grounds of basic motivational states, and tendencies to revert to a sleep level.

It is quite probable that Barmack would have found somewhat different results had the satiation activity been more intrinsic to every *S* than adding 6-place numbers.¹⁵ His *Ss*, because of strong extrinsic incentives, were probably forced to exhaustion, which is not the same as satiation, and may even have interfered with satiation.

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⁹ L. Zieve, The effect of benzedrine on activity, *Psychol. Rec.*, 1, 1937, 393-396.

¹⁰ S. A. Peoples and E. Guttman, Hypertension produced with benzedrine, *Lancet*, 1, 1936, 1107-1109.

¹¹ L. V. Searle and C. W. Brown, The effect of subcutaneous injections of benzedrine sulphate on the activity of white rats, *J. Exper. Psychol.*, 22, 1938, 480-490; W. J. McNamara, and R. E. Miller, The effect of benzedrine sulphate on mental work, *Psychol. Rec.*, 1, 1937, 78-84.

¹² B. F. Skinner and W. T. Heron, The effects of caffeine and benzedrine on conditioning, *Psychol. Rec.*, 1, 1937, 339-346, esp. 346.

¹³ In an unpublished experiment, Barmack found similar effects with ephedrine hydrochloride—although less intense than for benzedrine sulphate.

¹⁴ Barmack, Boredom and other factors in the physiology of mental effort, *Archiv. Psychol.*, 31, 1937, (no. 218), 1-83.

¹⁵ I am indebted to F. Nowell Jones for this suggestion.