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Author(s): Joseph E. Barmack

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increase in the capacity for brightness discrimination from lower to higher mammalian forms. Thus, although the extirpation studies indicate that there is no gradual

TABLE I  
COMPARATIVE SUMMARY OF BRIGHTNESS DISCRIMINATION THRESHOLDS

Subject	Investigator†	Minimum $\Delta I/I$	Intensity
Sunfish	Reeves	3.0*	?
Sparrow	Tugman	.18*	.098 cp.
Mouse	Yerkes	.11*	4.1, 16.6, 66.4 cp.
Deer-mouse	Moody	.83*	36.11 cp.
Rat (hooded)	Lashley	1.0*	?
Rat (white)	Munn-Slater	.59*	3.2 ml.
Rat (white)	Slater	.47*	?
Rat (white)	Spencer	.43*	?
Rat (both)	Ghiselli	1.00*	?
Raccoon	Munn	.27*	13.45 ml.
Cat	Smith	.23*	.49, 50.7 ml.
Cat	Mead	.19	.126, 26.1 ml.
Dog	Frolov	.02	?
Dog	Stone	.16*	1 cp.
Dog	Marquis	.20*	?
Monkey	Crawford	.098	.77 ml.
Human	König-Brodhun	.02	10-100 ml.
Human	Steinhardt	.01	1000 ml.
Human	Craik	.01	4000 equiv. fc.

† The references from which the data for this table were obtained are: C. D. Reeves, Discrimination of light of different wave lengths by fish, *Behav. Monog.*, 4, 1919, 1-106; E. F. Tugman, Light discrimination in the English sparrow, *J. Anim. Behav.*, 4, 1914, 55-109; Yerkes, *op. cit.*; Moody, *op. cit.*; Lashley, *op. cit.*; Munn and Slater, *op. cit.*; J. E. Slater, Brightness vision in the albino rat, *Univ. Pitt. Bull.*, 7, 1931, 394-395; L. T. Spencer, Central inhibition in the albino rat, *J. comp. Psychol.*, 3, 1923, 389-408; Ghiselli, *op. cit.* (footnote 14 above); N. L. Munn, Pattern and brightness discrimination in raccoons, *Ped. Sem.*, 37, 1930, 3-34; K. U. Smith, *op. cit.*; Mead, *op. cit.*; Frolov, *op. cit.*; C. P. Stone, Notes on light discrimination in the dog, *J. Comp. Psychol.*, 1, 1921, 413-431; Marquis, *op. cit.*, (footnote 4 above); Crawford, *op. cit.*; A. König und E. Brodhun, Experimentelle Untersuchungen über die psychophysische Fundamentalformel in Bezug auf den Gesichtssinn, *Zitzber. d. Akad. d. Wiss.*, 1889, 641; J. Steinhardt, Intensity discrimination in the human eye: I. The relation of  $\Delta I-I$  to intensity, *J. Gen. Physiol.*, 20, 1936, 185-209; K. J. W. Craik, The effect of adaptation on differential brightness discrimination, *J. Physiol.*, 92, 1938, 406-421.

shift in function from subcortical to cortical visual centers for this visual capacity in mammals, the anatomical encephalization of structure is accompanied by increased brightness discrimination capacity. The writer suggests that it may be the changes in the retina rather than the neurological modifications which determine this increased visual capacity in phylogeny.

University of Rochester

LEONARD C. MEAD

#### A DEFINITION OF BOREDOM: A REPLY TO MR. BERMAN

In the April issue of this JOURNAL,<sup>1</sup> Berman distorted a definition of boredom which I had suggested,<sup>2</sup> and proceeded to challenge my views within the framework of this distortion. I defined *boredom*:

<sup>1</sup> A. Berman, The effect of benzedrine sulfate (amphetamine sulfate) on satiation, this JOURNAL, 52, 1939, 297-299.

<sup>2</sup> J. E. Barmack, Boredom and other factors in the physiology of mental effort, *Arch. Psychol.*, 31, 1937, (no. 218), 1-83; The effect of benzedrine sulfate (benzyl methyl carbinamine) upon the report of boredom and other factors, *J. Psychol.*, 5, 1938, 125-132.

"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 for the physiology of the subject to revert back to the sleep level. The inadequate vital adjustments to the task are unpleasantly appreciated as the feeling of monotony or fatigue. If the task set is weak, the subject may go off to sleep or abandon the task. If the task set is sufficiently strong, the subject struggles to remain awake or partly escape from the depressing task. These latter objectives are achieved usually unconsciously, by shifting attention away from the task, daydreaming, creating extrinsic goals, modifying the procedure, etc."<sup>3</sup>

This view of boredom is elaborated in an early publication.<sup>4</sup> Berman, without explicitly stating that he is using his own terminology, substitutes the word *satiation*<sup>5</sup> for *boredom* in his article which opens as follows:

"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.'"<sup>6</sup> (Italics mine.)

There are at least two objections to this type of substitution. First, although the substitution may be quite harmless in one context, it can be unfortunate in another. For example, it is embarrassing to find attributed to me the view which Berman's following statements suggest.

"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. Barmack adopts just this point, *but errs when he generalizes this restricted view to all satiation.*"<sup>7</sup> (Italics mine.)

Secondly, the substitution of the word 'satiation' for 'boredom' is contra-indicated by the procedure of the experiments to which he refers. In belated correspondence, Berman attempted to justify the substitution on the grounds that Lewin and Karsten use the term, 'psychic satiation,' in describing similar experiments.<sup>8</sup> A basic difference in procedure between the experiments of Lewin and Karsten and my own is that in the former the subject is relatively free to stop an activity against which he has developed a negative valence,<sup>9</sup> and in the latter the subject is acting under the constraint of the experimenter's instructions to complete a specified period of activity. In the Lewin and Karsten experiments, the rejection of the activity may be considered a manifestation of satiation. In my own studies and other studies in which boredom has been the focal point of interest, the initial activity may be described conceivably as satiating, but the subsequent activity may be more effectively described as a not too happy *toleration* of an unpleasant task. In this situation, *S* conforms outwardly to the instructions of the *E*, but expresses a negative valence to parts of, or to the whole of the task by a diminished or

<sup>3</sup> *Ibid.*, 125 f.

<sup>4</sup> *Op. cit.*, *Arch. Psychol.*, 67-74.

<sup>5</sup> I do not use the word "satiation" in either of the publications to which Berman refers.

<sup>6</sup> *Op. cit.*, 297.

<sup>7</sup> *Ibid.*

<sup>8</sup> K. Lewin and A. Karsten, Untersuchungen zur Handlungs- und Affektpsychologie: V. Psychische Sättigung, *Psychol. Forsch.*, 10, 1928, 142-154.

<sup>9</sup> Lewin describes the technique as follows: "the subject must do a certain task repeatedly; he is, however, free to stop as soon as he has enough of it." *A Dynamic Theory of Personality*, 1935, 254.

variable rate of work, daydreaming, alterations in procedure, etc. 'Psychic satiation,' therefore, may be regarded as but one aspect of the state of boredom.

Again, the substitution of the word (and concept of) 'satiation' has led Berman into what may be regarded as one of the more serious misstatements of my views. He writes:

"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. . . . Barmack adopts just this point, but errs when he generalizes this restricted view to all satiation."<sup>10</sup>

In the quotation from my Benzedrine study appearing in this article, and to a more detailed extent in my other study,<sup>11</sup> it is clear that I refer to the physiological *consequences* of certain motives rather than to their antecedents. These *results* of motivation favor an alert attitude during the work. According to our hypothesis, then, after the exploratory drive is gratified (of which the relative novelty of the task may be considered the incentive), and under certain other conditions such as the lack of the operation of other strong motives, and with the restriction of attention to the task,<sup>12</sup> a condition develops which is unfavorable to the maintenance of the alert state. Out of this tendency stem two main effects, a desire to get away from the task or other environmental condition which, in a sense, had produced it, or a desire (usually unconscious) to correct the unpleasant state by introducing new methods of work, thinking of more strongly affective situations, which are, in a way, means of staying alert, etc. Through conditioning, the range of stimuli to which the rejection may appear is extended.

On the basis of the foregoing analysis, it follows that certain antihypnotics should allay or minimize the appearance of these two effects.<sup>13</sup> In fact, the antihypnotic, Benzedrine, was found effective in retarding (a) a drop in the rate of addition over a two-hour period, (b) the development of boredome, strain, irritation, fatigue, sleepiness and inattentiveness, as indicated by ratings on ten-point subjective rating scales.<sup>14</sup> Subsequently, we obtained evidence that 60 mg. of ephedrine hydrochloride and 2 gr. of caffeine (alkaloid form)<sup>15</sup> have similar properties, although, under the conditions of the experiments, to a lesser degree than the 10 mg. of Benzedrine.

Berman reveals still another confusion from his substitution of the word 'satiation' for 'boredom' as is apparent in the following:

"As is well known, the requisite for sleep, or a sleep-like state, is the exclusion of sensory stimulation. An abundance of stimuli in the field, as would be required to satiate an individual, would tend to reduce the tendency to go to sleep."<sup>16</sup>

It is not true that the requisite for sleep is the exclusion of sensory stimulation. So far as I know, no study has been performed in which the relative importance of motivation or other internal conditions has been compared to that of the exclusion of sensory stimuli, and to describe the conditions which facilitate the development

<sup>10</sup> *Op. cit.*, 297.      <sup>11</sup> *Op. cit.*, *Arch. Psychol.*, 67-74.      <sup>12</sup> *Ibid.*, 71.

<sup>13</sup> Those in which there are no other intrinsic factors which might induce a negative valence to the task.

<sup>14</sup> *Op. cit.*, *J. Psychol.*, 5, 1938, 125-133.

<sup>15</sup> Unpublished material.      <sup>16</sup> *Op. cit.*, 298.

of boredom as "an abundance of stimuli in the field" is not altogether warranted.

Towards the end of his paper Berman states:

"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.*"<sup>17</sup> (Italics mine).

Berman, I was informed by correspondence, bases the italicized statement on the following quotation appearing at the end of my Benzedrine study. "A state of boredom is caused principally by a physiological reversion to the sleep level due to inadequate motivation during the operation of a task set."<sup>18</sup>

Berman criticized the use of the subjective rating scales. "We doubt," he writes, "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."<sup>19</sup>

I have not used the subjective rating data as the *sole* criterion of boredom, but have used them in conjunction with changes in rate of addition. In the light of correspondence with Berman, it appears that his statement on the 'unreliability' of the 5-point rating scale which he used was based on an observed inconsistency between certain verbal reports of some individual *Ss* and their ratings. That the ratings of some individuals may not be too valid an expression of their subjective states is common knowledge. In the Benzedrine study, I dealt with *average ratings of many Ss* rather than with a consideration of individual cases. It is true that the critical ratios of differences between the means of the subjective ratings for Benzedrine and placebo at specific periods are only of the order 0.95 to 2.5. The duplication, however, of these values for a series of four sets of differences during the last hour of the 2-hr. work-period for each of the dependent variables gives most of them added statistical significance. Certainly the lowest qualitative evaluation that may describe such data is that they cannot be ignored. Further, essentially the same findings were obtained in another experiment using 15 mg. of Benzedrine on 10 *Ss* engaged in an entirely different task, operating the Poffenberger pursuitmeter.<sup>20</sup>

In a better founded criticism, Berman inquires why the data of the Benzedrine and other experiments using sympatho-mimetic compounds should be used to support an hypothesis on boredom rather than a more obvious fatigue interpretation. A feeling of fatigue is, in fact, usually associated with boring work. Because of its transient character, however, it is generally referred to as a pseudo-fatigue or feeling of monotony.

For the following reasons, the data may be more accurately integrated about a boredom concept than about a fatigue concept: (1) The *Ss* themselves verbalized post-experimentally their experiences as predominantly boring, rather than fatiguing, and this was particularly true after the 2-hr. pursuit-task. (2) In another study, *Ss* added numbers under the same conditions for 4 hr. without appreciable difficulty.<sup>21</sup>

<sup>17</sup> *Op. cit.*, 299.      <sup>18</sup> *Op. cit.*, *J. Psychol.*, 132.

<sup>19</sup> *Op. cit.*, 298.

<sup>20</sup> *J. Exper. Psychol.*, (in press).

<sup>21</sup> Barmack, The length of the work-period and the work-curve, *J. Exper. Psychol.*, 25, 1939, 109-115.

It is hardly likely, therefore, that the Ss in the Benzedrine experiment "were probably forced to exhaustion" within 2 hr., as Berman suggests.<sup>22</sup> (3) In still another study, with pursuit activity as the task, the introduction of a small added financial incentive after one hour of work resulted in a marked improvement in accuracy of performance for the second hour which surpassed that of any period of the first hour.<sup>23</sup> Accompanying the marked improvement in pursuit performance were equally striking changes in report of boredom, fatigue, sleepiness, etc., in the more favorable direction. It is improbable that such changes would occur as readily in fatigued Ss as in bored Ss. This finding is relevant here because the observed effects of Benzedrine on the report of boredom and other factors were duplicated with this type of task.

The inference is compelling that Berman's article arose chiefly out of a number of confusions which resulted from his unwarranted substitution of both the word and concept of 'satiation' for 'boredom.'

College of the City of New York

JOSEPH E. BARMACK

#### SATIATION OR BOREDOM? A REJOINDER TO DR. BARMACK

In a former paper appearing in this JOURNAL,<sup>1</sup> I attempted to demonstrate that the concept of satiation cannot entirely be explained in terms of a reduction in motivation and return to a sleep level, as suggested by Barmack.<sup>2</sup> The arguments presented are attacked by Barmack.<sup>3</sup> The principal criticism leveled against me is that I accepted the equivalence of the concepts of satiation and boredom—even to the point of a substitution of terms. Before the validity of such a procedure can be determined the operations governing the two concepts must be investigated. The term *psychical satiation* was originally used (as far as it is possible to tell) by Karsten and Lewin.<sup>4</sup> I objected to the term *psychical* because it implies that satiation is purely a mental process. It is easily shown that such a distinction cannot safely be made, for satiation is a behavioral phenomenon and not solely mental. Consequently the appendage *psychical* was dropped and the term *satiation* itself was employed as denoting behavioral satiation. It was recognized, in addition, that satiation has as many manifestations as there are behavioral activities. Thus one can be satiated with eating a certain food, or with all food (*i.e.* hunger satiation); with sexual activity; with listening to music; with adding numbers; with adjusting a bolt on a moving assembly line; etc. In fact, satiation may appear for any task or activity when it is repeated sufficiently to induce a negative valence and rejection of the task. It is not known whether the satiation which arises with the continuous activity of inserting pegs into a board is the same as that which develops with the repetitive ingestion of a single food, or class of foods. It is reasonably certain, however, that in general the principle of the satiation of behavior holds for all levels of activity. In my paper, the satiation of basic drives, *i.e.* hunger, sex, etc., was called primitive as

<sup>22</sup> *Op. cit.*, 299.

<sup>23</sup> Unpublished material.

<sup>1</sup> A. Berman, The effect of benzedrine sulphate (amphetamine sulphate) on satiation, this JOURNAL, 52, 1939, 297-299.

<sup>2</sup> J. E. Barmack, The effect of benzedrine sulphate (benzyl methyl carbinamine) upon the report of boredom and other factors, *J. Psychol.*, 5, 1938, 125-133.

<sup>3</sup> *Supra*, 467-471.

<sup>4</sup> K. Lewin and A. Karsten, Untersuchungen zur Handlungs- und Affektpsychologie: V., Psychische Sättigung, *Psychol. Forsch.*, 10, 1928, 142-254.