Does negative affect beget positive affect?
A test of the opponent-process theory

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A modified form of the Nowlis (1965, 1970) mood adjective checklist was administered to college students just before and immediately after taking a final course examination. In agreement with prediction from the opponent-process theory of motivation developed by Solomon and Corbit (1974), dysphoria decreased reliably and, more significantly, euphoria increased.

Solomon and Corbit (1974) have presented a theory of motivation that promises to capture most, perhaps all, major motivational phenomena, both learned and unlearned. In their view, the occurrence of a significant environmental event serves first to initiate and then to maintain a manifest hedonic state, pleasant or unpleasant (State A). With cessation of the significant event, the manifest state does not simply collapse to neutrality, but, rather, it swings beyond, and into the opposite state (State B). It then returns to a stable neutrality. Pain follows automatically upon pleasure, pleasure upon pain. And neutrality can only be achieved biphasically. Responsible for these manifest states are two underlying hypothetical processes, a and b. The a process is set into motion by the occurrence of the significant event. It rises quickly to a maximum and collapses with the termination of the event. The onset of a triggers a slave process, b. This process opposes the a process: It is opposite in sign, and it is the algebraic sum of a and b that determines, at any given instant in time, the sign and amplitude of the manifest state. With repeated exposure to the significant event, both manifest States A and B change; A becomes weaker and B, stronger. Changes in A and B reflect underlying changes in the b process, which is assumed to grow stronger with use and weaker with disuse; the a process remains essentially unchanged.

Evidence from the animal laboratory (Hoffman & Solomon, 1974; LaBarbera & Caul, 1967a, 1967b; Solomon & Corbit, 1974) is compelling. The theory seems a good fit to the facts of addictive behavior (Solomon & Corbit, 1973; Trapold & Sullivan, 1979). Sorely lacking is experimental evidence from the area of human behavior. The present study is directed to that end. College students yielded self-ratings of moods both immediately prior to and immediately subsequent to experiencing a stressful academic experience, a final

course examination. With completion of the exam, the opponent-process theory predicts not just a collapse in apprehension, but a surge in elation. From feeling bad, the student subject should swing to feeling good. It is the latter, the surge in elation, that constitutes the unique implication of the theory.

EXPERIMENT 1

Method
Subjects. Two replications were conducted. Each employed college students (males and females, 17-26 years of age) enrolled in introductory psychology classes taught by the same instructor during successive fall and spring semesters at the University of Alabama. The first replication employed 93 subjects, the second, 101.

Apparatus. Each subject was administered a modified short form of the Nowlis (1965, 1970) mood adjective checklist (MACL). Nowlis' MACL was chosen for its brevity and because it has been standardized on a college student population. The scale used sampled nine mood factors by self-ratings on four adjectives, each describing the subjective states: "aggression," "anxiety," "elation," "fatigue," "nonchalance," "sadness," "social affection," "surgency," and "vigor."

Procedure. The MACL was administered immediately before a final examination to all subjects as a group and was administered again to each subject immediately following the exam. The same form of the MACL was given each time; each administration required approximately 5 min. Instructions to the subject were printed on the face of the MACL and required the subject to rate him/herself on each of 36 adjectives on a 4-point scale. For example, circling the "(xx)" beside the adjective "jittery" indicated that the subject definitely felt jittery at that moment, and the response was later assigned a weight of 3. Other available responses were: slightly jittery, "(x)," assigned a weight of 2; cannot decide, "(?)," assigned a weight of 1; and definitely not jittery, "(no)," assigned a weight of 0.

Results and Discussion
Preliminary mixed-design variance analyses (Lindquist, 1953, Type 1) revealed no differences between the two replications for the nine MACL mood scales investigated. Separate factor analyses (four analyses: two replications and two MACL administrations per replication) indicated identical factor structures and highly similar factor loadings for the nine scales among the four MACL administrations. For this reason, in further analyses,

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the data from the two replications were combined.

Our primary interest focuses on the data from the anxiety and elation scales of the MACL. A decrease in postexam anxiety, accompanied by an increase in post-exam elation, would reflect the swing of a compensatory mechanism (b process) on the subject's manifest mood state (State B). For the combined replications (N = 194), mean anxiety level before the exam was found to be 5.9 (on a scale from 0 to 12), with a SD of 3.99. Following the exam, this mean dropped to 2.7, with a SD of 3.30. The decline in anxiety was highly statistically reliable [t(193) = 10.4, p < .001] but constitutes little more than a ho-hum finding. Of much greater significance, the elation scores increased significantly following the exam, from a preexam mean of 2.3 (SD = 2.21) to a postexam mean of 3.8 (SD = 3.19), an increase that was found to be highly significant statistically [t(193) = 6.8, p < .001]. It would appear that the data strongly support the opponent-process theory: A surge in elation follows upon the termination of a disturbing situation. However, before this conclusion can be drawn firmly, two demurrers must be entered: (1) Do the two mood scales, anxiety and elation, measure the same thing? If one scale simply presents antonyms for the words representing the other scale, the resulting negative correlation would generate the above finding in the absence of any theoretical significance. (2) What is the effect on MACL scores of immediate retest? In the present study, test and retest were separated by about 90 min.

Possible confounding arising from the first consideration was assessed by correlating anxiety before with elation before and anxiety after with elation after. In the first instance, a value of −.17 was found, in the second, −.22. Although both reached conventional levels of statistical reliability (.05 and .01, respectively), such small values account for very little of the variance (2.9% and 4.8%, respectively). We conclude that the anxiety and elation scales possess a high degree of independence and that a change in one does not "force" a change in the other.

The question of retest effects was evaluated by conducting a control study in which the same mood scale was administered to another group of comparable undergraduates (N = 137) before and after an entirely ordinary class lecture. Elation score exhibited little actual change for this group, from a prelecture mean of 4.1 (SD = 2.79) to the postlecture mean of 3.8 (SD = 2.58). To be noted here is the fact of decrease (not statistically reliable, however). We conclude that retest effects do not account for the surge in elation seen in our experimental subjects. And, again, the correlation between anxiety and elation was found to be negligible. In this group, again, anxiety before correlated quite weakly with elation before (−.11); anxiety after correlated quite weakly with elation after (−.04).

A further analysis of the data was undertaken. Scrutiny of the nine mood scales tapped by the MACL suggested that a further factoring might uncover the two high-level factors, euphoria and dysphoria, featured prominently in the Solomon and Corbit (1973, 1974) argument. Thus, elation, social affection, surgency, and vigor seem heavily weighted with euphoria (pleasant affect); aggression, anxiety, fatigue, and sadness are weighted with dysphoria (unpleasant affect); and nonchalance (gauged by the mood adjectives, "relaxed," "at peace," "quiet," and "calm") would, seemingly, more strongly reflect neutral affect. Factor analysis confirmed this intuitive consideration. Separate analyses were performed on the scores yielded by: (1) the experimental group before the examination, first replication, (2) the experimental group after the examination, first replication, (3) the experimental group before the examination, second replication, (4) the experimental group after the examination, second replication, (5) the control group before the lecture, and (6) the control group after the lecture. In all instances, principal axes were derived and rotated to varimax solution. A common factor structure prevailed, with two factors exhausting most of the variance. In all analyses, anxiety, aggression, and sadness were found to be heavily loaded on Factor 2 (dysphoria); elation, social affection, surgency, and vigor were loaded on Factor 1 (euphoria). None of these carried sizable loadings on the other factor. Nonchalance and fatigue were more variable across analyses and carried weaker loads. These two scales were dropped from the euphoria-dysphoria analysis that follows.

Unit-weight factor scores were used in the euphoria-dysphoria analysis. For euphoria, these scores could range from 0 to 48 (elation plus social affection, surgency, and vigor); for dysphoria, from 0 to 36 (anxiety plus aggression and sadness). For the experimental group, the preexam dysphoria mean was 12.9, with a SD of 8.29. Following the exam, this fell to 8.4, with a SD of 8.25. By t test, the decline was reliable [t(193) = 7.11, p < .001]. Euphoria, on the other hand, increased from 14.8 (SD = 8.77) to 17.2 (SD = 11.4) [t(193) = 3.42, p < .01]. For the control group, euphoria decreased slightly but reliably following the lecture [t(136) = 3.23, p < .01] from a mean value of 22.9 (SD = 9.87) to 20.9 (SD = 9.69). Thus, as was true of the elation scale in the earlier analysis, immediate retest is not the occasion for a necessary increase in euphoria in the control group. Further, the independence of the two states measured here is enhanced by the strong factor loadings of the scales defining them.

It is our conclusion, then, that the present data support the opponent-process theory: The question, "Does negative affect beget positive affect?" receives an affirmative answer. This conclusion would be strengthened, of course, if the present results could be

replicated further, especially so if using subjects recruited from another institution. With this in mind, Experiment 2 was conducted.

EXPERIMENT 2

Method

Subjects. The subjects (N = 129) were drawn from undergraduate students enrolled in introductory psychology classes at the University of Montevallo (Montevallo, Alabama).

Materials and Procedure. As in Experiment 1, the MACL was administered just before and immediately following a final course examination.

Results

The mean value for anxiety obtained just prior to the examination was 6.6 (SD = 3.86). This fell to 2.2 (SD = 2.93) following the exam. By t test, the difference was found to be highly reliable [t(128) = 12.72, p < .001]. The elation mean rose from 2.7 (SD = 2.53) before the exam to 5.8 (SD = 3.27) following the exam. Again, by t test, the change was found to be highly reliable [t(128) = 11.24, p < .001].

The nine mood scales measured by the MACL were factor analyzed as in Experiment 1 (varimax solution). Separate analyses were performed on the before and after scores. In both instances, the two high-level factors, dysphoria and euphoria, could be readily identified, with anxiety, aggression, and sadness again exhibiting heavy (and exclusive) loadings on the former, and elation, social affection, vigor, and surgency, on the latter. Using unit-weight factor scores, the euphoria-dysphoria analysis of Experiment 1 was applied to the present data. The dysphoria preexam mean was found to be 13.2 (SD = 8.58), the postexam mean, 5.3 (SD = 7.16). By t test, this decline was highly significant [t(128) = 10.80, p < .001]. The euphoria preexam mean was found to be 17.9 (SD = 9.92), the postexam mean, 24.0 (SD = 11.63). And, again, the difference was highly reliable [t(128) = 6.73, p < .001].

It is entirely evident that the findings of Experiment 2 are in full accord with those of Experiment 1.

GENERAL DISCUSSION

Freshman and sophomore college students recruited from two institutions of higher learning exhibited common changes in mood (Nowlis, 1970) with the completion of a final course examination: anxiety dropped, elation increased. Parallel changes were seen in the two high-level mood factors, dysphoria and euphoria; the former decreased, the latter increased. The

outcome of these experiments can be viewed as clearly supporting the opponent-process theory of motivation developed by Solomon and Corbit (1974). The surge in euphoria seen following the termination of a stressful experience as a unique implication of the theory is particularly impressive.

A stronger test would take a look at the quantitative relation holding between change in elation and euphoria (after minus before) and the intensity of the negative mood states, anxiety and dysphoria, prevailing just prior to the examination. It is an implication of the theory that this relation should be positive and substantial; the greater the negative affect (a process), the greater the consequent excursion of the b process. To assess this theoretical commitment, correlations were conducted between anxiety level before and change in elation (elation after minus elation before) and, in turn, dysphoria before and euphoria change (after minus before). For Experiment 1, these values (Pearson product-moment correlations) were found to be +.205 and +.263, respectively, and for Experiment 2, +.186 and +.212, respectively. Although all four values meet conventional significance criteria (p < .05), their magnitudes are disappointingly small; little variance (3%-7%) is accounted for. This finding constitutes no embarrassment to the theory, of course. The predicted direction is there; the weakness of the relationship is readily attributed to the insensitivity of the measures employed.

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