

The Influence of Feedback on Mood: Linear Effects on Pleasantness and Curvilinear Effects on Arousal

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We investigated the effects of feedback (grades) on two primary mood dimensions—Pleasantness and Arousal. We hypothesized that (a) cognitive comparisons of feedback to multiple standards yield cognitive appraisals of feedback sign, and that (b) feedback sign has a linear effect on harm/benefit appraisal, which influences mood Pleasantness, and a curvilinear effect on need for action appraisal, which influences Arousal. In Study 1 ($N = 281$), grades (a proxy for the sign of feedback-norm discrepancy) had a linear relationship with Pleasantness and a U-shaped relationship with Arousal. In addition, subjects who received grades had higher Arousal than control subjects. Study 2 ($N = 226$) replicated the results of Study 1 and showed that after controlling for the relationship of grades with Pleasantness and Arousal, the sign of feedback-expectation discrepancy (a second standard) also had a linear relationship with Pleasantness and a U-shaped relationship with Arousal.

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Only recently have organizational researchers (George & Brief, 1992) realized the wide spectrum of consequences that situational affect has on organizational behavior variables. Yet, organizational variables that are likely to be the antecedents of situational affect have not yet received

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detailed attention. One antecedent of situation affect is feedback (FB). The sign of FB has a strong and consistent effect on the valence of affect. For example, negative FB induces frustration (Mikulincer, 1988) and dissatisfaction (Podsakoff & Farh, 1989). This effect is so robust that affect researchers have frequently manipulated FB sign as a means to induce affect in the laboratory (e.g., Isen, 1987). Typically, positive FB is used to elicit positive mood, and negative FB is used to elicit a negative mood.

Most research on FB-induced affect has treated the affective response as a single dimension (e.g., positive–negative mood or satisfaction–dissatisfaction). Yet, a single affect dimension may be insufficient to account for some FB effects. For example, one episode of negative FB increases frustration, whereas repeated episodes of negative FB induce depression (at least for subjects high on internal locus of control; Mikulincer, 1988). Frustration and depression are two separate negative moods (Berkowitz, 1990). Therefore, at least one more dimension of affect may be involved in the reaction to FB.

In fact, researchers of mood structure have long recognized that affect is multidimensional (e.g., Russell, 1980; for recent criticism of a dimensional approach to the study of affect see Ortony, Clore, & Collins, 1988, and Lazarus, 1991). Russell's (1991) review suggests that three dimensions underlie the affective experience across all studies and cultures. The first dimension was labeled by various researchers as evaluation, valence, or pleasure and will be referred to as Pleasantness. The core of the Pleasantness dimension seems to be indistinguishable from similar concepts of affect dimensions such as positive–negative mood, good–bad mood, or satisfaction–dissatisfaction. The second dimension is arousal, activity or activation and will be referred to as Arousal, and the third is described as power, control, dominance, or potency. The second and the third dimensions are not found as consistently as the Pleasantness dimension. Russell (1991) suggested that sampling moods that relate to *intrapersonal* contexts yield the Arousal dimension, whereas sampling moods that relate to *interpersonal* contexts yield the dominance dimension. However, when the Pleasantness and Arousal dimensions are found, the moods can be represented as points on the perimeter of a circle anchored by these dimensions (Mano, 1991; Russell, 1980; Watson & Tellegen, 1985). This circular configuration yields an intercorrelation pattern of a circumplex and is presented in Fig. 1. The two dimensions of affect underlie the following circularly ordered octants: Arousal, Elation, Pleasure, Calmness, Quiescence, Boredom, Unhappiness, and Distress. Octants 45 degrees apart are moderately correlated (e.g., Pleasure and Elation), octants 90 degrees apart are independent (e.g., Arousal and Pleasure), Octants 135 degrees apart are moderately and negatively correlated (e.g., Pleasure and Distress), and octants 180 degrees apart are highly negatively correlated

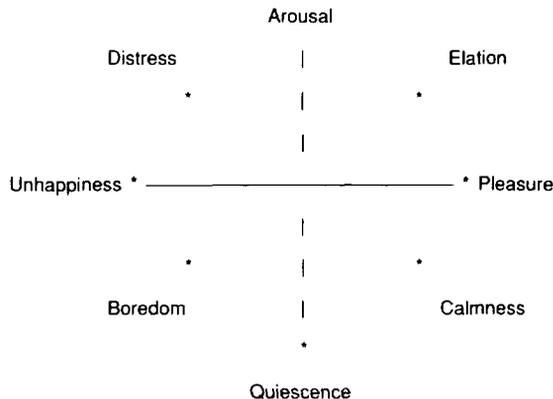


FIG. 1. The mood circumplex.

(e.g., Pleasure and Unhappiness). Although alternative views of the two dimensions that underlie the circumplex exist (Watson, Clark, & Tellegen, 1988), the Arousal and Pleasantness dimensions were adopted in the present investigation. The justification for this choice is presented after the exposition of the hypotheses.

In light of the evidence for the existence of the Arousal and Pleasantness dimensions, a question arises regarding the specific effects of FB sign on these dimensions. Theoretical guidance may be found in work on the *antecedents* of affect (Higgins, 1987; Lazarus, 1991; Taylor, 1991). A common assumption in these investigations is that cognitive appraisals of progress toward, or maintenance of, an important goal result in affective reaction (for a review and a criticism of appraisal theories of emotions, see Parkinson & Manstead, 1992). One primary appraisal is concerned with whether the stimulus is harmful or beneficial for the organisms' goals (Lazarus, 1991). A harmful appraisal leads to negative affect, whereas a beneficial appraisal leads to positive affect, i.e., the harm/benefit appraisal influences the Pleasantness dimension. This prediction is also consistent with FB research testing hypotheses derived from Goal Setting theory (e.g., Locke & Latham, 1990) and from Control Theory (Carver & Scheier, 1981). These studies consistently demonstrate that FB-goal discrepancy is linearly related to actual satisfaction (Kernan & Lord, 1991; Matsui, Okada, & Inoshita, 1983; for an earlier review see Taylor, Fisher, & Ilgen, 1984) and to cognitive evaluations of anticipated satisfaction, i.e., valence (Bandura & Cervone, 1986; Mento, Locke, & Klein, 1992).

Yet, there may be additional *types* of cognitive appraisals (antecedents) that are responsible for different affective reactions (Lazarus, 1991). One such appraisal, which may be relevant to the study of FB, is concerned with coping potential. When active coping (behavioral or cognitive) is

deemed desirable and feasible, emotions characterized by high arousal may ensue (e.g., anger), whereas when active coping is deemed unnecessary or impossible, an affect characterized by low arousal (e.g., sadness) is likely to occur. This argument is related to the notion of *mobilization* (e.g., Taylor, 1991). Mobilization of physiological and psychological resources occurs when the organism is faced with a need to take action (usually to protect itself). The preparation for action, cognitive or physical, results in arousal, i.e., the cognitive appraisal of a need for action influences the Arousal dimension.

Most research on arousal-inducing stimuli has concentrated on negative events (Christianson, 1992). However, there is evidence that positive events can also cause arousal (Christianson, 1992). This suggests that positive events may also be perceived as requiring action. Research on the distinction between elation (high arousal) and joy or gladness (medium arousal) may illustrate this point. "Elation occurs when a person suddenly finds that a wish involving the self has been fulfilled," it "gives rise to an impulse to jump up and down and a tendency to announce to others what has happened," and will "allow the person to 'realize' the wish, thus altering his or her self-image" (de Rivera, Possell, Verette, & Weiner, 1989, p. 1016). In other words, even events that are appraised to be beneficial may be appraised as requiring action, or at least action tendency (Ortony *et al.*, 1988), and extra cognitive processing regarding the self, resulting in heightened arousal.

One difficulty in predicting the effects of FB on affect is that the goals or the standards to which the recipient compare the FB are unknown. When the recipient has no clear goal, FB may have no affective consequences because the recipient is unable to "calculate" the subjective FB sign and therefore to assign a harm/benefit appraisal to the FB. Indeed, several researchers have demonstrated that in the laboratory, where the subject is unlikely to be equipped with internal standards regarding the unfamiliar task, FB has no effect on mobilization or effort, if goals are not provided (Erez, 1977; Bandura & Cervone, 1983). However, in familiar settings, such as receiving mid-term grades, recipients are likely to be equipped with some reference standard against which they will compare their performance. One such standard may be normative, i.e., "how am I performing relative to my peers"? The existence of such a standard received some empirical support (Lewin, Dembo, Festinger, & Sears, 1944). Since most people set their goals and standards well within the realms of possibilities (Lewin *et al.*, 1944), a familiar form of FB is likely to be perceived by some people as subjectively positive, by some as negative, and yet by some as neutral. Moreover, since most people have reasonable standards, extreme objective FB will tend to have a predictable effect, i.e., very positive FB will almost never be perceived as sub-

jectively negative (for exceptions, see Koestner, Zuckerman, & Koestner, 1987), and very negative FB will almost never be perceived as subjectively positive. Therefore, even without knowing the exact goal subjects have, we can predict that in a familiar situation, objective positive FB is likely to be perceived as beneficial and objective negative FB is likely to be perceived as harmful. In other words, the objective FB is likely to be a good proxy for the subjective FB sign perceived by the recipient. Therefore, there should be a strong positive correlation between actual FB sign and Pleasantness. This hypothesis is well supported empirically (see above) and will be tested here merely to demonstrate the difference between the effects of FB on Pleasantness and the effects of FB on Arousal.

Prediction regarding how FB will influence the need for action appraisal, and consequently Arousal, can be derived from Control Theory (Carver & Scheier, 1981). According to this theory, FB that signals a deviation from an acceptable standard will cause a corrective action aimed at reducing the gap between the FB and the standard. When the FB is negative, it signals that more effort is required to eliminate the perceived discrepancy. Indeed, subjects receiving negative FB are likely to exert more effort than subjects who receive positive FB (Campion & Lord, 1982; Kernan & Lord, 1990—at least initially for high valenced goal; Podsakoff & Farh, 1989). When the FB is positive, it signals that no more action is required regarding the standard directly indicated by the FB, yet the recipient will still attempt to eliminate the perceived FB-standard gap. This gap can be eliminated by raising the standard (cognitive action) for the future. Not surprisingly, several researchers have shown that the reaction to positive feedback entails changes in standards (Lewin, *et al.*, 1944; Campion & Lord, 1982). However, the change in standards does not have to be in the domain in which the positive FB was received. Positive FB may direct attention to other important goals of the organism, which do require action. At any given time, there are negative-FB loops which signal that goals are not met (Carver & Scheier, 1981). The success of over achieving one goal may present an opportunity to achieve other goals, *i.e.*, direct attention to other negative FB readings. For example, an employee who receives an unexpectedly positive FB from a supervisor, may usurp the opportunity to ask for a salary raise. In addition, when the sign of the FB is unexpected (extreme) it indicates not only a gap from the performance standard of the task at hand, but also a gap from a higher-order standard of being able to predict one's environment, *i.e.*, the FB may signal that the recipient failed to predict the environment (violating the need to "guess accurately;" Lewin *et al.*, 1944) and may require extra cognitive activity for retrospection. Indeed, the results of several experiments suggest that positive primes (the letter "A"

connoting a grade) and negative primes (F) attract more attention than neutral primes (C; Derryberry, 1991). In summary, extreme positive FB, just like extreme negative FB, may signal a need for (cognitive or other) action and therefore result in heightened Arousal.

This leads to the prediction that extreme FB, both negative and positive, will signal a deviation from internal standards (assuming that most people hold moderate standards) and therefore will increase Arousal relative to situations where FB is moderate. Moderate FB is not likely to be detected by most people as a large deviation from internal standards and therefore should not signal any need for action, hence, no Arousal.

This analysis suggests that the relationship between FB sign and Arousal will have a U-shaped form. Yet, repetitive negative FB may lead some recipients to an assessment that any action is futile and will therefore result in low Arousal. Thus, although extreme positive FB may only increase Arousal, extreme negative FB is likely to cause Arousal only when coping is deemed feasible. However, one episode of negative FB is unlikely to result in an assessment that any extra action is futile, i.e., learned helplessness response (e.g., Mikulincer, 1988). In the present investigation we studied the effect of one FB episode—midterm grades and therefore expected to find a U-shaped relationship between FB sign and Arousal.

This prediction of a U-shaped relationship between FB sign and Arousal necessitates a prediction that subjects who receive FB will be more aroused than subjects who do not receive FB. Among subjects who receive FB some will interpret it as a signal of a deviation from a standard (or standards), and therefore will experience an elevation in Arousal. Hence, although only some FB recipients will experience an elevation in Arousal, the average Arousal among FB recipients should be higher than the average Arousal of subjects who do not receive FB. In contrast, there should be no difference in Pleasantness between subjects that do and those that do not receive FB. The lack of difference in average Pleasantness should be expected because the increased pleasantness felt by recipients of positive FB will cancel out the increased unpleasantness felt by recipients of negative FB. Yet, FB recipients may experience more extreme moods on the Pleasantness dimension and hence exhibit greater variance in Pleasantness than control subjects.

In summary, we predicted that:

H1. FB sign will be linearly and positively correlated with Pleasantness and curvilinearly (U-shape) with Arousal.

H2. Subjects who receive FB will have higher mean Arousal and greater variance in Pleasantness than control subjects, who do not receive FB.

The circumplex model of affect we have used (Russell, 1980) is only one

of several circumplex models presently used to describe the dimensions of affect. A similar model, frequently used in organizational research (George & Brief, 1992), is based on the same basic dimensions, but after a rotation of the axes of Pleasantness and Arousal (Watson, Clark, & Tellegen, 1988). Such a rotation results in two new affect dimensions known as Positive Affectivity (PA) and Negative Affectivity (NA). These dimensions are independent (90 degrees apart on the circumplex), and their measurement roughly corresponds to the high ends of the Elation–Sadness axis and the Distress–Relaxed axis. Although many studies have used the PA and NA scales (PANAS), this rotation, and possibly the measurement of moods only from the high ends of these scales, will blur the psychological meaning of the reaction to FB (Larsen & Diener, 1992). Both PA and NA reflect a combination of Pleasantness and Arousal. Therefore, the independent effect of FB on Pleasantness and Arousal cannot be determined directly by measuring PA and NA. Accordingly, we concentrated on the Pleasantness and Arousal dimensions, because they are more appropriate for the goals of the present study (Larsen & Diener, 1992) than the PA and NA dimensions.

In Study 1, we tested the hypotheses by measuring the affective reactions of students to midterm grades. The midterm grades served as a proxy measure for normative FB sign. We assumed that subjects “calculate” FB sign by comparing it to a normative standard, i.e., “how well am I doing relative to my peers?” In Study 2, we investigated the role of multiple cognitive standards in “calculating” FB sign. In that study, we asked students for their expected grade. We tested the hypotheses by measuring FB signs of both the midterm grade and the grade-expectation discrepancy.

STUDY 1

Method

Subjects. A total of 281 students from four undergraduate classes in the business school of a large Northeastern University, and six graduate classes in the University’s Human Resources program participated in the study.

Procedure. Class instructors asked their respective classes to answer a mood survey during class time. In six of these classes ($N = 157$) a mood questionnaire was delivered immediately after the instructor returned a graded midterm exams to the students. These students were first asked to indicate the grade they had just received on the top of the mood questionnaire. In the other four (control) classes ($N = 124$), the questionnaire was delivered either at the beginning of class, or before the break. In all of the control classes the midterm was returned to students either a week

or 2 weeks prior to the administration of the questionnaire. The mood questionnaire appeared on one side of a page, and only after students completed it were they instructed to turn to the other side to indicate their midterm grade. This procedure decreased the likelihood that reporting the grade would activate moods via memory in the control classes.

Dependent variables. The mood questionnaire adopted from Mano (1991) contained 24 moods that were rated on a 7-point scale according to the following instruction: "Please indicate on the scales below in what mood state you are NOW. Your mood might change over time, but we are most interested in how you feel right NOW." Three items were used to sample moods from each of the circumplex major octants. The octants (see Fig. 1) and the items comprising them were: *Arousal* (astonished, surprised, aroused); *Elation* (elated, active, excited); *Pleasure* (satisfied, pleased, happy); *Calmness* (relaxed, calm, at rest); *Quiescence* (still, quiet, quiescent); *Boredom* (sluggish, sleepy, drowsy); *Unhappiness* (blue, sad, unhappy); and *Distress* (nervous, fearful, anxious). These moods are similar in their intrapersonal content to those used by Russell (1980) and therefore should yield the Pleasantness and the Arousal dimensions.

Since our hypotheses are specified at the dimension level and not at the specific mood level, it was desired to obtain two dimension scores, i.e., one representing the Pleasantness axis and one representing the Arousal axis. In order to obtain a dimension score, we factor-analyzed (principal component analysis) all the 24 mood items with a forced two factor solution. Some subjects did not respond to all mood items. Missing data were replaced by item means in order to retain as much statistical power and representativeness as possible. The minimum N for any mood item was 234. With this procedure, data from all subjects was included in the principal component analysis.

We also performed this analysis for a pre-test sample ($N = 256$). The pre-test sample consisted of subjects who participated in several FB experiments in the laboratory. In these experiments, we have manipulated one level of positive FB and one level of negative FB, which is not appropriate for the study of curvilinear relationships. The data from the pre-test are presented here as an evidence for the stability of the principal component analysis.

Inspection of the empirical loadings (Table 1), both for the pre-test sample and the present sample, confirms that the two factors largely represent the two theoretical dimensions of Pleasantness, and Arousal (Fig. 1). These factors are not correlated due to the orthogonal solution used and therefore prevent any interpretation problem.

Rotation of the factors blurred the Pleasantness and the Arousal dimensions. Although the rotation yielded a solution that was still similar to the

TABLE 1
FACTOR LOADINGS ON PLEASANTNESS (P) AND AROUSAL (A)

Item	Pre-test		Study 1		Study 2	
	P	A	P	A	P	A
Relaxed	.44	-.40	.68	-.39	.67	-.31
Astonished	-.24	.34	-.07	.34	.01	.56
Blue	-.66	-.03	-.68	-.04	-.84	.11
Unhappy	-.68	.15	-.72	.07	-.87	.13
Sad	-.66	-.02	-.64	.09	-.83	.19
Fearful	-.44	.30	-.57	.27	-.71	.34
Nervous	-.50	.45	-.59	.33	-.69	.43
Anxious	-.36	.51	-.47	.35	-.23	.52
Surprised	-.14	.30	-.07	.34	.02	.54
Aroused	.03	.46	.08	.45	.17	.60
Satisfied	.63	-.15	.81	.09	.89	.08
Sleepy	-.53	-.48	-.24	-.56	-.17	-.57
Drowsy	-.59	-.43	-.33	-.56	-.19	-.59
Sluggish	-.68	-.41	-.40	-.51	-.50	-.32
Active	.49	.49	.38	.56	.27	.48
Pleased	.71	-.11	.79	.18	.89	.09
Elated	.35	.10	.60	.41	.75	.26
Happy	.68	-.03	.79	.23	.89	.18
Excited	.33	.43	.49	.50	.66	.50
Calm	.28	-.63	.42	-.67	.41	-.53
Still	-.01	-.64	.18	-.74	-.10	-.41
Quiescent	-.16	-.55	.19	-.49	-.01	-.13
Quiet	-.15	-.43	.07	-.67	-.39	-.40
At rest	.19	-.48	.32	-.59	.44	-.45

Note. Loadings in columns which suggested that high loadings mean either low Pleasantness or low Arousal were multiplied by -1 .

Pleasantness and Arousal dimensions, it was expectedly tilted slightly and clockwise toward PA and NA solution (Watson & Tellegen, 1988). Therefore, we used the unrotated principal component solution which yielded the dimensions in which we were interested.

In order to derive a dimension score we used the factor scores. Factor scores are not usually used because a unit-weight score of the relevant variables is as robust in data replication as the fitted factor coefficients. However, the circular structure of the present data logically dictates a theoretical preference for factor scores that will give more weight to variables that have lower loadings on the other factor (e.g., the item "unhappy" should receive a higher weight on the Pleasantness dimension than the item "anxious" because the latter is also loaded on the Arousal dimension). Of course, the circular structure dictate that a two factor solution will *not* yield a *simple structure* solution because it will cause

some of the variables to have moderate loadings on both factors (Larsen & Diener, 1992).

Analyses. The grades received in the 10 classes differed in format. Therefore, all grades were converted to numerical values as follows: 4.00 (A+), 3.66 (A), 3.33 (A-), 3.00 (B+), 2.66 (B), 2.33 (B-), 2.00 (C+), 1.66 (C), 1.33 (C-), 1.00 (D or F). Despite this procedure, the meaning of a certain grade may vary between classes as a function of class difficulty or importance. Therefore, we also computed a standardized grade within each class. The statistical conclusions based on these standardized grades were identical to those obtained with the unstandardized grades, and hence are not reported here for the sake of brevity.

The first hypothesis regarding the relationships between FB sign and affect dimensions was tested with data obtained from the students who had just received FB. Among these students, eight failed to report their grade resulting in a sample size of 149. The test of the second hypotheses involved comparing the dimension scores of the FB group to the dimension scores of the control group, where there were no data losses.

Results

The average grade in the experimental group ($M = 2.84, SD = .82$) did not differ significantly ($t(260) = 1.48$) from the control group ($M = 2.7; SD = .75$); the quasi-experimental groups were roughly equivalent.

The results supported both hypotheses. Table 2 presents the results of regressions predicting Pleasantness (overall model $F(2,146) = 29.53, p <$

TABLE 2
STUDY 1: REGRESSION OF GRADES (G) AND GRADES SQUARED (G^2) ON PLEASANTNESS AND AROUSAL

Variable	G	G^2
Pleasantness		
β	.68	-.14
R^2	.29	.29
F for ΔR^2	58.97**	.10
Arousal		
β	-1.39*	1.40*
R^2	.00	.04
F for ΔR^2	.02	6.69*

Note. We provide the standardized coefficient (β) weights for completeness sake. However, the use of a square term creates a multicollinearity problem and hence weights which exceed |1.00|. In these situations, the β weights are misleading and only ΔR^2 should be interpreted (Cohen & Cohen, 1975).

* $p < .05, **p < .01.$

.01) and Arousal ($F(2,146) = 3.36, p < .05$) from grades (FB sign). In order to test the hypotheses, grades were entered first and the squared grades, testing the U-shaped effect, were entered second into the respective hierarchical regressions. As predicted, there was only a linear effect of FB sign on Pleasantness and only a curvilinear effect of FB sign on Arousal. The shape of the curvilinear effects conforms to the pertinent hypothesis (Fig. 2).

Furthermore, there were no mean differences in Pleasantness between subjects who received FB ($M = .02; SD = 1.06$) and subjects who did not receive FB ($M = .02; SD = .91; t(279) = .34$), but those who received FB exhibited larger variance in Pleasantness than the control group ($F_{\max}(156,123) = 1.35; p < .05$; one-tail). On the other hand, those who received FB had significantly ($t(279) = 2.62; p < .01$) higher Arousal ($M = .14; SD = .95$) than the control group ($M = -.17; SD = 1.04$), whereas variances were not statistically different.

Discussion

The results suggest that FB sign has (a) a strong linear effect on Pleasantness and (b) a U-shaped curvilinear effect on Arousal. Therefore, it is not surprising that, relative to the control group, subjects who received FB had (a) higher Arousal, (b) similar average Pleasantness, but (c) greater variance on Pleasantness.

We attributed the effects of FB on affect to the result of a cognitive comparison of FB to a goal or a standard. Across a variety of theoretical

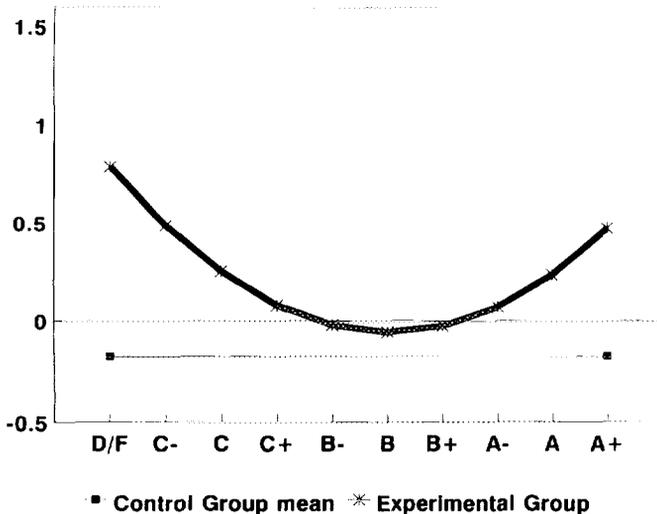


FIG. 2. Study I: A regression predicting Arousal from grades.

orientations (e.g., Mikulincer, 1988—Learned Helplessness Theory; Podsakoff & Farh, 1987—Control Theory; and Locke & Latham, 1990—Goal Setting Theory), researchers agree that the sign of the comparison of FB to a goal or standard is positively related to Pleasantness (or correlates of Pleasantness). However, Locke and Latham (1990) claimed that the relationship of FB sign and satisfaction (Pleasantness) should be perfect, and that the only reason that a perfect relationship is not observed is that we do not measure all the relevant standards against which the FB is assessed. Indeed, several researchers have concluded that people use multiple references to assess FB sign (e.g., Lewin *et al.*, 1944). Moreover, Ilgen (1971), and Ilgen and Hamstra (1972) demonstrated that satisfaction is a function of comparisons both to a norm and to a prior expectation. Similarly, anticipated satisfaction is a function of both anticipated level of performance, and anticipated discrepancy of that performance from one's goal (Mento *et al.*, 1992). Another standard that people use is past performance levels, which are used to assess velocity of approaching a goal (Carver & Scheier, 1990; for empirical evidence see Hsee & Abelson, 1991). The list of standards people use to assess FB sign is probably longer and include references such as the performance of other groups, and ideal goal (Lewin *et al.*, 1944). In summary, research suggests that FB is compared to multiple internal standards, and that the overall sign of these comparisons is the causal determinant of Pleasantness.

In Study 1, we studied the role of objective FB which we assumed to reflect normative FB, i.e., comparison to others (possible problems with this assumption are addressed in the discussion). However, if FB sign is assessed relative to multiple internal standards (e.g., Locke & Latham, 1990), then the findings of Study 1 should generalize to other standards. Specifically, we hypothesized that FB may be compared not only to a norm, i.e., how well one is doing relative to peers, but also to initial expectations. Each of these two standards can be used to assess FB sign, and therefore each of these comparisons should independently influence affect. Therefore, the sign of the *discrepancy* between actual FB and initial expectation should have a linear relationship with Pleasantness even after controlling for the sign of actual FB. Likewise, the sign of this discrepancy should have a U-shaped relationship with Arousal above and beyond the U-shaped effect of the sign of the actual FB. Accordingly, Study 2 was designed both to test the hypotheses regarding the additional roles of FB-expectation discrepancy sign in inducing affect, and to replicate the findings of Study 1.

STUDY 2

Method

Subjects. A total of 226 business and psychology students from five

undergraduate classes similar to those sampled in Study 1 participated in the study.

Procedure. The procedure used for the experimental group in Study 1 was used here with one modification. In the beginning of the class session in which the midterm was returned, one of the researchers gave a 1-page questionnaire to all students. This page asked "What grade do you expect to receive on the midterm?" Students were instructed to keep this page. Then the instructor returned the graded exams, and the researcher gave all students the questionnaire used in the FB condition in Study 1. Students were instructed to attach their expected grade questionnaire to the mood questionnaire. This procedure protected their anonymity, yet allowed the data to be matched.

Analyses. All grades were converted to numerical values as in Study 1. Missing data on the mood items were treated as in Study 1. The minimum N for any mood item was 191. Factor scores were computed for each subject as in Study 1 (for principal component analysis results see Table 1).

In order to test the hypotheses regarding FB-expectation discrepancy, we created a discrepancy score in two different ways. First, we defined discrepancy as the discrepancy between the actual grade and the expected grade. Given that this is a change score, we also calculated a measure of discrepancy by covarying out the actual grade from the expected grade. In this second definition, the expected grade residuals served as a measure of a discrepancy between expected grade and actual grade (the correlation between actual grade and expected grade was .56). However, the results obtained with either method were almost identical, and therefore we report results obtained only with the first (and more simple) discrepancy score.

In order to replicate Study 1 and to test the hypotheses regarding the effects of discrepancy on the Pleasantness and Arousal, we performed a hierarchical regression in which grades (actual FB assumed to reflect normative FB sign) were entered first, grade-squared second, the discrepancy score third, and the square of the discrepancy score last.

Results

The average grades were similar to those obtained in Study 1 ($M = 2.61$; $SD = .86$), and slightly, but significantly, higher than the average expected score ($M = 2.46$; $SD = .72$; t test for repeated measure = 3.13, $p < .01$).

Table 3 presents the results of the regressions of the linear and curvilinear effects of FB sign and the discrepancy sign on Pleasantness (overall model $F(4,221) = 39.61$, $p < .01$) and Arousal ($F(4,221) = 7.33$; $p < .01$). The results of the first two regression steps largely replicated the results

TABLE 3
STUDY 2: REGRESSION OF GRADES (*G*), GRADES SQUARED (*G*²), DISCREPANCY (*D*), AND DISCREPANCY SQUARED (*D*²) ON PLEASANTNESS AND AROUSAL

Variable	<i>G</i>	<i>G</i> ²	<i>D</i>	<i>D</i> ²
Pleasantness				
β	-.69*	1.12**	.28**	-.01
<i>R</i> ²	.35	.37	.42	.42
<i>F</i> for ΔR^2	117.42**	9.23**	18.06*	.06
Arousal				
β	-.55	.44	.06	.29**
<i>R</i> ²	.00	.03	.04	.12
<i>F</i> for ΔR^2	1.87	4.84*	3.02	18.70**

Note. See Table 2 footnote.

* *p* < .05, ***p* < .01.

of Study 1. A strong linear effect was found for FB sign (grade) on Pleasantness, and a significant curvilinear effect was found for FB sign on Arousal (Fig. 3). However, an unanticipated curvilinear effect on FB sign was also found for Pleasantness. This effect can not be explained by the presence of a single outlier. Yet, this effect was not hypothesized and was not found in Study 1. An investigation of the form of this effect suggested that the effect of FB sign on Pleasantness was monotone, i.e., the more positive the FB sign, the higher the Pleasantness factor score (Fig. 4). Therefore, this monotonic effect still supports the hypothesis that FB sign has an approximately linear relationship with Pleasantness.

The third and the fourth steps in these regressions lend full support for

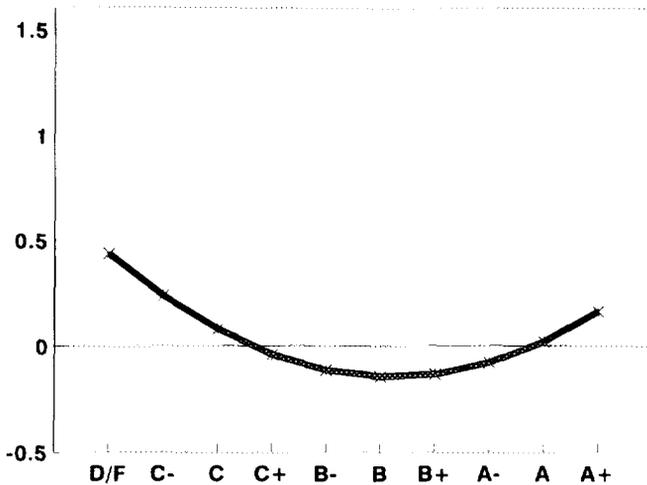


FIG. 3. Study 2: A regression predicting Arousal from grades.

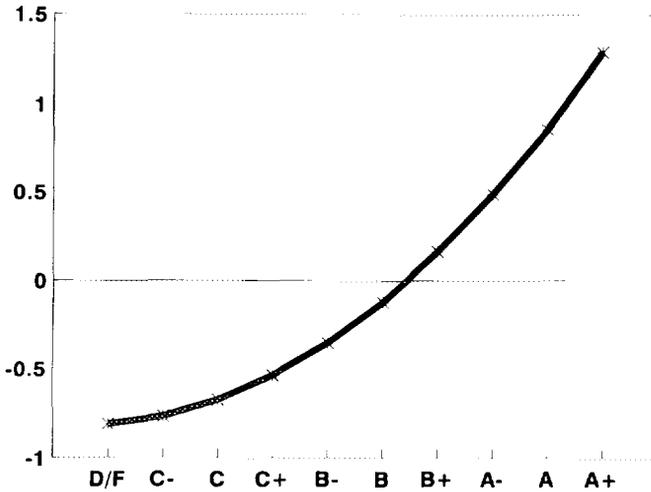


FIG. 4. Study 2: A regression predicting Pleasantness from grades.

the hypotheses of Study 2. The effect of the sign of the discrepancy of actual grades from expectations on Pleasantness was only linear, and on Arousal it was only curvilinear. These effects were obtained after the linear and the curvilinear effects of the actual grade were accounted for. Figure 5 shows the effect of discrepancy on the residuals of Arousal, after the effects of the actual FB on Arousal were partialled out, i.e., the effect

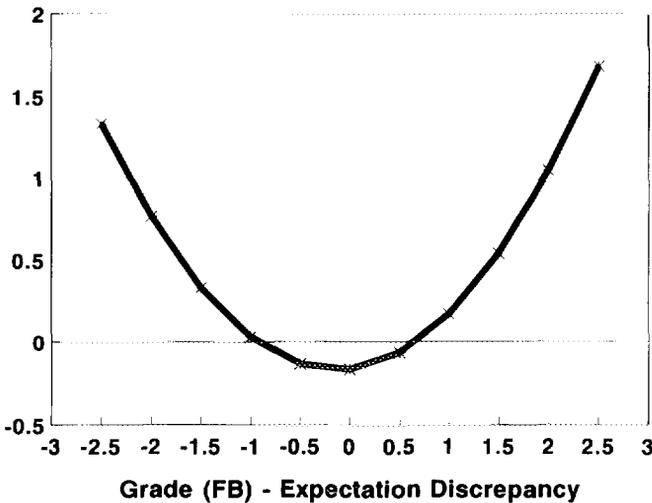


FIG. 5. Study 2: A regression predicting residual Arousal from FB-expectation discrepancy.

of Steps 3 and 4 in the regression, adjusting for Steps 1 and 2. These results suggest that actual FB and FB-expectation discrepancy have independent effects on moods. The effects of FB-expectation discrepancy on both Pleasantness and Arousal were similar to the effects of actual FB in the two studies.

Discussion

The results of Study 2 replicated the results of Study 1 and lent support to the hypothesis that FB sign is assessed relative to at least two cognitive standards. The pattern of the effects of FB sign on Pleasantness and Arousal suggests several intriguing post-hoc hypotheses. First, the effect of actual grade on Pleasantness seems stronger than the effect of FB-expectation discrepancy. This is consistent with findings showing that anticipated satisfaction is more strongly affected by anticipated actual outcome than by the anticipated discrepancy of the outcome from an internal goal (see Fig. 1 in Mento *et al.*, 1992). Second, we reversed the order of entering the grades and the discrepancy scores into the regression (see Table 4). After controlling for the linear and curvilinear effects of the discrepancy scores, actual grades still had a strong (monotonic) effect on Pleasantness, but no (curvilinear) effect on Arousal. These results may suggest that actual FB (which we believe reflect FB-norm discrepancy) is more potent in eliciting Pleasantness, while FB-expectation discrepancy is more potent in eliciting Arousal. This possibility should be explored in future research. Finally, future research should investigate the simultaneous roles of additional multiple internal standards on affect, including past performance (velocity), aspirations, and maximum possible performance (e.g., 100% correct).

GENERAL DISCUSSION

The results across both studies are consistent with our hypotheses regarding the origins and the effects of FB sign. According to our hypoth-

TABLE 4
STUDY 2: HIERARCHICAL REGRESSION OF DISCREPANCY (*D*), DISCREPANCY SQUARED (*D*²), GRADES (*G*), AND GRADES SQUARED (*G*²), ON PLEASANTNESS AND AROUSAL

Variable	<i>D</i>	<i>D</i> ²	<i>G</i>	<i>G</i> ²
Pleasantness				
<i>R</i> ²	.26	.26	.38	.42
<i>F</i> for ΔR^2	77.73**	.03	44.91**	13.25**
Arousal				
<i>R</i> ²	.00	.10	.11	.12
<i>F</i> for ΔR^2	0.07	26.21**	1.56	1.35

* *p* < .05, ***p* < .01.

eses, cognitive comparisons of the deviations of FB message from *several* internal standards, such as performance relative to others and performance relative to expectations, determine FB sign. FB sign is then cognitively evaluated both for its harm/benefit potential and for the need to take action. The harm/benefit potential is a monotonic, if not linear, function of the FB sign, while the need for action assessment is a function of the extremeness of the sign, or a curvilinear U-shaped function of the sign. The harm/benefit appraisal is reflected in the primary dimension of mood (i.e., Pleasantness), while the appraisal of the need for action is reflected in a secondary dimension of mood (i.e., Arousal). In control theory language (Carver & Scheier, 1981), we found that the larger the size of the error (feedback-standard discrepancy), the higher the resultant Arousal, and the more positive is the direction of the error (overshooting versus undershooting the standard), the higher is the resultant Pleasantness.

This conclusion allows an integration of research which concentrated on the motivational consequences of affect (Learned Helplessness, Goal-Setting, Control Theory) and the emerging literature regarding both the structure of affect (e.g., Russell, 1991) and the cognitive consequences of affect. Such an integration may help to clarify the complex effects of FB on performance (Ammons, 1956; Cusella, 1987; Ilgen, Fisher & Taylor, 1979; Kluger & Adler, 1993; Latham & Locke, 1991). Theories which attempt to explain the motivational consequences of FB largely treated moods on the Pleasantness dimension such as satisfaction (but see Mikulincer, 1988). In these theories, the effects of FB on satisfaction or dissatisfaction are concomitant with its effect on motivation, or even the cause of motivation. Accordingly, the effects of FB-induced affect on motivation are predicted to be traced in performance. However, the emerging literature on the consequences of affect for cognitive processing suggests that once affect is induced, it has several effects on cognitive processing. The effects of affect on cognitive processing may be involuntary and may influence performance even on tasks other than the one on which FB was provided.

First, mood researchers have suggested that Pleasantness has both inhibitory and facilitating effects on cognition and performance (Isen, 1987; Forgas, Bower, & Moylan, 1990; Mano, 1992). For example, *unpleasant* moods have been shown to facilitate elaboration of attitudinal messages (Bless, Bohner, Schwartz, & Strack, 1990) but also to inhibit cognitive flexibility and consequently decrease performance quality on a creative task (Murray, Sujan, Hirt & Sujan, 1990). In addition, this research suggests that once Pleasantness is induced, regardless of the manner in which it was induced, it has predictable effects on cognitive processing. For example, Forgas (1993) induced Pleasantness both through a film and

through bogus FB and obtained similar mood effects on a supposedly unrelated task. He interpreted his results as "suggesting the greater use of mood-based inferences in judgement of unusual targets that require more constructive processing" (p. 59). Moreover, in comparison to subjects in positive moods, subjects in negative moods are more likely to engage in deeper task processing when they perceive that they have to perform the task, but are more likely to quit the task if they perceive that they do not have to perform the task (Martin, Ward, Achee, & Wyer, 1993). This sample of a growing literature suggests that once FB has induced Pleasantness, Pleasantness will have multiple and independent complex effects on cognitive processing and on motivation. Specifically, FB-induced Pleasantness may influence performance through its effects on cognitive processing, independently of its effect on motivation.

Second, researchers of the effect of Arousal on performance also suggest a path through which FB-induced Arousal will affect performance. The major theory linking arousal and performance which received reasonable support (Christianson, 1992) is Easterbrook's (1959) cue-utilization hypothesis. (For information regarding the (in)famous Yerkes-Dodson Hypothesis, see Christianson, 1992; Neiss, 1990; and Anderson, 1990). According to the cue-utilization hypothesis, arousal increases attention to focal cues and reduces attention to peripheral cues. Hence, complex tasks which require frequent attentional shifts between focal and peripheral cues, such as creativity tasks, may be debilitated by a high level of arousal. Indeed, Lewinsohn and Mano (1993) have shown that arousal restricts the cognitive complexity of judgment strategies. Moreover, task complexity seems to moderate the effects of arousal on performance (Eysenck, 1982) such that performance of simple vigilance tasks is enhanced with high arousal, performance of creativity tasks is debilitated, while performance of some cognitive tasks (IQ test) is unaffected. However, while the arousal-memory and even the arousal-performance effects received reasonable support, the next step is to demonstrate the link between FB-induced arousal and these consequences. Again, these results suggest that once Arousal has been induced, it will have a pervasive effect on cognitive processing which may have an effect on performance independent of the motivational effect of FB. In summary, the emerging literature on the effects of affect on cognitive processing suggests that the effects of FB, which we have shown to elicit strong affective reactions, should be studied in tasks varying in their dependence on cognitive processes which are susceptible to affective influences. Such research may reveal that FB has opposing effects on motivation and on cognitive processing, which may explain the inconsistencies in the effects of FB on performance (Kluger & Adler, 1993; Latham & Locke, 1991).

The present results may also shed some light on two other theoretical issues. First, both Equity Theory and Cognitive Dissonance Theory predict an inverted-U relationship between FB-expectation discrepancy and satisfaction (Ilgen, 1971). Specifically, Equity theory suggests that when one receives an outcome which is discrepant from his/her own input (which creates expectations), a state of dissatisfaction emerges. Also, the motivational component of Dissonance Theory (Markus & Zajonc, 1985) posits that dissonance creates tension. Ilgen speculated that the FB-expectation discrepancy can create such a tension, which he expected to be expressed in (dis)satisfaction. Ilgen (1971) did not observe the hypothesized curvilinear effect and explained the inconsistency of his linear results with the results obtained by Cognitive Dissonance researchers (Aronson, Carlsmith, & Darley, 1963) by detailing the methodological shortcomings of the latter research. In contrast to his conclusions, our results suggest that his hunch was correct, but that the curvilinear effect of FB-expectation discrepancy should be sought on the Arousal dimension rather than on the Pleasantness dimension. Therefore, our results regarding Arousal are also consistent with Equity Theory and Cognitive Dissonance Theory.

Second, the symmetrical effect found here for FB sign on Arousal is apparently inconsistent with the notion that positive and negative stimuli have asymmetrical effects on cognition, affect, and behavior (Taylor, 1991). In general, positive stimuli are considered as less potent in creating arousal (Lazarus, 1991; Taylor, 1991) than negative stimuli. However, in ability contexts, rather than social contexts, positive information has been shown to have a high diagnostic value (Skowronski, & Carlston, 1987; 1989; Wojciszke, Brycz & Borkenau, 1993), and thus it may lead to an appraisal of a need for action, and hence arousal. Therefore, the effects of positive performance FB studied here may not generalize to the effects of positive interpersonal FB which may have low diagnosticity value (such as "He likes you"). This possibility may guide future research on the differences between performance FB and personal FB.

Three potential limitations of our method should be noted. First, in both studies we used grades as a proxy of subjective evaluation of FB-norm discrepancy. Therefore, caution should be exercised in interpreting the results obtained with grades. For example, it may well be that some subjects evaluated their grades not in comparison to their peers, but rather against a criterion of absolute perfect performance (e.g., grade of A), or acceptable performance (e.g., "gentlemen's B"). This threat to our interpretation can not be completely eliminated without a direct measure of FB-norm discrepancy (e.g., "In your estimation, what percentage of the students in this class received a grade higher/lower than the grade you received?"). Yet, even if the standard used by our subjects was different

from norms, the results of Study 2 with respect to the Pleasantness dimension are still consistent with the hypothesized presence of at least two standards, i.e., both grades and the FB-expectation discrepancy had a unique effect on Pleasantness which did not disappear when the other predictor was controlled for. Therefore, while we believe that the effects of grades reflect a comparison to a normative standard, future research should obtain direct measurement of FB-norm discrepancy. Moreover, this line of research should be extended to direct measurements of discrepancies of FB from other standards such as level of aspiration, perfect performance, past performance etc. (e.g., Lewin *et al.*, 1944).

Second, the method we used to derive the Pleasantness and the Arousal score is uncommon, and may suggest that our results may not be reliable. The loadings on the factors expectedly did not yield a "simple structure," and for the Arousal dimension the loadings were generally moderate and low. In order to assess the reliability of our factor scores, we performed an additional analysis. We aggregated the samples from the pre-test and the two studies into one sample and randomly split it into two groups. We computed factor scores for one group, and used the factor coefficient to estimate the Pleasantness and Arousal dimension scores of the hold-out group. We then repeated the process such that we computed factor scores also for the second group and applied them to the first group. The correlation between the Pleasantness factor scores and the estimated factor scores were .99 in both computations. For the Arousal dimension these correlations were .94 and .95. This analysis suggest that these dimension scores were highly reliable.

Third, although our dimension measures seem to be reliable, they, no doubt, reflect the sampling of mood items that were included in the questionnaires. We did not sample mood items that may have tapped into the third dimension of mood (i.e., dominance, or a second dimension of Arousal; cf. the Semantic Differential; Osgood, Suci, & Tannenbaum, 1957; Thayer, 1978a, 1978b). Moods that may be strongly loaded on the dominance dimension may include items such as scornful, respectful, irate, and resentful (Russell, 1991). This dominance dimension may play a role in the reaction to FB, and we can speculate that FB may reduce the score on this dimension due to a cognitive evaluation that the FB sender is in a superior power position.

Finally, our unrotated factor solution for indexing the two basic dimensions of affect suggests that the PANAS (Watson *et al.*, 1988) should be regarded as only one method to measure affect dimensions in organizational research (Larsen & Diener, 1992). For example, the beneficial effects of PA on organizational variables (George & Brief, 1992) may be the result of Pleasantness, or a combination of Pleasantness with Arousal. It may be interesting to know whether beneficial organizational effects may

be obtained just with Pleasant moods, or only with the interaction of Pleasantness and Arousal. Searching for the "best" approach may amount to reification of factors rotation. However, the point being made here, and recognized elsewhere (Larsen & Diener, 1992), is that different rotations may illuminate different aspects of both antecedents and consequences of affect.

In conclusion, we have demonstrated that at least two different affective dimensions are influenced by FB: Pleasantness and Arousal. The results suggest that (a) FB sign has a strong effect on Pleasantness, and that (b) extreme FB induces arousal and therefore, on the average, recipients of FB are more aroused than control groups. Moreover, our data are consistent with the argument that FB is evaluated against at least two cognitive standards, and that the results of each of these cognitive evaluations independently influences affect. These findings suggest a need to link the research on the effects of moods on performance with the research on the effects of FB on performance. Exploring this link may lead to solving some inconsistencies in the FB literature.

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