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Is The End in Sight? Student Regulation of In-Class and Extra-Credit Effort in Response to Performance Feedback

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Students enter courses with aspirations, but often their behaviors and performance don't put them on track to achieve those aspirations. We explore how students regulate their in-class attendance and extra-credit participation in response to performance feedback. We propose and find support for a punctuated-equilibrium model (Gersick, 1988) in which students' responses to goal-discrepant feedback vary over time, such that early feedback generates little behavioral response, but late feedback incites larger changes. We also find evidence that student reactions to positive goal-discrepant feedback can be stronger than their reactions to negative goal-discrepant feedback, and that student reactions to in-major feedback are qualitatively different than reactions to non-major feedback. We discuss implications for theory and for educators.

Student effort has long been recognized as an important determinant of achievement, along with other factors such as cognitive ability and personality (Harris, 1940; Johnson, Joyce, & Sen, 2002; Romer, 1993; Woodfield, Jessop, & McMillan, 2006). Moreover, effort is notable among determinants of achievement because students themselves regulate their level of effort. Consequently, it is important for educators to understand how students make choices regarding their effort in courses. The importance of understanding such choices is underlined by concerns that student absenteeism is "rampant" (Romer, 1993: 167). But how do students decide how much effort to devote to their courses? Currently there is little evidence regarding how students regulate their effort (Woodfield et al., 2006).

We address this issue here by examining whether and how students change their effort in courses in response to performance feedback. Specifically, we examine changes in class attendance and participation in out-of-class extra-credit opportunities following exams in an introductory management course at a large midwestern university. Control theory (Carver & Scheier, 1981; Klein, 1989) and social cognitive theory (Bandura, 1986) hold that when performance feedback shows a discrepancy between goals and actual performance, individuals respond by attempting to reduce that discrepancy so as to meet their goals. Changes in effort are one obvious such response, and we posit that class attendance and extra-credit participation will change following exam performance that is discrepant with student goals.

Student responses to goal-discrepant feedback may also vary with circumstances, such as the timing and the valence of the feedback. Punctuated-equilibrium research (Gersick, 1988) suggests that students may persist with a strategy until it becomes clear it will not lead to goal attainment, instead of responding promptly to performance-goal discrepancies. Building on this logic, we posit that exam feedback late in a course will influence student effort more than will feedback early in the

course. We also draw on prospect theory's finding that losses loom larger than gains (Tversky & Kahneman, 1981) to posit that negative performance-goal discrepancies will have a stronger influence on effort than will positive performance-goal discrepancies of similar magnitude. Finally, we examine whether student attributes (e.g., historical GPA, major, and gender) also may moderate responses to performance feedback. The two types of effort we examine have different characteristics: attendance has a complex and uncertain relationship with exam performance, whereas extra credit has a simple and certain benefit. By examining self-regulation of both types of effort, we can gain insight into how such differences may affect responses to performance feedback.

Our study provides new insights into how students regulate their efforts in response to performance feedback and under what circumstances such feedback is most important in motivating students to change their behavior. To date, the few studies that examine student effort (e.g., Woodfield et al., 2006) have focused largely on the influence of student attributes (e.g., gender) on overall effort levels, rather than how feedback may motivate changes in effort during a course. We find support for a punctuated-equilibrium model of effort self-regulation. Punctuated-equilibrium provides a powerful way of thinking about how feedback timing moderates responses to goal-oriented feedback. The other findings further develop this core contribution. When feedback has positive valence, its timing appears to affect responses in a qualitatively different way (i.e., response to early positive feedback is strong) than when feedback has negative valence (i.e., response to early negative feedback is weak). Task characteristics also appear to be important. A punctuated-equilibrium logic appears to apply for attendance (which has a complex and uncertain relationship to the grade goals) but not for extra-credit participation (which is a simple task with a certain benefit). Finally, we find that responses to in-major feedback provide a striking contrast to responses to non-major feedback, which may be because students' goals (e.g., mastery vs. performance) differ for in-major and non-major courses. Each finding extends or challenges extant theory on effort self-regulation. Our findings here can also provide educators with practical insight regarding how student responses to feedback may vary along several dimensions, and so inform educators' decisions about course design (e.g., exam timing and difficulty). Below, we develop hypotheses related to our research questions, describe the study and results, and finally, discuss implications of our findings.

THEORY AND HYPOTHESES

Student Effort and Response to Performance Feedback

Student effort has long been accepted as a significant contributor to academic achievement (e.g., Harris, 1940; Romer, 1993); however, relatively little achievement research has examined effort, especially compared to the wealth of research focusing on other factors, such as cognitive ability and personality (see Woodfield et al., 2006 for a discussion). Most studies that have examined effort have taken an economic utility-maximization perspective, and accordingly, have focused on the consequences of effort for student performance. Higher levels of effort have generally been associated with better academic performance, particularly where class attendance is concerned (Durden & Ellis, 1995; Johnson et al., 2002; Marburger, 2001; Romer, 1993; Schmidt, 1983). Studies examining determinants of effort have primarily focused on student attributes, such as gender, rather than on student self-regulation of effort (e.g., Woodfield et al., 2006). One study on self-regulation (Krohn & O'Connor, 2005) reported inconsistent results across two different types of student effort (class attendance and study time) but employed only student self-report measures of effort.

While self-regulation of student effort has received limited empirical attention, the broader goal-setting literature and self-regulation literature prominently features feedback and self-regulatory responses to it. Control theory (Carver & Scheier, 1981, 1982; Klein, 1989) and social cognitive theory (Bandura, 1986) both hold that individuals set goals and monitor their performance with respect to them. When performance feedback shows a discrepancy between goals and actual performance, individuals attempt to reduce that discrepancy to ensure that the goals are met (Bandura, 1986). Individuals attempt to reduce goal-performance discrepancies by changing effort levels (Mikulincer, 1994; Pittman & Pittman, 1980), as well as through other responses, such as adjusting goals (Donovan & Williams, 2003).

Much research on responses to feedback has focused on responses to a single goal in isolation and has tended to focus on negative goal-performance discrepancies. Some recent research, however, has conceptualized responses to feedback as being embedded in the broader problem of individual time allocation (Ashford & Northcraft, 2003). Individuals often face competing demands (e.g., from work, courses, relationships, and community) in a multiple-task environment, where time and effort are at a premium. This conceptualization is particularly relevant where responses to positive goal-performance discrepancies are con-

cerned. Specifically, if feedback indicates that performance on one task exceeds the goal, individuals should reallocate the "excess" effort to other tasks where negative goal-performance discrepancies still exist (Ashford & Northcraft, 2003; Carver & Scheier, 1981). The "competing-demands" view shares some consistencies with economic literature on time allocation (e.g., Dolton, Marcenaro, & Navarro, 2003). Economists also propose models where individuals trade off limited effort resources between different tasks (e.g., studying, working, leisure), although individual choices are driven by utility maximization rather than goal attainment in such models.[1]

Taken together, these points suggest that negative goal discrepancies will lead to increased effort, as students attempt to increase their performance and reach their goals, and that positive goal discrepancies lead to reduced effort, as students tend to allocate effort to other tasks. In our work here, the focus is on feedback from intermediate exams, which are a key indicator of progress toward grade goals. We consider such feedback relative to a specific performance goal: maintaining performance at the student's historical level (i.e., at the level of their overall GPA). We expect this to be a salient (and stable) goal, given evidence that students set goals that mirror their historical academic performance (Zimmerman, Bandura, & Martinez-Pons, 1992). Consequently, we expect that students are likely to treat exam performance above their historical GPA as indicative of a positive goal discrepancy, and exam performance below their historical GPA as indicative of a negative goal discrepancy. Thus:

Hypothesis 1: Following evaluations, students will increase (or decrease) their efforts in a course depending on the magnitude by which their exam scores fall short of (or exceed) their historical performance in other courses.[2]

[1] In models taking an economic perspective, individuals maximize such that allocation of resources is determined by the marginal benefits of alternatives to which the resources can be applied. As a result, economists tend to ask about the consequences of resource allocation decisions, because actual allocations are assumed to follow unproblematically (through maximization) from those consequences.

[2] The salience of historical performance in goal setting will vary across students. For example, we surveyed students in the same course in a later semester regarding their grade goals. Eighty-one percent of students reported that overall GPA would be "the major factor," "very important," or "important," in their goal setting for the course, though 9% indicated that their overall GPA would not significantly influence their goal. However, to the extent students have goals that vary significantly from their historical GPAs, it will tend to have a conservative influence on our tests.

Timing of Performance Feedback

Much experimental research on reactions to goal-discrepant feedback (e.g., Early, Northcraft, Lee, & Lituchy, 1990) assumes that goal discrepancies provide compelling evidence that a change in task strategy is required for the performer to meet goal expectations. However, when performance periods are long (e.g., a 15-week university course) and feedback is infrequent (e.g., an exam every 5 weeks), goal-discrepant feedback may not provide a compelling signal that strategy adjustment is needed for goals to be achieved by the end of the performance period. This is especially the case when evaluations are "noisy" (i.e., the relationship between effort and evaluation is complex or uncertain).

If there are relatively few (infrequent) performance-feedback occasions, the *timing* of feedback becomes critical to the issue of performers adjusting their strategy in the face of goal-discrepant feedback. Gersick's (1988, 1991) punctuated-equilibrium research suggests that groups tend to persist with a task strategy *until it becomes clear* the strategy cannot lead to goal attainment. Consequently, a group may persist with an ineffective strategy for some time early in a task period, especially if the link between the strategy, feedback, and goal attainment is uncertain or complex. However, when the group can finally see clearly that its strategy will not lead to goal attainment, major changes are quickly made.

Individual self-regulation of effort also may follow punctuated-equilibrium logic when the link between strategy, feedback, and goal attainment is uncertain or complex. For example, when students receive negative goal-discrepant performance feedback early in the semester, they may well conclude that there is still plenty of time to recover. It may not be clear that the current strategy (i.e., effort levels) will fall short in the first place, given the complex and uncertain ("noisy") relationship between student effort and exam grades. For these reasons, students may only change their effort levels to a limited degree, or perhaps not at all, early in the semester. On the other hand, when students receive negative feedback late in the semester, time is running out and many of the returns are already in. A negative discrepancy (goal shortfall) at that point may make it uncomfortably clear that the current strategy is not likely to succeed. Consequently, the student is likely to conclude that a sharp adjustment of effort is necessary,[3] such as an individual-level version of the "punctuated"-equilib-

[3] Alternatively, students can reduce their goals or even abandon them. While it would be desirable to measure changes in both goals and effort, that was beyond the scope of the current study.

rium adjustments made by Gersick's groups, when it becomes clear the goal will not be achieved.

A similar logic applies to positive discrepancies. Early on, a student may be reluctant to adjust effort following a positive discrepancy, because much work remains before the goal is achieved. Later in the semester, however, many returns will be in and a positive discrepancy is more likely to lead a student to conclude that goal achievement is assured. In turn, the student is likely to reallocate effort to other courses where negative (and now salient) discrepancies remain.

The argument above should apply to student effort in general. However, it may apply more strongly to decisions about effort that have a complex or uncertain relationship with performance. That is, if feedback does not provide a compelling signal that a strategy adjustment is needed *and* a change in effort might not assure higher performance, individuals may be particularly unlikely to change their performance strategies. While we do not advance a hypothesis about differences across types of effort, it is worth noting that this suggests feedback timing may have a stronger moderating effect on responses for attendance (which has an uncertain relationship with exam performance) than it will for extra-credit participation (which brings certain benefits).

The punctuated-equilibrium argument is also consistent with research on goal setting and responses to feedback (Bandura, 1986), which suggests that goals may have relatively weak effects when they are distant or do not provide effective guides for action. Conversely, achievement motivation increases when the goal is proximal rather than distal (Bandura, 1986; Raynor, 1969; Raynor & Roeder, 1987), therefore heightening sensitivity to perceived goal discrepancies. Thus we hypothesize:

Hypothesis 2: Student effort will change more in response to performance feedback from evaluations late in the semester, than it will to feedback from evaluations early in the semester.

Differential Response to Positive Goal Discrepancies

As discussed in the rationale for H1, the process of discrepancy reduction is thought to apply to both positive and negative goal discrepancies (Klein, 1989). In particular, positive goal discrepancies may lead individuals to allocate scarce effort to other pressing tasks (Ashford & Northcraft, 2003; Carver & Scheier, 1981). However, goal-setting and feedback research has focused much more on negative goal discrepancies than positive ones (Klein, 1989). Little research has contrasted responses to the two types of discrepancies, although it has been suggested that responses to positive goal discrepancies may be weaker than responses to negative goal discrepancies (Carver & Scheier, 1981). We also propose that responses to positive goal discrepancies will be weaker than responses to negative goal discrepancies of the same magnitude. One of the most well-known and supported findings of prospect theory (Kahneman & Tversky, 1979) is that losses "loom larger" than gains in a subjective utility sense, so that students are likely to be more responsive to losses than to gains of equivalent size. Thus:

Hypothesis 3: Students will reduce effort less in response to positive goal discrepancies than they will increase effort in response to negative goal discrepancies of the same magnitude.

Moderating Effects of Student Attributes

Student attributes may also moderate responses to goal-discrepant feedback. We consider whether this occurs for three such attributes: prior academic performance, student major, and gender. Although each attribute is salient from a pedagogical perspective and has points of connection with past theory, extant research fails to offer compelling rationales regarding the direction of potential moderating effects. Below, we discuss potential rationales for moderating effects, but consider the issue of whether such effects occur as empirical research questions rather than proposing formal hypotheses.

The first potential moderator is *prior academic performance*. A student's prior academic performance seems likely to affect response to goal-discrepant performance feedback because historically high-achieving students will have higher self-efficacy (Bandura, 1977). That is, these students will see their own performance as more personally controllable. People who believe their performance is under their control have a stronger tendency to respond to negative feedback (Mikulincer, 1994; Seligman, 1993; Weiner, 1986). This suggests that students with higher historical academic performance (i.e., GPA) may be more responsive to goal-discrepant performance feedback.

The second potential moderating attribute is whether the course is in the *student's major*. A key difference between in-major and non-major students is that the former are likely to have more interest in the course, as students select their majors in large part based on their interests (Harackiewicz, Barron, Tauer, Carter, & Elliot, 2000). This

has implications for the goals that students are likely to set. In general, students are likely to have both mastery and performance goals (Dweck, 1986; Harackiewicz, Barron, Tauer, Carter, & Elliot, 2000; Harackiewicz, Barron, Tauer, & Elliot, 2002). *Mastery goals* are about learning and developing skills and have been found to be closely associated with interests but not with grades (Barron & Harackiewicz, 2001; Harackiewicz et al., 2002). Given in-major students' likely greater interest in the course, mastery goals should be more important for those students than for non-major students. *Performance goals* are about demonstrating competence relative to others and have been found to be closely associated with grades. We expect performance goals to be important for both in-major and non-major students.

Individuals who have multiple goals must prioritize and allocate limited resources among their goals (Ashford & Northcraft, 2003), so that the effort they devote to each goal (e.g., performance vs. mastery) is a joint function of the multiple goals (Klein, 1989). In-major students are likely to have multiple goals (i.e., mastery goals *and* performance goals). In-major students may thus be as focused on learning as such as they are on calibrating their responses to exams in order to achieve a particular grade. This suggests that in-major students will be less responsive to *performance*-goal discrepancies than will be non-major students, who are likely focused primarily on performance goals.

Finally, gender differences have been of great interest to researchers in education and across the social sciences; however, no research appears to have examined gender differences in response to performance feedback, and little has directly examined gender differences in student effort regulation. Although prior research does not justify a strong prior expectation, the results will be of considerable interest.

METHODS

Context and Sample

Hypotheses were tested in the context of a large introductory management course (enrollment 600+ juniors and seniors) at a large midwestern public university. The professor had taught the course several times and had a well-established record of teaching effectiveness. The course met in large-lecture format twice weekly. The course was organized into three parts of six or seven substantive classes each, with an exam at the conclusion of each part (i.e., about every 5 weeks). Exams were equally weighted and questions were drawn primarily from lecture notes. The course was required for all in-major students and the majority of non-major students enrolled. Data were collected on exam performance, class attendance, extra-credit participation, and demographics for 612 students.

Dependent Variables

The two dependent variables, *In-Class Attendance* and *Extra-Credit Opportunities*, measure different types of student effort. Attendance was measured using a "clicker" (a calculator-like electronic device with several keys, also known as an audience response system). Students who "clicked" their responses to at least 80% of in-class questions received a small amount of in-class participation credit (regardless of how many of their responses were correct). There were no penalties for missing classes as such. The attendance variable has value = 1 if a student "clicked" in a particular class session, and value = 0 otherwise. There were a total of 20 class sessions for which attendance was measured (the course introduction, review sessions, and exams were excluded), so there are 20 data points for each student for this variable. The sessions were divided roughly evenly between the parts of the course (six sessions for Part 1, and seven sessions for Parts 2 and 3).

The second dependent variable measured participation in out-of-class *Extra-Credit Opportunities*. Students had the opportunity to participate as subjects in up to four research studies during the semester. (The students formed a "subject pool" for laboratory experiments and survey studies conducted by marketing or organizational behavior faculty.) Students received a small amount of extra credit for each study. The dependent variable is a count of how many extra-credit sessions a student participated in during a particular week of the course. (Students could and some did participate in more than one extra-credit study in a particular week.) Extra-credit participation is by week rather than by class session, because individual experiments often ran across several days and so it was not feasible to assign a particular experiment to a particular class session. There were 13 weeks during which students could participate in extra-credit opportunities, so the unit of analysis is a "student-week" and there are a maximum of 13 data points per student.

Independent Variables

Goal Discrepancy Exam 1 and *Goal Discrepancy Exam 2* were constructed by subtracting a student's historical GPA (*Hist GPA*)—the implicit

goal—from the exam grade (0–4.33 with 4 being A), which they received at the end of Part 1 (Exam 1) and Part 2 (Exam 2) of the course. The goal discrepancy variables are negative when the exam grade is lower than the student's historical GPA, and positive when the exam grade is higher than the student's historical GPA. Coefficients were predicted to be negative, indicating an increase in effort when there is a negative goal discrepancy and a decrease in effort when there is a positive goal discrepancy.

To test the relative effects of positive and negative goal discrepancies (H3), we used the goal discrepancy calculations described above but separately modeled the effects of positive and negative discrepancies as a spline function (Greene, 1993: 235–238). Spline specifications allow the variable coefficient to change at a predetermined point by entering separate variables for values above and below that point. We implement the spline by constructing two variables for each exam. For example, *Negative Goal Discrepancy Amount Exam 1* is the *Goal Discrepancy Exam 1* variable with any positive values set to zero, so that the variable captures only negative discrepancies. *Positive Goal Discrepancy Amount Exam 1* is constructed similarly, except negative values (indicating negative goal discrepancies) are set to zero. We construct similar variables for Exam 2. Similarities or differences in the coefficients for these variables indicate similarities or differences, respectively, in students' responses to positive or negative goal-discrepant feedback.

We tested the potential moderating effects of student's prior academic performance, as well as student major and gender, using subsample analyses as described below.

Control Variables

We used fixed-effect models in our analyses. Fixed-effect models estimate within-subject differences only, so it is not necessary (or possible) to explicitly control for fixed student characteristics such as ethnicity, historical GPA, and gender.[4] We controlled for the *Baseline Rate Change* in attendance or extra credit participation across the two periods that are compared in each analysis, because there are changes in the *overall* rate of attendance and extra- credit participation between parts of the course. By including this control, we are able to test whether goal-discrepant feedback is associated with changes in attendance or extra-credit participation *relative* to the general trend. Additionally, in models predicting attendance, we controlled for whether the student has previously achieved the maximum possible clicker credit for the semester (*Maxed-out control)*. With perfect attendance, students could earn the maximum possible "clicker" credit three classes before the semester ended. While the conscientious students who "maxed out" in attendance credit did continue coming to class thereafter (they actually did so at higher rates than students who had not "maxed out"), we controlled for this because "maxed-out" students still reduced their attendance somewhat. In order to ease interpretation, we do not present these control variables in the tables.

Analyses

The models of class attendance were estimated with pooled cross-sectional time series regression techniques, specifically fixed-effect logistic regressions (xtlogit in STATA). Fixed-effect models provide conservative tests of the hypotheses because they examine only within-subject variation.[5] The analyses assess whether performance on part-ending exams leads to adjustments in attendance in subsequent parts of the course.

The analyses of extra-credit participation were also estimated using pooled cross-sectional time series regression—specifically, fixed-effects negative binomial regression (xtbnreg in STATA), because the dependent variable is a count variable (the number of extra-credit studies a student participated in during a given week). Again, the analyses assess whether performance on part-ending exams leads to relative adjustments in extra-credit participation in subsequent parts of the course.

There are two additional complexities in the extra-credit analyses. Course policy specified that students could participate in a maximum of four extra-credit opportunities during the semester. A number of students reached that maximum before classes finished. Their participation subsequent to

[4] We also estimated random-effect models that did control for key student characteristics (specifically: female, GPA, Hispanic, Black, Asian, Not US Citizen, Senior, Credit Hours, and Major). Results were substantively identical (available from authors).

[5] Since fixed-effect models examine within-subject variation, students whose attendance (or extra-credit participation) shows no variance across the modeled periods are dropped from the analysis. For example, this means that the 64 students who attended every class are dropped, as are the 9 students who apparently attended no classes. The "*n*" for each analysis is net of these dropped students. As mentioned above, we also estimated random-effects models (available from authors). These models do not drop these students, and showed substantively identical results. The same comments apply to the extra-credit analyses.

reaching the maximum was zero, but this was by rule rather than by their choice. Consequently, we dropped data points (i.e., student-weeks) associated with students who had reached the maximum in a previous week. This technique is commonly used in event and hazard rate analysis, where actors who are no longer "at risk" of experiencing the event of interest are dropped (Hsiao, 1986). The second complexity is that 157 students (just over 25% of the class) were concurrently enrolled in another large course (a marketing class). This course also gave credit for participation in the same set of extra-credit opportunities (students could participate in eight, rather than four, extra-credit sessions if they were enrolled in both courses). However, students were not required to specify which course they were putting their extra credit toward until the very end of the semester. Consequently, it was not possible to know which course these students' extra-credit participation might be in response to, and so the sample for analyses of extra-credit participation is the 455 students who were not concurrently enrolled in the other course. The two groups of students (those concurrently enrolled in the marketing course and those not enrolled) are not statistically different on available demographic or other variables, and the results are substantively identical if the concurrently enrolled students are included (using a simple dummy control for their concurrent enrollment status).

RESULTS

Descriptive statistics for the analyses of attendance and extra credit are presented in Table 1 and Table 2, respectively. The mean attendance rate is 78.7%, which is somewhat higher than Romer's (1993) finding of a 67% average attendance rate in the large classes he studied. Figure 1 displays attendance rates and absences during each part of the course. It shows that overall attendance rates generally declined through the semester. This secular decline is important to keep in mind, because our theorizing is about *relative* changes in class attendance and so models are estimated net of the overall downward trend. Attendance rates did vary with the student attributes that were identified as potential moderators of responses to performance feedback. Students with above-median historical GPAs had significantly higher average attendance rates (83%) than did those below median (72%), as did in-major students (84%) when compared to non-major (77%) students, and female (84%) when compared to male (75%) students. We do not present a figure corresponding to Figure 1 for extra-credit participation, because *overall* rates of extra-credit participation were more reflective of opportunities that experimenters made available than student choices. Again, our analyses estimated how *relative* rates of participation varied with the independent variables and across groups of students. That said, students with above-median GPAs, in-major students, and female students did have somewhat higher overall (i.e., absolute) extra-credit participation rates than did their respective counterparts.

Main Effects and Effects of Feedback Timing

Table 3 presents models that address the first two hypotheses: whether students adjust their effort in response to performance feedback (H1) and whether these adjustments vary with the timing of feedback (H2). Model 3A compares attendance in Part 1 and Part 2 of the course. A negative Exam 1 goal discrepancy is followed by a (marginally) significant attendance increase *relative* to other students, consistent with H1. Model 3B compares attendance in Part 2 and Part 3 of the course. The *Goal Discrepancy Exam 2* coefficient is highly significant, and (notably) twice the magnitude of the *Goal Discrepancy Exam 1* coefficient in Model 3A. This provides evidence that students' responses to performance feedback are stronger when they re-

TABLE 1
Means, Standard Deviations, and Correlations for Attendance Analysis (n = 10780)

Variable	*M*	*SD*	1	2	3	4	5	6	7	8
1 Attendance (Dep. Var.)	.787	.418								
2 Goal Discrepancy Exam 1	−.508	.947	.02							
3 Goal Discrepancy Exam 2	−.328	.900	.03	.46						
4 GPA	3.30	.441	.17	.23	.12					
5 In-Major	.109	.312	.05	.04	.03	.06				
6 Female	.419	.493	.08	−.09	−.09	.14	.11			
7 Part 2 (indicator)	.350	.477	.01	.00	.00	.00	.00	.00		
8 Part 3 (indicator)	.350	.477	−.08	.00	.00	.00	.00	.00	−.54	
9 Maxed Out	.040	.195	−.01	.00	.01	.06	.02	.00	−.15	.28

TABLE 2
Means, Standard Deviations, and Correlations for Out-of-Class Extra-Credit Analysis (n = 5477)

Variable	*M*	*SD*	1	2	3	4	5	6	7
1 # of Studies Participated in This Week	0.220	0.534							
2 Goal Discrepancy Exam 1	−0.523	0.977	−.03						
3 Goal Discrepancy Exam 2	−0.341	0.927	.00	.50					
4 GPA	3.323	0.432	.05	.26	.13				
5 In-Major	0.092	0.289	.02	.06	−.04	.05			
6 Female	0.426	0.494	.04	−.08	−.10	.12	.12		
7 Part 2 (dummy)	0.408	0.491	−.11	.00	.00	.01	.00	.01	
8 Part 3 (dummy)	0.260	0.439	.37	.01	.00	−.03	−.01	−.01	−.49

Note. Mean values of these variables are different than in Table 1 because students concurrently taking the "sister" marketing course are excluded, as noted in text.

ceive feedback later in the course, as predicted by H2. To calibrate the magnitude of the Exam 2 effect, consider that during Part 3 of the course an average student misses class just over 25% of the time. That same student would be expected to miss class 20% of the time if their Exam 2 score was a full grade point *below* their historical GPA, and to miss class just over 30% of the time if their Exam 2 score was a full grade point *above* their historical GPA.

We performed two supplemental analyses to support the findings above. First, H1's prediction that students will increase attendance after a negative goal discrepancy is based on the assumption that increased attendance leads to higher exam scores. We verified that attendance increases in Part 2 of the course were significantly ($p < .002$) related to increased scores on Exam 2, after controlling for historical GPA, Exam 1 score, and Part 1 attendance. Second, we verified that the findings were not driven by high GPA students for whom positive goal discrepancies are difficult to achieve. We found that the results were unchanged if students with high GPAs (specifically, the 13% of students with GPAs > 3.83) were not included in the analysis.

The bottom half of Table 3 pertains to extra-credit participation rates. The *Goal Discrepancy Exam 1* coefficient in Model 3C is negative and highly significant, indicating that students who received negative goal-discrepant feedback from Exam 1 increased their extra-credit participation (in Part 2) relative to students who do not receive such feedback. Model 3D, however, shows that Exam 2 does not significantly influence extra-

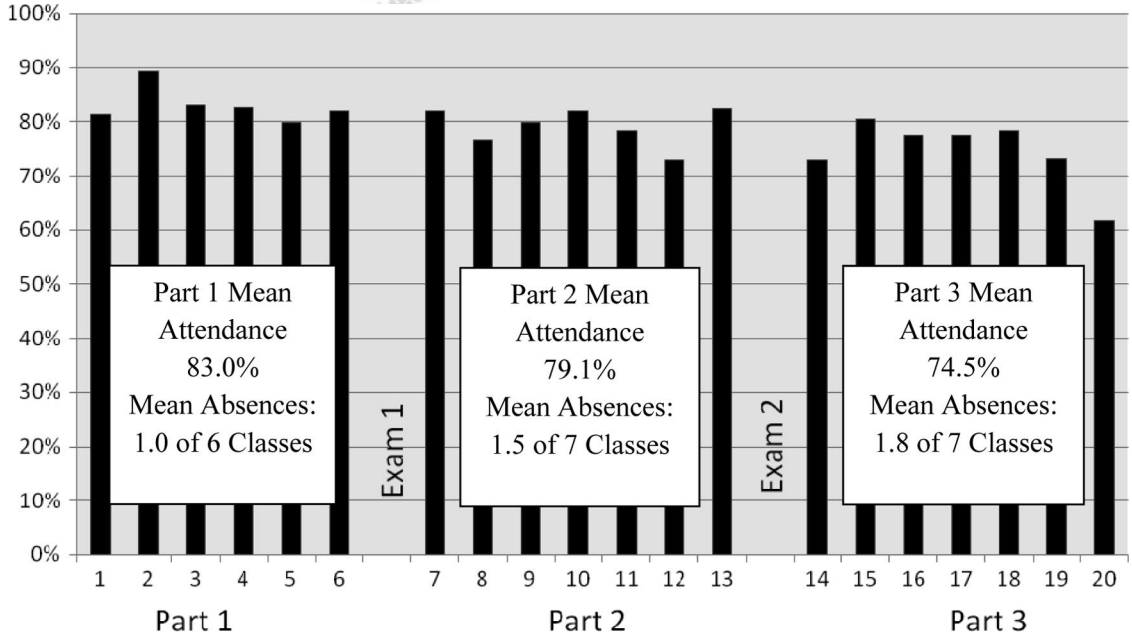

FIGURE 1
Overall Attendance Rates by Class Session. *Note*. Mean Attendance Rate during entire course: 78.7%.

TABLE 3
Relationship Between Performance Discrepancy and Effort (Attendance & Extra-Credit Participation)

Attendance	Model 3A. Part 2 vs. Part 1	Model 3B. Part 3 vs. Part 2
Goal Discrepancy Exam 1	**−.12† (.07)**	−.11[a] (.07)
Goal Discrepancy Exam 2		**−.24*** (.07)**
Extra-Credit Participation	**3C. Part 2 vs. Part 1**	**3D. Part 3 vs. Part 2**
Goal Discrepancy Exam 1	**−.44** (.17)**	−.09[a] (.09)
Goal Discrepancy Exam 2		−.10 (.09)

Note. Standard errors in parentheses. Fixed-effect pooled cross-sectional time-series models.

[a] The coefficient for *Goal Discrepancy Exam 1* in Model 3B and Model 3D estimates whether student responses to the Exam 1 goal discrepancy changed from Part 2 to Part 3 of the course. The nonsignificant coefficients indicate that the responses that occurred in Part 2 (i.e., those estimated in Models 3A and 3C, respectively) were maintained during Part 3.

† $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$. Two-tailed tests.

credit participation. The temporal pattern of performance feedback on extra-credit participation thus appears opposite than predicted. Early feedback (Exam 1) is associated with a strong reaction, whereas late feedback (Exam 2) appears to have minimal impact.

Feedback Valence Differences

Table 4 presents models of whether students' responses to positive goal discrepancies were weaker than responses to similar-magnitude negative goal discrepancies, as predicted by H3. The table reveals no support for this proposition, and equivalent models specified with interaction terms (not shown) show that none of the coefficient pairs are significantly different.

Two supplemental analyses used subsamples to further explore how responses to goal discrepancies varied with the valence and timing of performance feedback. For the first of these, students were first divided into two groups according to whether their Exam 1 goal discrepancy ("GD") was positive or negative, and then again divided at the respective median goal discrepancy of those groups. The four resulting subsamples are labeled "large negative GD," "small negative GD," "small positive GD," and "large positive GD." Figure 2 plots actual attendance rates for Part 1 and Part 2 for each of the four subsamples.

Figure 2 shows that attendance decreases for every subsample, reflecting the overall trend evident in Figure 1. However, the question of interest is whether there are *relative* differences between attendance declines across subsamples. Three of the four subsamples (large negative, small negative, and small positive goal discrepancies) show strikingly similar attendance decreases from Part 1 to Part 2, as seen by the nearly parallel lines for these groups in Figure 2. However, the "large positive" goal discrepancy demonstrated a significantly larger attendance decrease relative to the three other subsamples. This is opposite to H3's prediction.

The apparent "business as usual" reaction within the large negative goal discrepancy subsample in Figure 2 also stands out. This group is composed of students whose mean historical GPA is 3.17 (in the B/B+ range) and whose mean score on Exam 1 was a C- (mean GPA-equivalent of 1.58). These students react no differently than students in the small negative or small positive groups where attendance is concerned, contrary to predictions (as in H1) developed using control theory and

TABLE 4
Responses to Performance Feedback by Positive or Negative Valence of Feedback

Attendance	4A. Part 2 vs. Part 1	4B. Part 3 vs. Part 2
Negative Goal Discrepancy Amount Exam 1	−.05 (.08)	−.13 (.09)
Positive Goal Discrepancy Amount Exam 1	**−.47† (.29)**	−.04 (.25)
Negative Goal Discrepancy Amount Exam 2		**−.20* (.10)**
Positive Goal Discrepancy Amount Exam 2		−.36 (.23)
Extra-Credit Participation	**4C. Part 2 – Part 1**	**4D. Part 3 – Part 2**
Negative Goal Discrepancy Amount Exam 1	**−.41† (.23)**	−.20 (.12)
Positive Goal Discrepancy Amount Exam 1	−.60 (.63)	.46 (.39)
Negative Goal Discrepancy Amount Exam 2		−.08 (.13)
Positive Goal Discrepancy Amount Exam 2		−.11 (.28)

Note. None of the coefficients between corresponding positive and negative goal discrepancy feedback variables are significantly different. However, the supplemental analyses (see Figures 2 & 3) provide additional evidence that students do respond differently to positive and negative goal discrepancies.

† $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$. Two-tailed tests. Standard errors in parentheses.

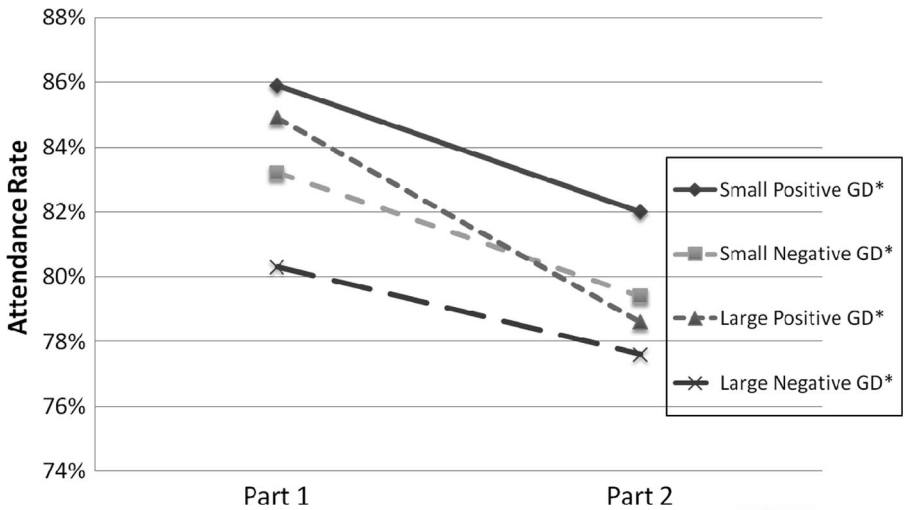

FIGURE 2

Attendance Rate for Part 1 & Part 2 of Course, by *Exam 1* Goal Discrepancy. *Students are divided into four groups in two steps. First, students are divided into two groups according to whether their Exam 1 goal discrepancy was positive or negative. Then, each of those groups are split at their respective medians. The four resulting groups are labeled "large negative GD," "small negative GD," "small positive GD," and "large positive GD." *T* tests showed that the attendance changes were not significantly different between groups except between the Large Negative GD and Large Positive GD groups ($p < .07$). Also, if the Large Negative, Small Negative, and Small Positive groups are combined, the combined group's attendance change is significantly different than that of the Large Positive GD group.

social cognitive theory. However, the reaction of students in the large negative group *is* consistent with a punctuated-equilibrium logic (as in H2)—that is, early feedback, even if strong and negative, might not provoke an effort change because it is not a sufficiently definitive signal that a "business as usual" approach will fail to achieve the student's goals. It could be that these students did not adjust their efforts in response to feedback because they made external attributions for their poor performance or because students rationalized that there was plenty of time to recover, as two more exams were yet to come.

For the second supplemental analysis students were again divided according to valence and magnitude of goal discrepancy, but using Exam 2 goal discrepancies and comparing attendance during Part 2 and Part 3 of the course. Figure 3 demonstrates that reactions to Exam 2 follow a quite different pattern than the reactions to Exam 1. First, students in the "large negative" group buck the general declining trend in attendance following Exam 2. They show a (significant) *relative* attendance increase compared to the other student groups. That is, even though students in the "large negative" group do not actually increase their attendance, we can infer that these students' stable attendance is the net outcome of two opposite forces: a general downward attendance trend across all students and a positive reaction to exam feedback that is relatively strong within this group specifically. Moreover, the differences in responses to Exam 2 goal discrepancies in Figure 3 are visibly stronger and more consistent than the responses to Exam 1 shown in Figure 2. As we move from the most negative to most positive feedback groups, each succeeding group shows a visibly greater decline in attendance. The differences between groups are statistically significant in most cases (see notes below figure for details) and appear large enough to be practically important as well. The marked differences are consistent with findings in Model 3B that student attendance in Period 3 differs significantly depending on feedback from Exam 2. The contrast between the limited between-group differences in Figure 2 and widespread between-group differences in Figure 3 is consistent with punctuated-equilibrium logic and provides additional support for H2.

Student Attribute Effects

We use subsample analyses to explore the influence of the three student attributes (prior academic performance, student major, and gender) on response to performance feedback. The models in Table 5 examine the role of prior academic performance using subsamples derived from a median

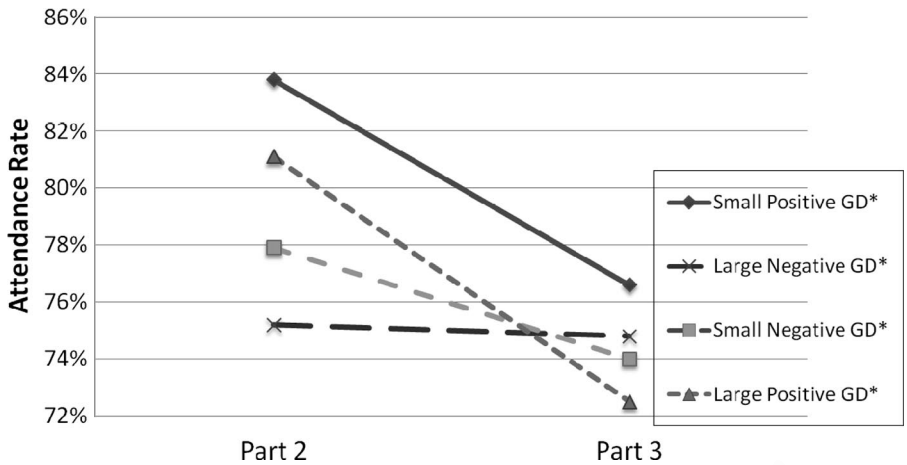

FIGURE 3

Attendance Rate for Part 2 & Part 3 of Course, by *Exam 2* Goal Discrepancy. *Students are divided into four groups as in Figure 2, *except* the groups are based on the Exam 2 goal discrepancy rather than the Exam 1 goal discrepancy. That is, first students are divided into two groups according to whether their Exam 2 goal discrepancy was positive or negative, and then each of those groups are split at their respective medians. The resulting groups are labeled "large negative GD," "small negative GD," "small positive GD," and "large positive GD." *T* tests showed that the attendance change was significantly different across each successive group ($p < .03$ to $p < .08$) except for the Small Positive GD and Large Positive GD groups. While the two positive goal discrepancy groups do not show significantly different attendance changes, the mean goal discrepancies within each group are quite similar (+.21 vs. +.66, respectively). The larger magnitude coefficient for positive valence in Model 4B (−.36 vs. −.20 for negative valence) does suggest that students continue to respond to positive goal discrepancies in Part 3.

split on historical GPA (at GPA = 3.39). The models are specified and interpreted identically to those in Table 3 otherwise. Models 5A to 5D are for attendance. They show that responses to Exam 1 in Part 2 are similar across the high and low GPA subsamples (Models 5A & B). In Part 3, however, there are differences across the GPA subsamples. Students in the high GPA subsample (Model 5C) respond strongly to goal discrepancies from Exam 2, whereas students in the low GPA subsample (Model 5D) do not. The differential responses are intriguing. However, Model 5D also shows that low GPA students did respond to feedback in Part 3—it is just that they (belatedly) responded to feedback from Exam 1 instead of responding to Exam 2. If the responses to feedback late in the course are combined across the two exams (i.e., responses to both Exam 1 and Exam 2 are considered together for Part 3 of the course), responses to feedback are quite similar across GPA subsamples where attendance is concerned.

The bottom half of Table 5 examines extra-credit participation. The models show just one point of difference between subsamples: Exam 2 goal discrepancies within the high GPA subsample had a highly significant ($\beta = -.56$, $p < .001$) and significantly stronger ($p < .05$) influence than within the low GPA subsample (Models 5G & H).

The models in Table 6 assess whether responses to performance feedback differ for in-major students and non-major students. The models show striking between-group differences in response to feedback where attendance is concerned. In-major students show no response (Model 6A, $\beta = .17$, n.s.) for Exam 1 goal discrepancies, which contrasts with a significant negative coefficient (Model 6B, $\beta = -.14$, $p < .05$) for nonmajor students. Exam 2 goal discrepancies show a similar pattern (Models 6C & 6D).

Table 7 presents a supplemental analysis that shows attendance changes relative to the full sample, broken down by in-major and non-major students and positive or negative goal discrepancies. Positive entries indicate that attendance of students in that subsample increased relative to the full sample. Negative entries indicate that the attendance rate *declined more* than did the full sample. H1 implies increased relative attendance where students had negative goal discrepancies, and decreased relative attendance where students had positive goal discrepancies. In-major students show a pattern opposite to that predicted by H1, for both Exam 1 and Exam 2 goal discrepancies. That is, in-major students with negative goal discrepancies reduced their attendance *more* than the full sample, whereas in-major students with positive goal discrepancies *increased* their attendance rel-

TABLE 5
Responses to Performance Feedback by High and Low Historical GPA Subsamples

	Part 2 vs. Part 1		Part 3 vs. Part 2	
Attendance	**5A. High GPA**	**5B. Low GPA**	**5C. High GPA**	**5D. Low GPA**
Goal Discrepancy Exam 1	−.12 (.14)	−.10 (.08)	**.12 (.13)[a]**	**−.20* (.09)[a]**
Goal Discrepancy Exam 2			**−.50*** (.14)[a]**	**−.13 (.09)[a]**
	Part 2 vs. Part 1		**Part 3 vs. Part 2**	
Extra-Credit Participation	**5E. High GPA**	**5F. Low GPA**	**5G. High GPA**	**5H. Low GPA**
Goal Discrepancy Exam 1	**−.42† (.23)**	**−.41† (.25)**	−.16 (.15)	−.14 (.09)
Goal Discrepancy Exam 2			**−.56*** (.17)[a]**	**.12 (.09)[a]**

Note. High GPA subsample includes students with Historical GPA at or above median (3.39). Low GPA subsample includes students below median.

[a] For this variable, coefficients of High Hist. GPA and Low Hist. GPA students are significantly different ($p < .05$) in a full-sample model.

† $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$. Two-tailed tests. Standard errors in parentheses.

ative to the full sample. Non-major students, on the other hand, responded as predicted by H1. Table 7 thus shows that in-major students consistently responded to exam feedback in a qualitatively different way than did non-major students.

Models 6E–6H show that responses to feedback where extra-credit participation rates are concerned are mostly similar between the subsamples. The exception is that in-major students respond more strongly to Exam 2 goal discrepancies than do non-major students ($\beta = -.66$, $p < .05$ vs. $\beta = -.04$, n.s., respectively). This difference is only marginally significant in a full-sample model with appropriate interaction terms (not presented).

Table 8 presents models that assess whether there are gender differences in responses to performance feedback. Coefficients differ across the male/female subsamples, but tests using full-sample models with appropriate interaction terms reveal that the differences are not significant except in one case: female students do react more strongly to feedback from Exam 2 where extra-credit participation is concerned. In several other cases, however, the coefficients are larger or more significant for the male subsample, suggesting

TABLE 6
Responses to Performance Feedback by Student Major

	Part 2 vs. Part 1		Part 3 vs. Part 2	
Attendance	**6A. In-Major**	**6B. Non-Major**	**6C. In-Major**	**6D. Non-Major**
Goal Discrepancy Exam 1	**.17 (.30)**	**−.14* (.07)**	**−.27 (.29)**	**−.09 (.07)**
Goal Discrepancy Exam 2			**.22 (.25)[a]**	**−.29*** (.08)[a]**
	Part 2 vs. Part 1		**Part 3 vs. Part 2**	
Extra-Credit Participation	**6E. In-Major**	**6F. Non-Major**	**6G. In-Major**	**6H. Non-Major**
Goal Discrepancy Exam 1	**−.50 (.61)**	**−.45* (.18)**	**−.06 (.39)**	**−.09 (.09)**
Goal Discrepancy Exam 2			**−.66* (.34)[b]**	**−.04 (.09)[b]**

Note. In-major subsample includes students whose major is in same department as the course. Non-major subsample includes students whose major is in a different department.

[a] For this variable, coefficients of in-major and non-major students are significantly different ($p < .05$) in a full-sample model.

[b] For this variable, coefficients of in-major and non-major students are significantly (marginally so) different ($p < .10$) in a full-sample model.

† $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$. Two-tailed tests. Standard errors in parentheses.

TABLE 7
Percentage Changes in Attendance by Student Major and Goal Discrepancy

	In-Major Students *Relative* Attendance % Change	Non-Major Students *Relative* Attendance % Change
Negative Exam 1 Goal Discrepancy	−0.2%	+0.8%[b]
Positive Exam 1 Goal Discrepancy	+1.0%	−1.6%[b]
Negative Exam 2 Goal Discrepancy	−4.7%[c]	+3.4%[a]
Positive Exam 2 Goal Discrepancy	+1.3%[c]	−3.9%[a]

Note. Attendance percentage changes are from Part 1 to Part 2 of course for Exam 1 Goal Discrepancy, and from Part 2 to Part 3 for Exam 2 Goal Discrepancy. In each case changes are reported *relative* to the full-sample mean change in attendance. For example, in-major students with negative goal discrepancies had a 92.3% attendance rate in Part 1 (not presented). Their attendance rate was 88.2% in Part 2, a change of −4.1%. The full-sample mean change in attendance from Part 1 to Part 2 was −3.9%. Consequently, the top-left hand entry on the table shows the difference (−0.2%) between the full-sample mean change of −3.9% and the −4.1% change for the in-major/negative goal discrepancy exam 1 subsample.

[a] For this pair of cells, *t* tests indicate that attendance changes for negative and positive goal discrepancy subgroups are significantly different ($p < .001$).

[b] For this pair of cells, *t* tests indicate that attendance changes for negative and positive goal discrepancy subgroups are (marginally) significantly different ($p < .10$).

[c] For this pair of cells, *t* tests indicate that attendance changes for negative and positive goal discrepancy subgroups are (marginally) significantly different ($p < .10$).

that males may react more strongly in other situations. The results provide no clear evidence that overall strength of response to performance feedback differs across gender.

DISCUSSION

We have examined how exam feedback affected student effort levels—in particular, their class attendance and extra-credit participation. We predicted and found that discrepancies between performance and goals would lead to changes in effort (H1). We also considered two fundamental contingencies: feedback timing and valence. The results provided substantial (but not universal) support for the prediction (H2) that responses to performance feedback would be stronger later in the semester, consistent with models of punctuated equilibrium. The supplemental analyses (Figures 2 & 3) were particularly illuminating regarding the effects of feedback valence. They showed that contrary to predictions (H3), students reacted more strongly to positive goal discrepancies, at least where attendance was concerned. We also found evidence that students reacted quite differently to in-major performance feedback than to non-major performance feedback.

Implications for Theory

The study's findings both replicate and extend existing research on goal setting and self-regulation. The main effect findings are consistent with much existing research (see Latham & Locke, 1991), and provide evidence that the logic of discrepancy reduction applies in an area where empirical work has been lacking. The analyses of moderating con-

TABLE 8
Responses to Performance Feedback by Gender Subsamples

	Part 2 vs. Part 1		Part 3 vs. Part 2	
Attendance	**8A. Females**	**8B. Males**	**8C. Females**	**8D. Males**
Goal Discrepancy Exam 1	−.13 (.11)	−.12 (.09)	.00 (.12)	**−.17† (.09)**
Goal Discrepancy Exam 2			**−.21† (.12)**	**−.28** (.09)**
	Part 2 vs. Part 1		**Part 3 vs. Part 2**	
Extra-Credit Participation	**8E. Female**	**8F. Males**	**8G. Females**	**8H. Males**
Goal Discrepancy Exam 1	−.31 (.23)	**−.63* (.26)**	**.07 (.14)**	−.20 (.13)
Goal Discrepancy Exam 2			**−.40*** (.14)[a]**	**.14 (.13)[a]**

[a] For this variable, coefficients of High Historical GPA and Low Historical GPA students are significantly different ($p < .05$) in a full-sample model.

† $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$. Two-tailed tests. Standard errors in parentheses.

tingencies (e.g., timing and valence) extend existing research.

Temporal differences in responses to feedback have not been explored in theoretical or empirical depth within the broader goal-setting and self-regulation literatures (Fried & Slowik, 2004). We argued that a punctuated-equilibrium logic (Gersick, 1991), which has previously been applied to group-level dynamics, could also be used to model individuals' responses to goal discrepancies. A punctuated-equilibrium model suggests when performance periods are long and feedback is "noisy," goals may have little impact on behavioral strategies until enough feedback is received to insure that the goals will not be attained unless strategies are changed. Our findings regarding attendance are consistent with this prediction (see Figures 2 & 3). These findings suggest that laboratory goal-setting research—which often deals with short performance periods and relatively clear feedback (e.g., Early et al., 1990)—may overestimate the power of goals to regulate behavior that occurs under such circumstances. Intriguingly, we also found that for extra-credit participation, responses to feedback showed a different temporal pattern such that performance-goal discrepancies from early feedback generated a strong behavioral response. The differential response may be attributable to differences in task characteristics between attendance and extra-credit participation. The clear benefits associated with extra-credit participation may have encouraged students to respond to early feedback, even if that feedback was not compelling enough to engender changes in their attendance strategy (where the relationship between effort and performance is more complex). Together, the findings not only add to the limited evidence that feedback timing moderates response strength, but also suggest that such moderation is itself dependent on task characteristics. Further exploration using a punctuated-equilibrium approach seems a promising avenue for future research.

We also found that responses to feedback differed in surprising ways depending on the valence of the feedback. While most goal-setting research has focused on individuals who fall short of their aspirations rather than on those who overachieve, researchers have suggested that responses to positive goal discrepancies are likely to be weaker than responses to negative goal discrepancies of the same magnitude (Carver & Scheier, 1981). In this study, early performance feedback led instead to the opposite pattern for attendance—responses to positive goal discrepancies were stronger than responses to negative goal discrepancies. It may be that in multiple-task situations (which also have not received wide attention in goal-setting research; see Ashford & Northcraft, 2003), individuals are quick to reduce effort in the presence of positive feedback, as that allows them to reallocate the effort to other tasks where performance is weaker. In contrast, individuals may need a stronger signal to respond to negative feedback, because increasing effort requires "finding" and reallocating that effort from another task. The finding for attendance is also difficult to reconcile with the predictions of prospect theory (Tversky & Kahneman, 1981), which explicitly considers the influence of valence on decision making and also predicts weaker responses in the face of gains (e.g., positive goal discrepancies) than losses (e.g., negative goal discrepancies). Finally, the asymmetry between early responses to positive and negative feedback is intriguing to consider from the perspective of punctuated-equilibrium research, which has not considered responses to positive goal discrepancies.

Among student attributes, student major was the only one that consistently moderated responses to performance feedback. However, this moderating effect (again) varied with type of effort. Attendance of in-major students changed in an opposite pattern than would be predicted by control theory and social cognitive theory. Yet, these same students *did* respond as those theories would predict where extra-credit participation was concerned. In fact, in-major students responded more strongly than non-major students. The differing characteristics of the two types of effort may provide some clues here.

We proposed that responses to in-major and non-major feedback might vary because of associated differences in performance and mastery goals. While the results were different than expected, the performance–mastery goal distinction may still be important. Extra-credit studies, for example, would seem relevant only for performance goals. The stronger response to feedback by in-major students may have been due to their having stronger performance goals. Moreover, students with strong mastery goals can increase their effort following success (Barron & Harackiewicz, 2001; Dweck, 1986). If in-major students also have strong mastery goals, this may be why positive goal discrepancies led them to (unexpectedly) increase attendance on a relative basis.

Overall, the findings offer contributions to theory in two broad ways. First, they provide evidence regarding contingencies (e.g., timing, valence, student attributes) that have not been extensively examined by prior goal-setting and self-regulation

research. Second, some of the findings were unexpected (e.g., stronger early effects of positive goal discrepancies) and so present challenges for existing theorizing. Given this and the multiple theoretical points of contact, future research could usefully examine responses to these contingencies with a view toward identifying mechanisms that drive the varied and sometimes unexpected results.

Implications for Educators

The findings also have practical implications for how educators think about student behavior and course design. The results add to the limited evidence that student effort is often responsive to exam feedback. However, the results also suggest complexities to such responses that educators would do well to take note of. One complexity is that, consistent with a punctuated-equilibrium model, many students did not respond to early exam feedback. At the heart of the punctuated-equilibrium model is the idea that strategy adjustment—in this case, change in attendance—only occurs after it becomes clear that the current strategy will not assure goal attainment. The problem in many courses is the absence of enough early data points (evaluation opportunities) to make any sort of reliable estimate of the performance trajectory. Many large undergraduate courses may feature only two such evaluation opportunities: a midterm examination and a final exam. That means that halfway through the course there will be only one significant data point to form the basis for projecting goal attainment. And of course that one data point may be "noisy": Did the kind of questions surprise me? Did I have the flu? Was it the same week as a major project due in another course? Did I just have a bad day? Such thoughts might well lead to the external attribution and discounting (Zuckerman, 1979) of goal-discrepant feedback, and thus nonadjustment of a student's effort strategy. A *second* (or even third!) data point earlier in the semester (e.g., by midterm) might help move back the punctuation of student strategy reevaluation, by making it clearer earlier in the course that students' planned level of effort will not get them where they want to go. Another strategy would be to focus specifically on students who had performed poorly early in the course by drawing out the potential causes and implications of that performance. Students could be informed that research suggests early negative goal discrepancies are often not taken as seriously as they probably should be, and students with poor early performance could be encouraged or even required to craft a recovery plan. For example, one might offer extra credit to students who reviewed their initial exam with a teaching assistant and outlined a changed study strategy for subsequent exams.

A second complexity in students' response to feedback is seen in the marked decline in attendance following *positive* exam feedback, even when such feedback occurred early during the course. This suggests that performance feedback is a "double-edged sword" and that educators must consider both the benefits and costs of feedback and particularly early feedback. For example, educators may aim to provide early positive feedback (perhaps to build student confidence or engagement based on an underlying reinforcement-theory or mastery goals model). However, this might result in a substantial number of students receiving large positive goal discrepancies. This study's findings suggest that students may then react by cutting back on their efforts—the opposite of the educator's intentions. One possible strategy is to provide early feedback, for the reasons suggested earlier, but to make it difficult to *excel* on early exam(s) or assignments. This could minimize the number of students who receive large positive goal discrepancies, and so might delay or mitigate effort reductions.

The differences in feedback effects for attendance and extra-credit participation may generalize to illuminate an important dimension of class design. The findings for extra-credit participation suggest that when the link between effort and performance is clear, students are more likely to respond to early performance-goal discrepancies. Educators may be able to achieve a similar result by making the link between effort and performance clearer or more certain on more traditional course elements, such as problem sets or early exams and quizzes. For example, students could be given credit for turning in problem sets with evidence of effort, in addition to the traditional credit for getting problems correct.

Finally, the contrasting response patterns of in-major students and non-major students also have interesting implications for educators. Notably, it appears that in-major students did not demonstrate the pedagogically troubling response to positive feedback that their non-major peers did. This suggests that when courses are largely composed of in-major students (as many intermediate and advanced courses are) performance feedback and particularly positive feedback may be utilized with fewer risks than in required introductory courses such as the one studied here.

Despite the insights offered by this research,

there are several important limitations to this study. The study context was a single large introductory course with a healthy mixture of in-major and non-major students. This context is of particular interest for management educators, as many undergraduate business programs have similar large introductory courses where the results may generalize quite well. However, our results may not fully generalize to other types of courses and so similar research in other contexts (e.g., smaller classes) would be useful. Another limitation is that data was unfortunately not available on self-reported achievement goals, failure attributions, ability attributions, and self-efficacy. As the focus here was on adjustments to effort, concomitant adjustments to the amount of studying done in response to performance-goal discrepancies also need to be included to complete the picture. Our analyses could not incorporate conscious choices students might make to revise or even abandon their initial goals (Senko & Harackiewicz, 2005; Williams, Donovan, & Dodge, 2000).[6] To the extent students do revise their goals in the direction of feedback, it would generally tend to weaken our results so that results reported here are likely conservative tests. Future research could usefully consider goal and effort revision simultaneously. Finally, our investigation focused on performance rather than mastery goals. The substantial educational literature on multiple goals suggests that examining the relationship between self-regulation of effort and both performance and mastery (learning) goals would be another fruitful avenue for future research.

As researchers and educators, how busy students choose to allocate their effort to courses is a critical concern. Education provides an opportunity to learn, but one that is dependent on the efforts of students to harvest that opportunity. Our study of the determinants of in-class and extra-credit effort helps clarify how students use feedback to adjust their course strategies. In doing so, our findings may help educators understand the tradeoffs they face in trying to better design educational opportunities so that students are more likely to meet their educational goals. The findings might also encourage goal-setting and self-regulation researchers to focus additional attention on the feedback–effort relationship and particularly on the contingencies that produced such intriguing results herein.

[6] We gathered some preliminary data to address some of these limitations by conducting an informal survey of students in the same course at the end of a later semester (see also footnote 2). We did not feel it was appropriate to include these data in the body of the paper, given that responses are based on retrospective self-reports. That said, respondents reported the following: (1) 59% of responding students indicated they missed class because "I decided to spend time on other classes." (2) 76% of responding students reported that attending class helped them do better on exams. (3) 61% of respondents indicated their grade goals were stable through the semester; 28% indicated their grade goals had decreased; 11% indicated they had raised their goals. (4) Students reported they did change their effort in response to feedback from the exams. 52% indicated their likelihood of coming to class changed; 70% reported they changed how hard they studied; 48% reported their likelihood of participation in extra credit changed. In each case considerably more students indicated that they increased their effort than indicated they decreased their effort. Each result is consistent with our conceptual arguments and findings.

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