

Unexpected Improvement, Decline, and Stasis: A Prediction Confidence Perspective on Achievement Success and Failure

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The authors hypothesized that reactions to performance feedback depend on whether one's lay theory of intelligence is supported or violated. In Study 1, following improvement feedback, all participants generally exhibited positive affect, but entity theorists (who believe that intelligence is fixed) displayed more anxiety and more effort to restore prediction confidence than did incremental theorists (who believe that intelligence is malleable). Similarly, when performance declined, entity theorists displayed more anxiety and compensatory effort than incremental theorists. However, when performance remained rigidly static despite a learning opportunity, incremental theorists evinced more anxiety and compensatory effort than entity theorists. In Study 2, this pattern was replicated when the entity and incremental theories were experimentally manipulated. Study 3 demonstrated that for both groups, theory violation impairs subsequent task performance. Taken together, these studies provide evidence that lay theory violation and damaged prediction confidence have significant and measurable effects on emotion and motivation. The authors discuss the implications of these findings for the literature on achievement success and failure.

Keywords: lay theories, prediction confidence, motivation, achievement

When people perform achievement-related tasks (e.g., a student taking a test, a sprinter running a race), common sense dictates that they may experience a positive, negative, or neutral outcome. But how do people determine whether a given outcome is a psychological "success," "failure" or "neither"? Although on rare occasions the decision metric might be apparent (e.g., life-and-death situations), in most cases, one person's "failure" might be another person's "nonsuccess" or even "potential success." In the present article, we propose that the meaning people assign to a given performance outcome is determined in large measure by their beliefs, or lay theories, about the mutability of human abilities. We further propose, and test, the hypothesis that people react negatively when their outcome disconfirms their particular self-theory. Why might this be? Drawing on classic and contemporary research on the psychology of prediction and control (e.g., Pittman & Pittman, 1980; Weary, Gleicher, & Marsh, 1993; White, 1959), we suggest that a theory violation threatens people's sense that they fully understand and can predict their own behavior.

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With three studies, we tested these ideas by assessing or manipulating lay theories of intelligence and examining participants' reactions to performance that declined, improved, or remained static. Before providing a fuller account of the model, we turn first to a more detailed description of the lay theories examined in these studies.

THE ENTITY AND INCREMENTAL THEORIES

Dweck and colleagues have found that most people possess lay theories about the fixedness or malleability of personality attributes such as intelligence and moral character (e.g., Dweck, 1999; Dweck, Chiu, & Hong, 1995; Dweck & Leggett, 1988). One theory, the entity theory, holds that personal characteristics are fixed entities, despite a person's efforts or motivation to change them. This perspective is captured by the item from the Implicit Theories Measure–Intelligence Version (ITM; Dweck, 1999), "Everyone has a certain amount of intelligence, and there is not much that can be done to really change that." A second theory, the incremental theory, holds that intelligence is dynamic and cultivatable with effort. This view is captured by the item, "No matter who you are, you can significantly change your intelligence level."¹ In addition to being measurable by questionnaire, both theories may be temporarily primed with persuasive written materials (Chiu, Hong, & Dweck, 1997, Experiment 5; McConnell, 2001, Experiment 2; Plaks, Stroessner, Dweck, & Sherman, 2001, Experiment 3). In Studies 1 and 3, we assessed participants' chronic theories, whereas in Study 2, we randomly assigned participants to receive either an entity message or an incremental message.

¹ Note that the entity and incremental theories are alternative lay perspectives on human nature, with neither necessarily reflecting the "true" state of affairs.

Numerous studies have shown that entity theorists' tendency to attribute performance to fixed qualities leads to comparatively severe negative affect and self-recrimination following a setback. In contrast, incremental theorists' tendency to attribute performance to dynamic processes leads to more adaptive reactions to the same setback (e.g., Hong, Chiu, Dweck, Lin, & Wan, 1999; Niiya, Crocker, & Bartmess, 2004; Robins & Pals, 2002). According to these approaches, the incremental theory's dynamic assumption blunts the sting of failure and sets up a framework for growth through effort (Blackwell, Trzesniewski, & Dweck, 2007; Cury, Elliot, Da Fonseca, & Moller, 2006; Hong et al., 1999). It is important to add that the entity and incremental theories are conceptually and statistically independent of other well-known predictors of achievement, including general intelligence, self-esteem, self-efficacy, and Big Five trait dimensions (e.g., Dweck et al., 1995; Niiya et al., 2004; Spinath, Spinath, Riemann, & Angleitner, 2003; Taberero & Wood, 1999).

Other studies have found that, compared with incremental theorists, entity theorists expect people to exhibit greater behavioral consistency (Chiu et al., 1997; Plaks et al., 2001) and are, in fact, discomfited by evidence of a person acting inconsistently with expectations (Plaks, Grant, & Dweck, 2005). For example, Plaks et al. (2005) presented participants with a fictional target person ("Brad") who was described as a "math geek" (implying high ability in math and science but low ability in "artsy" and humanities subjects). Participants were told that Brad's university required him to take an intensive remedial course in expository writing and textual analysis. Following successful completion of the course, Brad performed a randomized series of math geek-stereotypic and counterstereotypic behaviors. Analyses of participants' attention allocation, memory, and affective reactions revealed that entity theorists were made more anxious by Brad's behavior when it implied a significant change in abilities (e.g., "Brad scored a 760 on the Verbal section of a practice GRE

exam"). In addition, entity theorists shifted their attention away from such information, whereas incremental theorists did not. In contrast, incremental theorists selectively ignored and were made anxious by Brad's behavior when it implied an *inability* to cultivate new skills—despite the golden opportunity provided (e.g., "Brad scored a 460 on the Verbal section of a practice GRE exam"). Plaks et al. (2005) argued that because understanding and predicting behavior is central to adaptive functioning, it is important for individuals to experience the confirmation of their theories.

In the present studies, we examined whether the same reasoning would extend to participants' analysis of their own behavior. That is, would evidence of one's own lack of improvement—despite the opportunity and motivation—prompt more anxiety and compensatory effort from incremental theorists than from entity theorists? Would evidence of significant change prompt more anxiety and compensatory effort from entity theorists than from incremental theorists? More intriguingly, would evidence of significant change continue to elicit such a reaction from entity theorists even if the change were for the better? If so, then this could have important implications for understanding the psychology of achievement success and failure.

THE PRESENT MODEL

The first tenet of the proposed model (depicted in Figure 1) is that people mentally represent achievement outcomes at both the outcome level and the theory level. The *outcome level* refers to the individual's representation of his or her most recent performance compared with previous performances. The *theory level* refers to the lay theory-generated implications of this performance.

The second element of the model is that theory level implications exist both in terms of self-evaluation (the right side of Figure 1) and self-prediction (left side). That is, lay theories not only turn positive and negative outcomes into implications for self-

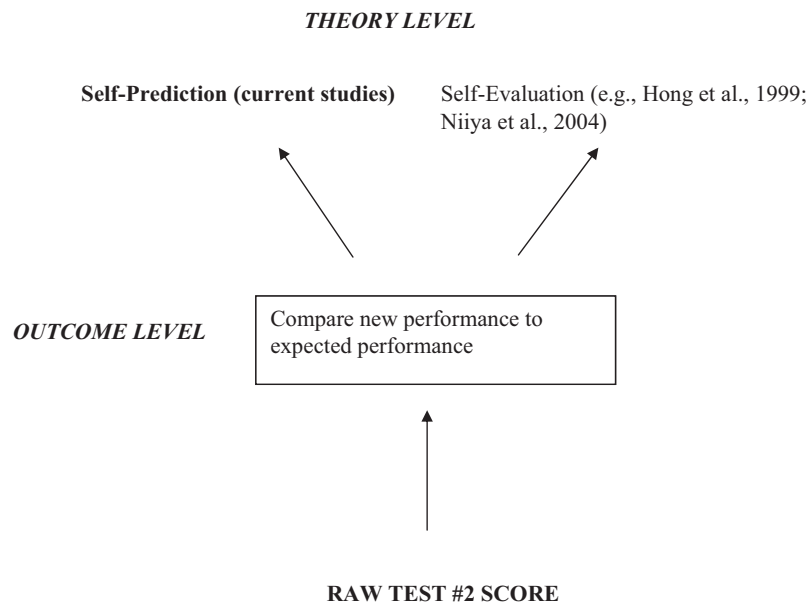


Figure 1. The proposed model.

evaluation (e.g., Hong et al., 1999; Niiya et al., 2004) but also generate concrete predictions for future performance (Plaks et al., 2005). Thus, a high-, medium-, or low-performance outcome not only speaks to one's ability in the domain in question ("Am I capable?") but also speaks to one's ability to understand and predict one's own behavior ("Do I know myself?").

For the purposes of illustrating the model, consider a high school student who (a) takes the Scholastic Aptitude Test (SAT) exam and receives a score, (b) takes a course designed to improve her SAT performance (as offered by such companies as Kaplan and Princeton Review), and (c) retakes the SAT. What will be her construal of, and reaction to, an improvement in her score versus no change versus a decline?

First, as depicted at the outcome level of Figure 1, a cognitive process of comparison allows the student to compare the new score with the old score and determine whether it is higher, lower, or unchanged. As depicted on the right side of the figure, the process does not stop there; Dweck and colleagues (Blackwell et al., 2007; Hong et al., 1999) have shown that the individual uses her predominant theory to assign psychological meaning to the Time 2 score by invoking such concepts as "success," and "failure."

NOVEL PREDICTIONS OF THE MODEL

We propose a novel, parallel element to this scheme (depicted on the left side of Figure 1). According to the present model, an individual's Time 2 performance (better, worse, or status quo) not only speaks to her underlying ability but also speaks to the predictive power of her working theory. To continue our example, if the student is an entity theorist and she experiences a dramatic change in her SAT score (even an improvement), then this represents a theory violation. Although her performance has improved, her representation of intelligence as a fixed entity has been contradicted. This, in turn, compromises her confidence in her ability to understand and predict her own behavior ("Do I truly know myself?"). Thus, although dramatic improvement will undoubtedly yield some positive affect (e.g., happiness, pride), we hypothesize that, relative to incremental theorists, this positive affect will be tinged with the epistemic confusion and anxiety commonly associated with prediction uncertainty (e.g., Barlow, 1988; Mineka & Kihlstrom, 1978). Moreover, if given the opportunity, she will attempt to alleviate the damage to her sense of prediction confidence. This may come in the form of more methodical and systematic information processing—a demonstrated consequence of "causal uncertainty" (for a review, see Weary & Edwards, 1996; see also Pittman & D'Agostino, 1989, for related ideas).

Similarly, imagine our example person is an incremental theorist who experiences rigid stasis in her performance, even despite the Kaplan course. This violates her assumption that change is always possible given the effort and opportunity (Blackwell et al., 2007). Thus, for incremental theorists, relentlessly unchanging performance should induce analogous signs of anxiety and intensified information gathering.

The full model predicts the following:

(a) When faced with dramatically declining performance, entity theorists (compared with incremental theorists) should suffer a double setback: Such an outcome not only reflects badly on their task ability but also challenges their prediction ability. Thus, entity theorists (compared with incremental theorists) will exhibit higher

anxiety. This anxiety, in turn, will contribute to more vigorous compensatory effort to restore the sense of prediction confidence.

(b) Performance that remains fixed despite the opportunity and desire to improve violates the notion that human attributes are dynamic and alterable. Thus, when faced with rigidly static performance, incremental theorists will (compared with entity theorists) evince greater anxiety and higher effort to restore prediction confidence.

(c) When faced with dramatically improving performance, although everyone may experience signs of pleasure, entity theorists, with their assumption of behavioral stability, will (compared with incremental theorists) simultaneously exhibit greater anxiety and effort to restore prediction confidence.

In summary, the present model posits that, regardless of one's theory, theory-violating information introduces prediction uncertainty and anxiety that, in turn, drives compensatory behavior aimed at reasserting one's sense of prediction mastery.

UNIQUE EFFECTS OF THEORY VIOLATION ON ANXIETY

According to our model, whereas emotions such as disappointment or shame are more closely tied to the failure of one's *performance*, anxiety is more closely tied to the failure of one's *predictions*. Thus, the affective consequences of theory violation are hypothesized to be primarily restricted to anxiety. If so, then this would be consistent with previous findings in which theory violation increased participants' anxiety, but not sadness, shame, guilt, or anger (Plaks et al., 2005). It would also be consistent with prominent theories of emotion expressly linking anxiety with feelings of uncertainty (e.g., Barlow, 1988; Mineka & Kihlstrom, 1978). It would also resonate with findings in the cognitive dissonance literature linking dissonance with increased anxiety but not dejection (e.g., Elliot & Devine, 1994). Finally, such a pattern is suggested by the theoretical framework outlined by George Kelly (1955), who drew a direct connection between anxiety and exposure to information violating one's "personal construct system."

Anxiety Drives Compensatory Effort

As noted, theory violation is hypothesized to produce heightened prediction uncertainty, which, in turn, yields higher anxiety. Thus, when individuals in a state of theory violation are provided with an opportunity to solidify their sense of prediction competence, they should do so with vigor. Put differently, the more anxious one is made by a theory violation, the more effort one should expend on a subsequent task relevant to reasserting prediction and control. Such a task is provided to participants in the present studies: a control estimation task in Studies 1–2 and a counterfactual generation task in Study 3. In all three studies, we tested the following mediational hypothesis: theory violation → anxiety → compensatory effort.

Anxiety Impedes Performance

In addition, we hypothesized that the anxiety induced by theory violation would impair subsequent performance on a task of equal difficulty. This hypothesis is inspired by the literature on stereo-

type threat. Recent studies have found that the underperformance of members of stigmatized groups is at least partially attributable to arousal (Ben-Zeev, Fein, & Inzlicht, 2005; O'Brien & Crandall, 2003) and physiological anxiety (Blascovich, Spencer, Quinn, & Steele, 2001) that is activated when group identity is salient. Performance anxiety, of course, may stem from any number of sources, beyond the fear of confirming stereotypes about one's group. We hypothesize that one such source is theory violation. Thus, in Study 3, we tested the prediction that theory-violating feedback would induce anxiety that would, in turn, impair subsequent performance.

DO ENTITY THEORISTS PREFER NOT to IMPROVE?

Entity theorists, like everyone, should experience greater overall positive affect following improved performance compared with static performance. However, according to the present model, the epistemic disorientation created by unanticipated success means that for entity theorists, this joy will be mingled with anxiety. Thus, entity theorists' "preference" for static performance is predicted to be only *relative to incremental theorists*, with affective consequences limited to *anxiety*.

Similar logic applies to our hypotheses regarding static performance. Clearly, incremental theorists, like anyone, should generally experience greater overall negative affect (e.g., sadness, shame, anger) after declining performance than after static performance. A decline is, after all, farther from the desired outcome. However, with respect to self-prediction, stasis in the face of a learning opportunity may be more threatening to the incremental theory than to the entity theory. Why? Given their stronger belief in the efficacy of effort and toil (Blackwell et al., 2007; Hong et al., 1999), incremental theorists are more likely to view a decline as a painful but necessary prelude to success (i.e., "one step back to go two steps forward"). Indeed, recent studies have shown that incremental theorists assign high utility to, and express high interest in, negative performance feedback, despite its psychological pain (Trope, Gervy, & Bolger, 2003). In contrast, a lack of movement of any kind is more ambiguous regarding the effectiveness of their strategy and provides less diagnostic information regarding their strengths and weaknesses. Note that incremental theorists do not believe that performance is inherently variable. Instead, it is only when outcomes are perceived to be *overly static* that one should observe a threat to incremental theorists' sense of self-understanding.

Study 1

Overview

To test these hypotheses, participants performed a novel task that was ostensibly an indicator of an important kind of intelligence. After receiving a predetermined mid-level score, they were provided with a learning opportunity purportedly intended to boost their score. After a second test, participants received feedback indicating that their performance had improved, remained the same, or declined. (In the present studies, this feedback information was presented to participants in the form of percentile score. We chose this form of feedback because college students often

find such normative information especially useful for assessing their performance; e.g., Butler, 2000; Grant & Dweck, 2003.) After this second round of feedback, we assessed affective and motivational responses. As noted, the experience of theory violation was predicted to yield a systematic increase in only anxiety (and not other negative emotions such as sadness or anger).

Theory violation was also predicted to influence participants' subsequent information-processing thoroughness. Previous research on prediction and control motivation has found that when people experience a subjective decline in their ability to predict outcomes, they initiate more methodical information gathering in the name of reasserting their sense of prediction confidence (e.g., Pittman & D'Agostino, 1989; Weary, Jacobson, Edwards, & Tobin, 2001). According to the present model, theory violation undermines one's sense of prediction and control confidence. Thus, when incremental theorists learn that their performance has not changed (despite the desire and opportunity), they should initiate more methodical information gathering. Similarly, when entity theorists learn that their performance has significantly declined or improved, they should experience an analogous increase in effort on the control estimation task.

Method

Pretesting Battery

In a pretesting battery session (at least 1 week prior to the experimental session), participants completed the 8-item Implicit Theories Questionnaire (intelligence version; Dweck, 1999) to identify a relative preference for the entity theory or the incremental theory. Items on this measure ask participants to rate their level of agreement (on 1–6 scales) with statements such as "Intelligence is something basic about a person that cannot be changed." Responses to the eight items are averaged, after reverse scoring where necessary, to create an index for each participant. Scores can range from 8 (*most entity*) to 48 (*most incremental*). (For further information regarding the reliability and validity of the measure, see Levy, Stroessner, & Dweck, 1998.) Although this variable is represented by a continuous measure in the analyses reported below, for ease of exposition we refer to those with higher scores as *incremental theorists* and those with lower scores as *entity theorists*.

In addition, participants completed the Rosenberg (1965) Self-Esteem Scale. We included the Self-Esteem Scale as a covariate in the analyses below to test whether lay theories were statistically independent of this known predictor of reactions to success and failure (e.g., Brown & Dutton, 1995). (For discussions and examples of lay theories' conceptual and empirical independence from self-esteem, see Dweck, 1999; Dweck et al., 1995; Niiya et al., 2004.)

Experimental Session

A total of 118 University of Washington undergraduates (77 women and 41 men) participated in exchange for extra course credit. Two participants failed feedback manipulation checks and are thus excluded from the analyses. Note that the degrees of freedom reported below vary from measure to measure because not all participants completed all measures.

Procedure

At the outset, participants completed a series of questions to assess baseline affect and expectancy levels. The affect measure asked participants to rate (on 1–7 scales) the degree to which they were currently experiencing 18 different emotions. The emotions were associated with one of three dimensions: happiness-sadness, agitation-relaxation, and feelings of self-worth. The first two dimensions reflect the core dimensions of Higgins's (1997) regulatory focus theory. The third dimension reflects self-aware emotions described by Brown and colleagues in their work on success and failure (e.g., Dutton & Brown, 1997). This particular measure combining the Higgins and Brown frameworks has proved effective in distinguishing between different types of positive and negative affect elicited by success and failure (e.g., Marshall & Brown, 2006).

The expectancy measure asked participants to provide 1–7 ratings for the following items: "How good or bad do you expect your performance to be?" "How accurately do you think this test will measure your ability?" "How hard do you expect to try on the test?" "How important is it to be good at what this test measures?" "What percentile score will you realistically strive for?" "What percentile score do you think you will get?" "What would be the lowest percentile score you would be satisfied with?" and "How much do you think you will enjoy doing this test?"

Test 1. Participants were seated at computers. As part of the cover story, participants were told that they would perform a series of tests meant to measure "Integrative Orientation," ostensibly an important kind of intelligence (e.g., Brown, 1990). The task was actually a Remote Associations Test (Mednick, 1962) comprising 10 items in which the aim is to find the commonality among three words (e.g., BOOK-HOOK-APPLE [answer: WORM]). Prior pilot testing was conducted to generate versions of the test that yield a mean score of approximately 5.0. This was done to reduce the likelihood of ceiling or floor effects on participants' responses. Following a series of practice trials, participants were presented sequentially with the 10 problems comprising Test 1. Participants were free to take as long as they wished before pressing *Enter* to move to the next problem.

Feedback 1. After completing Test 1, the computer took 20 s to "calculate" each participant's score in terms of percentile rank (relative to hundreds of University of Washington students who were purported to have taken the test previously). The computer indicated to all participants that they had scored in the 61st percentile. This was a value that, according to pilot testing, students find both plausible and psychologically neutral (Plaks, 2004). Following both this round of feedback and the second round, participants completed a short manipulation check measure assessing the degree to which they found the feedback believable.

Post-Feedback 1 affect. At this point, participants completed the affect measure. (This post-Feedback 1 self-rating of emotion was later used as a covariate in the analyses, as described below.)

Lesson. Participants were presented with "A Lesson in Integrative Orientation"—a list of actual tips and practice exercises. (e.g., "When you think of an associate for one clue, think of alternative possible meanings for that word. For example, for SURPRISE-LINE-BIRTHDAY, 'party' means both a celebration and a political group. Thus, you have 'surprise party' and 'party line'.") Pilot testing demonstrated that participants find these tips

plausible and helpful. The purpose of the "lesson" was to introduce the possibility of improvement on a subsequent test.²

Test 2. Participants took a second "Integrative Orientation" test, consisting of different but equally difficult items.

Feedback 2. Participants were randomly assigned by the computer to one of three feedback conditions. Thirty-two participants received 91st percentile feedback (representing an improvement), 46 received 62nd percentile feedback (representing no change), and 38 received 29th percentile feedback (representing a decline). Pilot testing (Plaks, 2004) had established these percentile values as both plausible and psychologically impactful. Note that this second round of feedback allows each participant's theory of change or stasis to be put to the test.

Post-Feedback 2 affect. Participants completed the affect measure again to assess any differences in affect following Feedback 2 compared with following Feedback 1. This was one of two principal dependent measures.

Control estimation task. The second dependent measure was the thoroughness of participants' subsequent information gathering. The procedure for assessing this was modeled on one described by D'Agostino and Pittman (1982). Participants were prepared for what was ostensibly an unrelated task by another experimenter. Instructions stated that on each trial, they would see a row of As on the screen. On each trial, after a "3 . . . 2 . . . 1" countdown, participants were to press or not press the space bar and then observe what happened. Following their response (or nonresponse), the As would either turn into Bs or not. Participants' task was to estimate the percentage of trials on which they had control over whether the As turned into Bs. (The actual level of control was set at 35%; D'Agostino & Pittman, 1982.) Participants were encouraged to sample both the "press" and "not-press" options. They were further instructed that they could take as few or as many trials as they needed before quitting the task (by pressing the *ESC* key) and rendering their percentage judgment. The dependent measure of interest was the number of trials taken by each participant before quitting. (The program was set to end after a 100-trial limit.) Consistent with D'Agostino and Pittman (1982), we assumed that more trials indicated more effort to assess one's level of control.³ Following the last trial, all participants indicated their estimate of control on a scale ranging from 0% (*no control*) to 100% (*complete control*).

A timeline of the full procedure is depicted in Figure 2. At the conclusion, participants were given a full debriefing describing the hypotheses as well as the need for temporary deception.

Hypotheses. Feedback indicating dramatic change from Test 1 to Test 2 (either a decline or an improvement in performance) should violate the entity theory more than the incremental theory. In contrast, unchanging performance despite a learning opportunity should violate the incremental theory more than the entity theory. Thus, we predicted that entity theorists would evince

² These materials are available upon request from Jason E. Plaks.

³ In previous research, control-deprivation was less likely to produce intensified information gathering if (a) participants felt that enhanced effort would not yield improved performance or (b) failure could be attributed to external factors (D'Agostino & Pittman, 1982; Snyder, Stephan, & Rosenfield, 1976). Care was taken in the instructions to ensure that these circumstances were not present in the current studies.

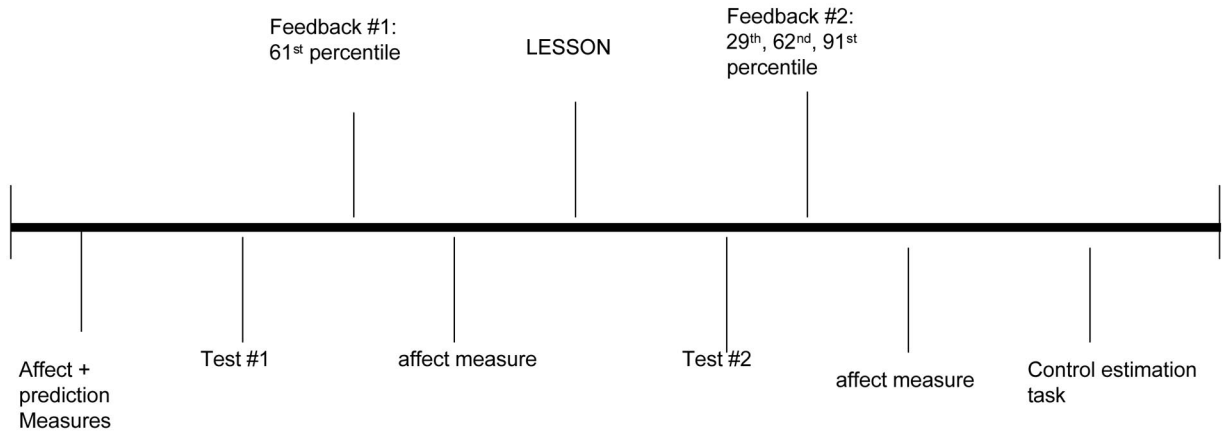


Figure 2. Procedure timeline in Study 1.

higher anxiety and take more control estimation trials than incremental theorists when faced with a dramatic decline or improvement, but incremental theorists would evince higher anxiety and take more trials than entity theorists when faced with static performance.

Results and Discussion

Responses to the Implicit Theories Measure

Participants' responses to the eight items on the Implicit Theories Measure (ITM) were averaged, after reverse scoring where necessary, to create an index for each participant (Cronbach's $\alpha = .92$). The normally distributed scores ranged from 8 to 46 ($M = 30.55$, $SD = 8.87$), with higher scores indicating more incremental beliefs. As noted, participants' self-esteem was also assessed using the Rosenberg (1965) Self-Esteem Scale ($M = 18.59$, $SD = 4.48$; Cronbach's $\alpha = .60$). As in previous research, the ITM did not correlate significantly with the self-esteem measure in this study or in any of the other studies reported here (all r s $< .18$).

Control Estimation Data

To examine the influence of feedback and lay theory on number of trials taken, we centered the values and conducted a regression analysis in which number of trials was predicted from the ITM score, feedback (decline, no change, improvement), the ITM \times Feedback interaction term, as well as participants' self-esteem score and the interaction term Self-Esteem \times Feedback.⁴ This analysis revealed a near significant ITM main effect ($\beta = .52$), $t(97) = 1.90$, $p = .06$, and the predicted ITM \times Feedback interaction ($\beta = .57$), $t(97) = 2.15$, $p < .05$. The raw means are depicted in Figure 3A, with the entity incremental variable presented in a dichotomous fashion for presentational clarity.

To investigate the nature of this interaction, simple slopes were estimated at scores of -1 standard deviation and $+1$ standard deviation from the mean of the ITM score distribution, representing agreement with the entity or incremental theory, respectively. These analyses confirmed that entity theorists took fewer trials following static performance than following declining performance ($\beta = .58$), $t(104) = 5.71$, $p = .01$, and improving perfor-

mance ($\beta = .41$), $t(104) = 3.68$, $p < .05$. Incremental theorists, in contrast, displayed a mirror image of this effect: more trials following static performance than declining performance ($\beta = .87$), $t(104) = 8.31$, $p < .001$, and improving performance ($\beta = .80$), $t(104) = 7.61$, $p < .001$.

Testing our primary hypothesis, there was a significant effect for ITM within each feedback condition. Entity theorists took more trials than incremental theorists in the decline condition ($\beta = .65$), $t(104) = 6.09$, $p < .001$, and improvement condition ($\beta = .42$), $t(104) = 3.14$, $p < .05$, whereas incremental theorists took more trials than entity theorists in the static performance condition ($\beta = .92$), $t(104) = 8.25$, $p < .001$.

In summary, the pattern was consistent with our hypothesis. This pattern is analogous to previously published data in which participants observed another person exhibit no change or dramatic change (Plaks et al., 2005, Experiment 3). The present data indicate that this phenomenon extends to cases when people experience change or stasis in their own performance.

Affect Data

As noted, participants provided momentary ratings (1 = *not at all* . . . 7 = *extremely*) for 18 different emotions at the start of the experiment, after Feedback 1, and after Feedback 2. Post-Feedback 2 affect was the dependent measure of interest; this was the point at which participants knew their scores on both Test 1 and Test 2.

An exploratory principal-component analysis on participants' post-Feedback 2 emotion ratings (using varimax rotation and eigenvalues greater than 1.0) yielded five factors (accounting for 36.50, 9.22, 8.08, 6.58, and 6.30 percent of the total variance, respectively). One of these factors clearly contained only anxiety-related emotions ("anxious," "uneasy," "uncomfortable," and "bothered"). Thus, an anxiety index was created by taking the mean of participants' responses to these four emotions.

⁴ A similar analysis that included participant gender revealed so significant effects involving gender. Likewise, gender did not influence the results in any of the subsequent studies. Thus, gender is not discussed further.

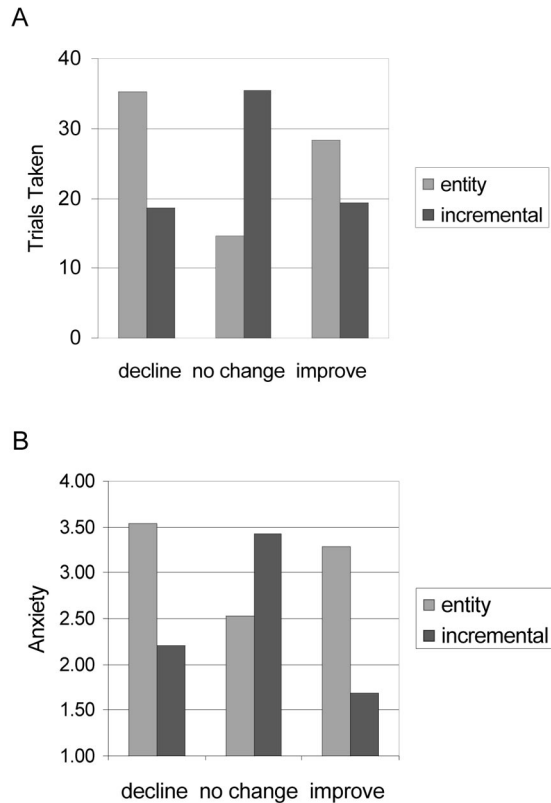


Figure 3. A: Mean trials taken on control estimation task as a function of type of feedback and participants' lay theory in Study 1. B: Self-reported anxiety as a function of type of feedback and participants' lay theory in Study 1.

With this anxiety index as the dependent measure, we found no significant relationship between participants' ITM score and baseline (preexperiment) anxiety or post-Feedback 1 anxiety (both $r_s < .10$). Thus, entity and incremental theorists did not differ in anxiety prior to Feedback 2. Because entity and incremental theorists did not differ on post-Feedback 1 anxiety, and because we were primarily concerned with participants' affect following the cumulative effect of both rounds of feedback, we included post-Feedback 1 anxiety (rather than preexperiment anxiety) as a covariate in the analyses to follow.

To test whether theory violation would increase anxiety after the second round of feedback, we centered the values and conducted a multiple regression analysis in which participants' post-Feedback 2 anxiety was predicted from the ITM score, feedback, ITM \times Feedback, and the covariates self-esteem score, Self-Esteem \times Feedback, and Post-Feedback 1 anxiety. This analysis revealed a significant main effect for ITM score ($\beta = .58$), $t(97) = 2.25$, $p < .05$, indicating that entity theorists reported more post-Feedback 2 anxiety than incremental theorists overall. More important, the predicted ITM Score \times Feedback interaction approached significance ($\beta = .48$), $t(97) = 1.87$, $p = .06$.

To test the nature of the interaction, simple slopes were estimated at scores of -1 standard deviation and $+1$ standard deviation from the mean ITM score. The comparisons are depicted in Figure 3B. Entity theorists evinced lower scores on the anxiety

index following static feedback than declining feedback ($\beta = .54$), $t(101) = 4.22$, $p < .01$, and improving feedback ($\beta = .31$), $t(101) = 2.64$, $p = .01$. In contrast, incremental theorists reported significantly more anxiety following static feedback than declining ($\beta = .67$), $t(101) = 5.70$, $p < .01$, and improving feedback ($\beta = .65$), $t(101) = 5.32$, $p < .01$.

Within each feedback condition, we found the predicted effect for the ITM score. Entity theorists reported more anxiety than incremental theorists in the decline condition ($\beta = .60$), $t(101) = 5.58$, $p < .01$, and the improvement condition ($\beta = .42$), $t(101) = 2.88$, $p < .05$, whereas incremental theorists reported more anxiety than entity theorists in the static performance condition ($\beta = .69$), $t(101) = 6.04$, $p < .01$. Comparing Figure 3A and 3B, it is evident that the anxiety pattern paralleled the control estimation measure.

In addition, although nonanxiety-related emotions such as, "sad," "disappointed," and "unhappy" all showed significant main effects for feedback in the predicted direction (e.g., more unhappiness after a decline than after no change and after improvement; all $\beta_s > .30$, $p_s < .05$), the Theory \times Feedback interactions were not reliable for these emotions (all $\beta_s < .25$, $p_s > .10$). It is not surprising (and, indeed, is a form of manipulation check) that participants overall became "unhappier" following a decline compared with no change or improvement. However, entity and incremental theorists did not differ on these nonanxiety emotions.

Thus, incremental theorists do not generally prefer a decline to no change, and entity theorists do not generally prefer stasis to improvement. After all, across a variety of negative emotions (e.g., unhappiness, dejection), poorer performance affected entity and incremental theorists equally. As predicted, however, the lone exception was anxiety. This points to the unique effects of theory violation on anxiety in particular.

Thus far, we have shown that entity and incremental theorists display different patterns of (a) trials taken on the control estimation task and (b) post-Feedback 2 anxiety. Is the relationship between theory violation and control estimation trials mediated by anxiety?

Mediational Analysis

To test this mediational hypothesis, regression analyses were performed following the steps outlined by Baron and Kenny (1986). In Step 1, a regression analysis with trials as the dependent variable and ITM, feedback, self-esteem, ITM \times Feedback, and Self-Esteem \times Feedback as the independent variables revealed a significant effect for the ITM \times Feedback interaction term ($\beta = .57$, $p < .05$). In Step 2, post-Feedback 2 anxiety was substituted as the dependent variable, and post-Feedback 1 anxiety was added as a covariate. This revealed an effect for ITM \times Feedback that approached significance ($\beta = .43$, $p = .08$). In Step 3, a regression analysis with trials as the dependent variable and post-Feedback 2 anxiety, ITM, feedback, self-esteem score, ITM \times Feedback, and Self-Esteem \times Feedback as the independent variables found a significant path between anxiety and trials taken ($\beta = .50$, $p < .001$), but a significantly reduced direct path between ITM \times Feedback and trials, such that it was no longer significant (Goodman test: $Z = 1.99$, $p < .05$). It is worth noting that although the direct path between Theory \times Feedback and trials was significantly reduced, it continued to approach significance ($\beta = .46$, $p = .06$), suggesting that the mediating effect of anxiety was not

complete. It is likely that other (unmeasured) variables would be needed in the design to reduce the value of the direct path even further. Nevertheless, analogous analyses conducted with nonanxiety emotions did not suggest comparable evidence of mediation (i.e., at least one critical leg of the mediational model was not significant). Taken together, these analyses suggest that the experience of theory violation induces anxiety that, in turn, contributes to more methodical processing. The mediational model for Study 1 is presented in Figure 4 (top panel).

Expectancy Data

Entity and incremental theorists did not differ in their a priori (pretask) ratings of (a) how well they expected to perform on the task ($M = 4.84$, $SD = 0.97$), (b) how accurately they believed the test would measure their integrative orientation ability ($M = 4.22$,

$SD = 1.04$), (c) how hard they expected to try ($M = 4.69$, $SD = 0.95$), (d) how important it was to be good at integrative orientation ($M = 4.70$, $SD = 1.07$), (e) how much they would enjoy the task ($M = 67.28$, $SD = 15.27$), and (f) their percentile score level of aspiration ($M = 76.08$, $SD = 16.28$; all $ps > .45$). (Items a–d were on 1–7 scales; Items e–f were percent estimates.) Thus, a priori differences between entity and incremental theorists in expectancies could not explain the observed pattern.

Summary

In summary, the Study 1 data provide evidence that people do not react uniformly to declining, static, and improving performance. Rather, different starting assumptions about the mutability of intelligence lead people to assign different meanings to different kinds of feedback. Dynamic performance (whether for worse or for better) violated the entity theory, whereas rigidly static performance (no improvement despite the opportunity and motivation) violated the incremental theory.

Readers familiar with the literature on the entity and incremental theories may find these data counterintuitive in that the incremental theory has been uniformly depicted as the more adaptive theory (e.g., Beer, 2002; Blackwell et al., 2007; Cury et al., 2006; Dweck, 1999, 2006; Hong et al., 1999; Niiya et al., 2004; Robins & Pals, 2002). The present data are, in fact, consistent with previous findings in that incremental theorists expressed a less anxious reaction to failure (i.e., declining performance). At the same time, however, the incremental theory is not entirely free of costs—particularly when performance acquires the appearance of being “stuck.” Like entity theorists, the experience of theory violation causes incremental theorists to display measurable signs of anxiety and control deprivation.

If the entity and incremental theories truly are knowledge structures that establish meaning systems for motivational striving (Molden & Dweck, 2006), then it should be possible to situationally activate each theory and obtain effects similar to those in Study 1. Moreover, if striving for prediction confidence is truly an important aspect of motivated behavior, then similar effects should be obtained even using a different type of achievement task. These questions are addressed in Study 2.

Study 2

In several studies, experimenters have successfully induced the entity and incremental theories (e.g., Chiu et al., 1997, Experiment 5; Hong et al., 1999; Levy et al., 1998, Experiment 4; McConnell, 2001, Experiment 2; Plaks et al., 2001, Experiment 3; Poon & Koehler, 2006). This typically has been accomplished by having participants read persuasive written materials espousing either the entity theory or incremental theory (see the *Experimental Session* section below).

One might wonder how a person who is a chronic entity or incremental theorist may be so easily persuaded to adopt the contrary theory. The emerging approach suggests that although most people have a preference for one theory or the other, both theories are widely intuitive (see Plaks et al., 2005; Poon & Koehler, 2006). Consider, for example, that one common idiomatic expression, “a leopard never changes its spots,” reflects the entity perspective, whereas another, “turning over a new leaf,”

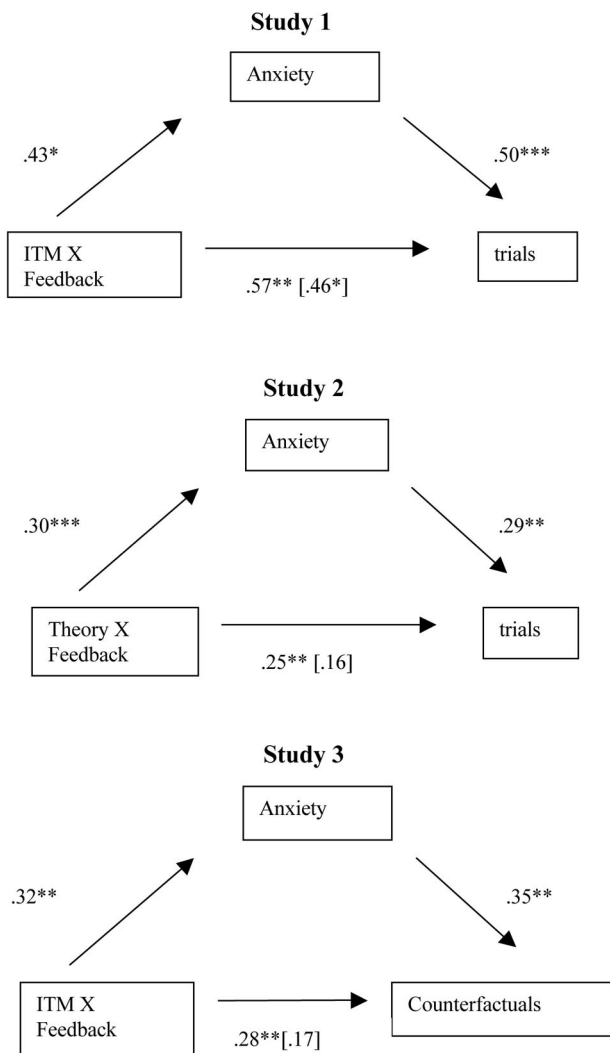


Figure 4. The relationships among lay theory (Implicit Theories Measure; ITM), feedback, anxiety, and compensatory effort in Studies 1–3. Bracketed values refer to the direct effect of the independent variable on the dependent variable when the mediator is included in the analysis. * $p < .10$. ** $p < .05$. *** $p < .001$.

reflects the incremental perspective. It appears that, above all, people wish to avoid being left “theory-less.” When faced with theory-violating information only—and no viable alternative theory—people react negatively and try to resist the change (Plaks et al., 2005). However, when provided with a persuasive, “scientifically validated” alternative, people are generally more willing to accept the alternative, at least for the short term (e.g., Chiu et al., 1997; Levy et al., 1998; McConnell, 2001). If the effects described in Study 1 could be obtained simply by activating either theory in participants’ mind, then this would provide evidence of the causal role played by lay theories in the motivational phenomena outlined in this article.

A second purpose of Study 2 was to investigate whether the findings of Study 1 would extend to a new achievement task. If so, then this would demonstrate that the effects found in Study 1 were not restricted to the Remote Associations Test. The Study 2 task was described to participants as a “subliminal visual perception” task, in which letters were flashed very briefly on the computer screen. Participants were to report what letters were flashed. This task was hypothesized to be well suited for the present purposes because its difficulty and novelty would mean that participants would have few and poorly defined intuitions about the task and their progress. Thus, experimenter provided feedback would be readily believed.

Method

Participants

One hundred forty-six University of Washington undergraduates (91 women and 55 men) participated in exchange for extra course credit.

Battery Session

In a questionnaire battery session at least 1 week prior to the experimental session, participants completed the ITM (Cronbach’s $\alpha = .90$), a measure of academic self-efficacy (Zimmerman, Bandura, & Martinez-Pons, 1992; Cronbach’s $\alpha = .72$), and the Rosenberg (1965) Self-Esteem Scale (Cronbach’s $\alpha = .64$), among other measures not relevant to the present study.

Experimental Session

In what was ostensibly a reading comprehension task, the experimenter gave participants a mock article—complete with color photos and graphs—that had ostensibly been published in a recent popular psychology magazine. (For recent successful examples of this method of theory induction, see McConnell, 2001; Niiya et al., 2004; Plaks et al., 2001, Study 3.⁵) Participants were randomly assigned to read one of two versions. The incremental version, entitled “You Can Become a New Person,” presented research suggesting that basic personality characteristics such as intelligence can be altered through effort and experience. The entity version, entitled “Can You Really Become a New Person?” presented research suggesting that personality characteristics are stable, despite effort and experience. The same types of evidence (longitudinal studies, case studies, and intervention programs) were described in both articles, although the findings were altered to support either the entity position or the incremental position.

Although these articles quite thoroughly addressed the entity and incremental positions, they made no reference to dependent measures later used in the present study. After reading the article, participants completed items about the understandability and interest level of the article as well as the manipulation check item, “To what extent do you believe that a person’s traits or characteristics are stable?” (1 = *not at all stable*, 9 = *extremely stable*).

Subliminal visual perception. Next, in what was purported to be a separate experiment by another researcher, participants were told that they would perform a series of tests meant to measure “subliminal visual perception,” described as an important life skill. Instructions noted that the task is difficult and that even if they thought they did not see any of the letters, they should nevertheless guess because, “. . . you may be surprised how perceptive your subliminal vision is.” (In fact, this turned out to be the case; participants who claimed not to see any of the letters performed better than chance.) At this point, participants completed the same baseline affect and expectancy items as in Study 1.

Test 1. Each trial consisted of a forward mask of “*pound signs*” presented for 300 ms, followed by three random letters (e.g., *ghr*) presented for 64 ms, followed by a backward mask of “*pound signs*” that persisted until participants began their response. These duration parameters made it difficult for most participants to detect the target letters. After each trial, an open-ended response space appeared on the screen, into which participants were to type letters. After 10 acclimating trials, participants completed Test 1, which consisted of 10 experimental trials.

Feedback 1. As in Study 1, all participants received 61st percentile feedback. Following both this round of feedback and the second round, participants completed a short manipulation check measure assessing the degree to which they found the feedback believable. At this point, participants completed the post-Feedback 1 affect measure.

Lesson. Participants were presented with “A Lesson in Subliminal Visual Perception.” This was a list of tips and practice exercises, ostensibly grounded in research from the laboratory, that were touted as highly effective. (e.g., “Scan the stimuli with your eyes unfocused, i.e., intentionally somewhat blurry” and “Do not expect any colors except for the black and white of the computer screen. The expectation of other colors can interfere with your visual processing.”⁶) Prior pilot testing demonstrated that participants found these tips plausible and helpful. The purpose of the “lesson” was to introduce the possibility of improvement on a subsequent test.

Test 2. Participants then took a second “Subliminal Visual Perception” test of 10 items.

Feedback 2. As in Study 1, the computer randomly assigned participants to the 29th percentile ($n = 40$), 62nd percentile ($n = 49$), or 91st percentile ($n = 48$).

Post-Feedback 2 affect. Participants completed the affect measure again.

Control estimation task. As in Study 1, participants were asked to take as many trials as necessary before they felt they had detected the relationship between their bar presses and the change of the letters of the computer screen. At the conclusion, partici-

⁵ These materials are available upon request from Jason E. Plaks.

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pants were given a full debriefing describing the theory and hypotheses as well as the need for temporary deception.

Hypotheses. We expected the theory manipulation to yield effects equivalent to that of chronic theories: Entity theorists would take more trials and evince higher anxiety than incremental theorists when faced with a dramatic decline or improvement in performance, but incremental theorists would take more trials and experience higher anxiety than entity theorists when faced with unchanging performance.

Results and Discussion

Manipulation Check for Lay Theories Induction

Of the participants, 72 received the entity induction, and 64 received the incremental induction. Analyses of participants' responses to the principal manipulation check item ("How stable do you believe personality characteristics are?" on a 1–9 scale) indicated that the induction articles successfully manipulated person theories. Participants who received the entity induction were more likely to believe that traits are stable ($M = 6.97$) than were participants who received the incremental induction ($M = 2.91$), $F(1, 135) = 186.47, p < .001$. Both means differed significantly from the midpoint of the scale (5.0), $t(71) = 6.40, p < .001$, for those receiving the entity article, and $t(63) = 2.92, p < .01$, for those receiving the incremental article. There were no significant differences between the entity and incremental conditions on questions about the comprehensibility, credibility, or persuasiveness of the article. In addition, because we collected participants' chronic theory in the prior battery session, it was possible to examine whether chronic entity and incremental theorists differed in their receptivity to the entity or incremental induction, as gauged by their response to the primary manipulation check question (regarding the stability of personality). Participants' responses on the stable/malleable question were submitted to a 2 (chronic theory: entity vs. incremental) \times 2 (manipulated theory: entity vs. incremental) analysis of variance (ANOVA). This analysis revealed a strong main effect for manipulated theory, $F(1, 131) = 102.77, p < .001$, but no significant interaction, $F(1, 131) = 0.37, ns$, indicating that participants' chronic theory did not influence their receptivity to either article. Thus, the theory manipulation articles appeared to activate both theories effectively by temporarily superseding participants' chronic predisposition.

Control Estimation Data

To test whether theory violation would provoke more methodical information gathering on the control estimation task, the number of trials taken by each participant was submitted to a 2 (theory: entity vs. incremental) \times 3 (feedback: decline, no change, improve) analysis of covariance (ANCOVA), with participants' self-esteem score and self-efficacy score included as covariates. Replicating Study 1, this analysis revealed only a near significant Theory \times Feedback interaction, $F(2, 129) = 2.97, p < .06$. There were no significant effects involving self-esteem, self-efficacy, or their interactions with feedback.

What was the nature of the Theory \times Feedback interaction? As in Study 1, entity theorists took marginally more trials than incremental theorists in the decline condition, $F(1, 133) = 3.10, p <$

.08. The pattern in the other two conditions, though not reaching standard levels of significance, was in the predicted direction. The overall pattern (presented in Figure 5A) conformed to the pattern of Study 1, this time substituting manipulated theories for chronic theories.

Affect Data

As in Study 1, an anxiety index containing participants' post-Feedback 2 scores on "anxious," "uneasy," "uncomfortable," and "bothered" emerged from the same factor analytic procedures used in Study 1. Participants' scores on the anxiety index were submitted to a 2 (theory: entity vs. incremental) \times 3 (feedback: decline, no change, improve) ANCOVA, with post-Feedback 1 anxiety index, self-esteem score, and self-efficacy score included as covariates. This analysis revealed a significant Theory \times Feedback interaction, $F(2, 130) = 6.19, p < .01$.

As in Study 1, in the decline condition, entity theorists ($M = 3.42$) evinced more anxiety than did incremental theorists ($M = 2.60$), $F(1, 135) = 3.57, p = .06$. In the no-change condition, however, it was incremental theorists ($M = 3.37$) who exhibited marginally greater anxiety than entity theorists ($M = 2.72$), $F(1, 135) = 2.89, p = .09$. Finally, in the improvement condition, entity theorists reported significantly more anxiety ($M = 3.01$) than did incremental theorists ($M = 2.18$), $F(1, 135) = 4.81, p < .05$. Thus,

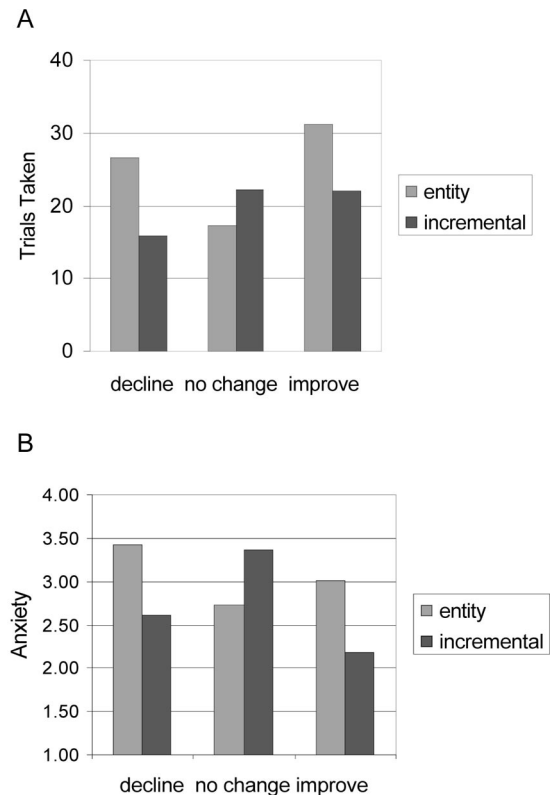


Figure 5. A: Mean trials taken on control estimation task as a function of type of feedback and participants' lay theory in Study 2. B: Self-reported anxiety as a function of type of feedback and participants' lay theories in Study 2.

the overall anxiety pattern (presented in Figure 5B) replicated that of Study 1.

As in Study 1, although there were significant main effects for feedback in the predicted direction on several nonanxiety emotion dimensions (e.g., unhappiness, sadness, ashamed), there were no significant Theory \times Feedback effects (all F s $<$ 2.50). Thus, the effect of theory violation on emotion was again restricted to anxiety.

Mediational Analysis

To test whether anxiety would again mediate the relationship between Theory \times Feedback and trials taken on the control estimation task, regression analyses were performed in a fashion analogous to Study 1. However, unlike Study 1, the theory variable in the present study was manipulated and thus dichotomous. Given that static feedback violates the incremental theory and dynamic feedback violates the entity theory, we created a new dichotomous variable ("Theory \times Feedback"), with -1 representing theory-confirming feedback, and 1 representing theory-violating feedback, applied to all participants (see Plaks et al., 2005, for a similar instance of this procedure). In Step 1, a regression analysis with trials as the dependent variable and theory, feedback, self-esteem, self-efficacy, Self-Esteem \times Feedback, Self-Efficacy \times Feedback, and Theory \times Feedback as the independent variables revealed a significant effect for Theory \times Feedback ($\beta = .25, p < .05$). In Step 2, a regression analysis that substituted post-Feedback 2 anxiety as the dependent variable and added post-Feedback 1 anxiety as a covariate likewise revealed a significant effect ($\beta = .30, p < .001$). In Step 3, a regression analysis with trials as the dependent variable and post-Feedback 2 anxiety included with theory, feedback, self-esteem, self-efficacy, Self-Esteem \times Feedback, Self-Efficacy \times Feedback, and Theory \times Feedback as independent variables found a significant effect of anxiety on trials ($\beta = .29, p < .05$), but a significantly reduced effect of Theory \times Feedback effect on trials (Goodman test: $Z = 2.18, p < .05$). This pattern replicates the mediational model found in Study 1 (theory violation \rightarrow anxiety \rightarrow trials). Analogous analyses conducted with nonanxiety emotions did not suggest comparable evidence of mediation (i.e., at least one critical leg of the mediational model was not significant). The mediational model for Study 2 is presented in Figure 4 (middle panel).

Expectancy Data

As in Study 1, entity and incremental theorists did not differ in their a priori (pretask) ratings on any of the expectancy items (all t s $<$ 1.50). Thus, a priori differences in expectancies could not explain the observed pattern.

In summary, the effects of theory violation on anxiety and prediction and control motivation found in Study 1 were generally replicated in Study 2 when theories were manipulated. These data suggest that lay theories are not merely correlated with different reactions to declining, static or improving performance. Rather, the activation of either theory establishes a distinct meaning framework through which performance feedback is interpreted (Molden & Dweck, 2006).

Study 3

One purpose of Study 3 was to test whether the affective and motivational effects found in Studies 1 and 2 would translate into actual test performance. Of central importance to any research on motivation and achievement is the effect of attributional, affective, and motivational variables on subsequent performance output (e.g., Blackwell et al., 2007; Grant & Dweck, 2003; Lewin, Dembo, Festinger, & Sears, 1944). On the basis of the anxiety data of Studies 1 and 2, we hypothesized that the experience of theory violation would debilitate performance. Just as the arousal and anxiety engendered by stereotype threat contributes to impaired performance (Ben-Zeev et al., 2005; Blascovich et al., 2001), so too the anxiety engendered by theory violation may contribute to impaired performance. Thus, we measured participants' actual performance on a third test of equal difficulty.

The secondary purpose was to examine whether the effect would replicate with a distinct measure of compensatory effort to restore prediction confidence. Recall that in Studies 1 and 2, compensatory effort was measured with a control estimation task. Because of the indirect nature of the control estimation measure, as well as the centrality of the prediction and control construct to the present theorizing, it was important to triangulate this concept with multiple measures.

In Study 3, we used a counterfactual generation method. Markman and Weary (1996) asked participants to describe a negative life event (e.g., a poor grade on an important exam, a romantic break up) and to generate counterfactuals that would have improved the outcome. Judges who were blind to the independent variables rated these counterfactuals on whether they referred to controllable versus uncontrollable aspects of the situation. Markman and Weary found that mild depressives (i.e., people in a chronic state of control deprivation) generated more controllable counterfactuals than uncontrollable counterfactuals, whereas control participants generated equivalent amounts of both types. According to Markman and Weary's (1996) formulation, generating controllable counterfactuals may serve as a cognitive-affective "compensatory mechanism" (p. 308) through which depressives attempt to repair their damaged sense of prediction and control.

We hypothesized, likewise, that if the experience of theory violation precipitates a temporary sense of damage to prediction and control mastery, then those participants who receive theory-violating feedback should generate more controllable counterfactuals than participants who do not receive theory-violating feedback.

Method

Participants

One hundred four University of Washington undergraduates (79 women and 25 men) participated in exchange for extra course credit. Two participants failed manipulation checks regarding the feedback manipulation or evinced suspicion of the truthfulness of the feedback and are thus excluded from the analyses. Note that the degrees of freedom reported below vary from measure to measure because of occasional missing data.

Procedure

Battery session. In a questionnaire battery session at least 1 week prior to the experimental session, participants completed the ITM and the Rosenberg (1965) Self-Esteem Scale, among other measures used by other experimenters.

Experimental session. The procedure was identical to that of Study 2 except for the following: (a) Lay theories were measured (rather than manipulated) using the ITM and (b) after receiving the post-Test 2 feedback, participants completed the counterfactual generation task (described next). As in Studies 1 and 2, all participants received 61st percentile feedback following Test 1. Following Test 2, 35 participants were randomly assigned to receive 91st percentile feedback, 32 to the 62nd percentile, and 39 to the 29th percentile.

Counterfactual generation task. Participants read the following instructions:

We would like you to take a moment and recall a *negative* event that has happened to you in your life. The event should have these characteristics:

1. It should be a *moderately negative event* (it should have made you unhappy or upset you in some way—but please do not recall an event that was psychologically devastating).
2. It should involve you (events you only heard about, for example, don't count).
3. It should have happened recently (within the last year or so).
4. It should be an event that could possibly *happen to you again in the future* (e.g., taking an exam).⁷

After completing written descriptions of the event, participants indicated how negative they thought the event was (on a scale ranging from 1 [*not at all negative*] to 9 [*very, very negative*]) and how much control they felt they had over what happened to them (on a scale ranging from 1 [*none at all*] to 9 [*very, very much*]). This second item was a measure of precounterfactual control. In addition, participants completed other items rating their level of distress, optimism, responsibility, and satisfaction regarding the event on similar 1–9 scales.

Next, participants were asked to vividly imagine the event a second time for about 20–30 s and to list aspects of the event that could have improved the outcome. As in Markman and Weary (1996), participants were asked to make upward counterfactuals because thinking about how a negative event could have been worse carried the risk of unacceptable levels of psychological distress.

Next, embedded among numerous other items assessing confidence, preparedness for the future, responsibility, and satisfaction (on 1–9 scales), participants were asked to indicate how much control they felt they had over what happened to them (ranging from 1 [*none at all*] to 9 [*very, very much*]).

Test 3 Performance

Following the counterfactual generation task, participants completed a third “subliminal visual perception” test of equivalent difficulty. On each trial, participants were given the opportunity to type up to three letters that they believed were flashed on the screen. The computer recorded these responses. This allowed us to

tabulate how many letters participants correctly identified on each trial (0–3).

Results

Responses to the ITM

Participants' responses to the eight items on the ITM were averaged, after reverse scoring where necessary, to create an index for each participant (Cronbach's $\alpha = .90$). The normally distributed scores ranged from 8 to 48 ($M = 32.31$, $SD = 9.49$). Higher scores indicated more incremental beliefs. As in Studies 1–2, participants' Rosenberg (1965) Self-Esteem Scale score ($\alpha = .70$) was included in the analyses as a covariate.

Counterfactual Coding

Counterfactual statements generated by the participants were coded by two judges who were blind to the experimental conditions. The coding scheme, based on that of Markman and Weary (1996), focused on whether the event “could have been controlled by the actor at that time” versus “could not have been controlled by the actor at that time.” For example, counterfactuals that emphasized particular behavior (e.g., “If only I had worked harder . . .”) were coded as controllable, and counterfactuals that emphasized enduring, dispositional aspects of the self (e.g., “If only I wasn't so stupid . . .”) or uncontrollable aspects of the environment (“If only it hadn't been raining . . .”) were coded as uncontrollable. Interjudge agreement was $r = .88$. Disagreement was resolved through discussion.

Counterfactuals Generated

An initial analysis found no significant overall association between the ITM score and number of counterfactuals generated ($r = .08$). To test whether feedback condition would influence the relationship, we centered the values and conducted two separate regression analyses in which number of (a) controllable counterfactuals and (b) uncontrollable counterfactuals were predicted from the ITM score, feedback (decline, no change, improvement), $ITM \times Feedback$, self-esteem score, and $Self-Esteem \times Feedback$. There were no significant effects involving any of the independent variables on participants' generation of uncontrollable counterfactuals. Thus, uncontrollable counterfactuals are not discussed further.

For controllable counterfactuals, however, the analysis revealed main effects for ITM and feedback (both $\beta_s > .25$, $p < .05$) and the predicted $ITM \times Feedback$ interaction ($\beta = .28$, $t(101) = 2.01$, $p < .05$). The pattern of controllable counterfactuals generated is depicted in Figure 6A, with ITM represented dichotomously. As in Studies 1 and 2, comparisons of entity versus incremental theorists within each feedback condition yielded significant effects for the ITM score in the predicted direction in the

⁷ For reasons relating to their theoretical framework, Markman and Weary (1996) included an additional condition which stipulated that the event participants recalled could not possibly happen again in the future. Differences in counterfactuals generated were only evident in the “repeatable” condition. Thus, our design only involved a repeatable event.

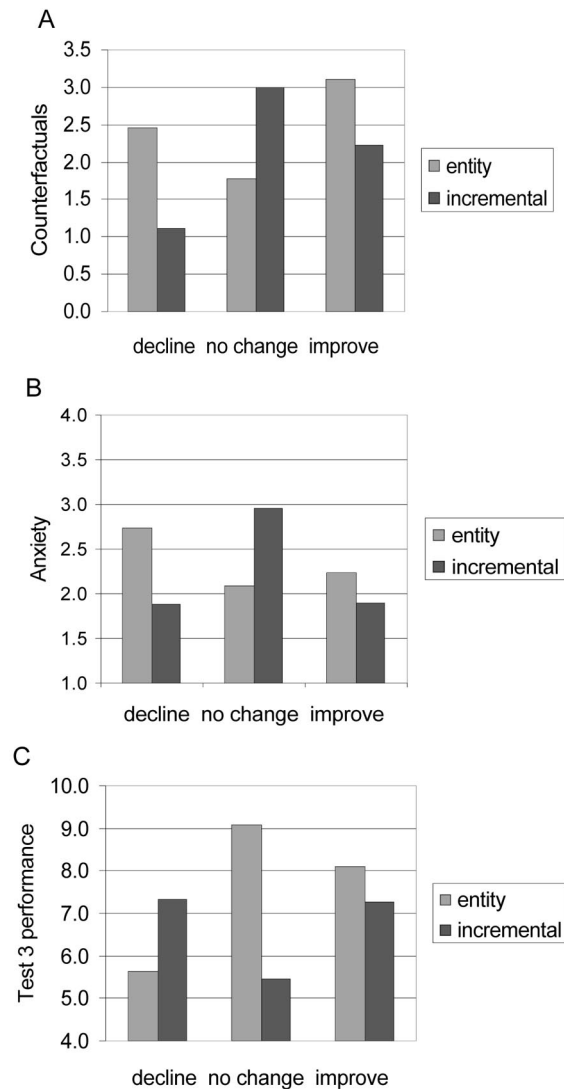


Figure 6. A: Mean controllable counterfactuals generated as a function of type of feedback and participants' lay theory in Study 3. B: Self-reported anxiety as a function of type of feedback and participants' lay theory in Study 3. C: Mean subliminal letters detected (out of maximum of 30) on Test 3 as a function of type of feedback and participants' lay theory in Study 3.

declining-feedback condition ($\beta = .73$, $t(105) = 5.89$, $p < .01$, and the static-feedback condition ($\beta = .76$, $t(105) = 5.12$, $p < .01$. In the improving-feedback condition, the effect, though in the predicted direction, fell short of significance ($\beta = .21$, $t(105) = 1.56$, $p = .12$).

Counterfactual Control Ratings

Initial analyses revealed no differences between entity and incremental theorists in how negatively they rated their recalled event, how much control they felt they had over the event prior to generating counterfactuals, and how much control they felt they had over the event after generating counterfactuals (all $ps \geq .50$).

Moreover, participants' statements of how much control they experienced did not differ as a function of feedback condition (decline, static, improvement), nor was the ITM \times Feedback interaction significant for either the pre- or postcounterfactual statement of control over the event. That is, entity and incremental theorists' claims of how much control they had over the event were not influenced by the type of feedback they had received in the subliminal visual perception task. This is consistent with Markman and Weary (1996), who found that most of the relevant effects involved the number of controllable counterfactuals generated, not participants' estimates of control.

In summary, the overall pattern of counterfactuals generated in Study 3 tracked the pattern of trials taken on the control estimation task in Studies 1 and 2. This replication occurred even though the tasks were superficially quite different from one another: one involved estimating whether As would change into Bs, whereas the second involved autobiographical memory. It appears that both dependent measures tap similar psychological processes involved in reasserting one's damaged sense of prediction confidence.

Affect Data

An anxiety index was generated from the same items used in Studies 1 and 2. Initial analyses found no significant relationship between the ITM score and baseline anxiety or post-Feedback 1 anxiety (both $rs < .14$, $ps > .15$). To test whether feedback condition would elicit increased post-Feedback 2 anxiety, a regression analysis was performed with post-Feedback 2 anxiety as the dependent measure and the ITM score, post-Feedback 1 anxiety, feedback, self-esteem score, and the ITM \times Feedback and Self-Esteem \times Feedback interaction terms as the independent variables. The pattern of postfeedback anxiety as a function of theory and feedback is presented in Figure 6B.

This analysis found the predicted ITM \times Feedback interaction ($\beta = .34$, $t(88) = 2.23$, $p < .05$. Simple slope analyses revealed that entity theorists displayed more anxiety in the decline condition than did incremental theorists ($\beta = .57$, $t(92) = 4.06$, $p < .001$, whereas incremental theorists displayed more anxiety in the static condition than did entity theorists ($\beta = .76$, $t(92) = 4.49$, $p < .001$. The difference between entity and incremental theorists was not as clear-cut in the improvement condition ($\beta = .19$, $t(92) = 1.27$, $p > .20$).

As in Studies 1 and 2, although there were significant main effects for feedback on many of the affect dimensions (e.g., "unhappiness"), there were no significant ITM \times Feedback effects for any of the nonanxiety emotions. Again, to the extent that there were entity-incremental differences in post-Feedback 2 emotion, these differences were restricted to anxiety.

Mediational Analysis

To test whether increased anxiety would mediate the effect of theory violation on the generation of controllable counterfactuals, we performed regression analyses analogous to those of Studies 1 and 2. In Step 1, a regression analysis with controllable counterfactuals as the dependent variable and ITM, feedback, self-esteem score, Self-Esteem \times Feedback, and ITM \times Feedback as the independent variables revealed a significant effect for the ITM \times Feedback term ($\beta = .28$, $t(101) = 2.00$, $p < .05$. In Step 2, a

regression analysis substituting post-Feedback 2 anxiety index as the dependent measure and adding post-Feedback 1 as a covariate also revealed a significant effect for the ITM \times Feedback term ($\beta = .32$), $t(101) = 2.26$, $p < .05$. Finally, an iteration with controllable counterfactuals as the dependent variable and post-Feedback 2 anxiety, ITM, feedback, self-esteem, Self-Esteem \times Feedback, and ITM \times Feedback as the independent variables found a significant path between post-Feedback 2 anxiety and controllable counterfactuals ($\beta = .35$), $t(101) = 3.69$, $p < .01$, whereas the direct path between ITM \times Feedback and controllable counterfactuals was significantly reduced (Goodman test: $Z = 1.93$, $p = .05$). As in Studies 1–2, the effect of the entity-incremental variable on the relationship between feedback and compensatory effort was mediated by anxiety. This is presented in Figure 4 (bottom panel).

Test 3 Performance

Recall that the performance dependent measure was the number of letters detected. Initial analyses revealed no relationship between the ITM and baseline letter detection (Test 1 $r = .09$) or letter detection after receiving the lesson (Test 2 $r = .12$). To test whether theory-violating feedback affected letter detection on Test 3, we conducted a regression analysis with letters detected as the dependent variable and the same independent variables as above, with Test 1 score and Test 2 score added as covariates. This analysis revealed the predicted ITM \times Feedback interaction ($\beta = .27$), $t(101) = 1.93$, $p = .05$. The means are presented in Figure 6C. Note that the maximum possible score was 30.

Comparing entity and incremental theorists within each feedback condition, incremental theorists performed better in the decline condition ($\beta = .50$), $t(105) = 3.87$, $p < .01$, and the improvement condition ($\beta = .51$), $t(105) = 3.71$, $p < .01$. In the static condition, however, entity theorists outperformed incremental theorists ($\beta = .81$), $t(105) = 5.24$, $p < .01$. As predicted, the experience of theory violation appeared to have an adverse effect on subsequent performance.

Mediational Tests Examining Feedback, Anxiety, and Performance

To test whether increased anxiety mediated the effect of theory violation on Test 3 performance, we again conducted three regression analyses. In Step 1, a regression analysis with Test 3 performance as the dependent variable and ITM, feedback, self-esteem, Self-Esteem \times Feedback, and ITM \times Feedback as the independent variables revealed a significant effect for the ITM \times Feedback term ($\beta = .27$), $t(101) = 2.00$, $p = .05$. In Step 2, a regression analysis that substituted post-Feedback 2 anxiety index as the dependent measure and added post-Feedback 1 anxiety as a covariate revealed a significant effect for ITM \times Feedback ($\beta = .32$), $t(101) = 2.26$, $p < .05$. Finally, an iteration with Test 3 performance as the dependent variable and post-Feedback 2 anxiety, ITM, feedback, self-esteem, Self-Esteem \times Feedback, and ITM \times Feedback as the independent variables found a significant path between post-Feedback 2 anxiety and controllable counterfactuals ($\beta = .59$), $t(101) = 3.37$, $p < .01$, whereas the direct path between ITM \times Feedback and controllable counterfactuals was reduced so that it was no longer significant (Goodman test: $Z =$

1.90, $p = .058$). Thus, the effect of the entity-incremental variable on the relationship between feedback and Test 3 performance appeared to be mediated by anxiety. This pattern is consistent with the hypothesis that the anxiety-producing effect of theory violation would systematically impair subsequent performance.

How does anxiety impair performance on challenging tasks? Researchers have proposed several cognitive and motivational mechanisms. For example, anxiety may impose an additional cognitive burden that depletes resources available for the task at hand (Schmader & Johns, 2003). In addition, the experience of anxiety may act as a signal that the individual is not up to the task, leading to lower motivation, lower expectations, and allocation of attention elsewhere (Ben-Zeev et al., 2005; Stangor, Carr, & Kiang, 1998; Wheeler & Petty, 2002). The present data do not allow us to determine which of these mechanisms is most responsible for theory violation's effect on performance, but present research in our laboratory is investigating this question.

Expectancy Data

As in Studies 1 and 2, entity and incremental theorists did not differ in their a priori expectancies regarding how well they would do, how hard they would try, and so forth (all r s $< .10$). In all three studies, the differences between entity and incremental theorists could not be explained by different a priori expectancies.

In summary, the pattern of findings in Study 3 closely tracked that of Studies 1 and 2. Entity theorists evinced signs of damaged prediction and control confidence when their performance trajectory changed dramatically from Time 1 to Time 2 (whether for the worse or for the better). Incremental theorists evinced parallel symptoms when their performance remained static from Time 1 to Time 2. For both groups, these equivalent affective and motivational reactions negatively impacted subsequent performance.

GENERAL DISCUSSION

In Study 1, we used an intelligence test paradigm and found evidence consistent with our hypothesis: Feedback indicating dramatic decline or dramatic improvement elicited more anxiety (and only anxiety) from entity theorists than from incremental theorists. In contrast, feedback indicating rigidly static performance elicited more anxiety from incremental theorists than from entity theorists. For both groups, increased greater anxiety was associated with enhanced compensatory effort on the control estimation task. In Study 2, we replicated the Theory \times Feedback effects with manipulated theories and a new achievement task (subliminal visual perception). In Study 3, we replicated the effects using a different compensatory control task (generating counterfactuals). Moreover, in Study 3, theory violation impaired the subsequent performance of both entity and incremental theorists. Taken together, these data highlight the central role played by lay theories and prediction confidence in reactions to changing and unchanging outcomes.

The finding that the Theory \times Feedback effects on emotion were restricted to anxiety suggests that entity theorists are not, in principle, opposed to improvement. Rather, dramatic, unexpected, or difficult-to-explain improvement simply represents a greater challenge to their theory than to the incremental theory—thus, a relative difference in only anxiety was predicted (and found). Similarly, incremental theorists do not demand constantly fluctu-

ating performance. Instead, stasis in the face of a clear learning opportunity represents a greater challenge to their predictive model than to the entity model.

These findings have noteworthy implications for the literature on reactions to expected and unexpected success and failure. Renner (2004) used a health screening paradigm to provide evidence that, in general, people place greater value on negative health feedback when it is expected, compared with when it is unexpected. Renner further found that positive feedback was not accepted unconditionally; some forms of unexpected positive feedback were doubted, whereas expected positive feedback was accepted uncritically. In contrast, Shepperd and McNulty (2002) found that negative feedback generally feels worse when it is unexpected, whereas positive feedback generally feels better when it is unexpected. Both approaches, however, did not account for the source of the expectancy. The present findings suggest that the violation of an expectancy originating from a core lay theory is especially anxiety provoking. Thus, more precise hypotheses about people's reactions to positive and negative outcomes may require taking into account the different expectancy sets established by different lay theories.

These studies also extend the research literature on lay theories by exploring, for the first time, their role in fostering a sense of prediction confidence as people encounter life's ups and downs. Most of this literature has focused on the effect of the entity and incremental theories on reactions to failure (e.g., Hong et al., 1999; Niiya et al., 2004). The present studies add to this by investigating reactions to improvement and stasis. According to the present approach, the motivation to view oneself as a competent predictor of behavior is a powerful, largely overlooked component of the psychology of success and failure. On one level, people want to succeed on the task, but at the same time, they want to know themselves and understand their abilities. Because of this motivation, people will at times sacrifice their sense of task competence in the name of prediction competence.

Related Constructs

The principle of theory confirmation/violation may contribute to the literature on self-verification. Just as mild depressives find it aversive when they are rated unexpectedly positively (Swann, Stein-Seroussi, & Giesler, 1992), so too might entity theorists display signs of epistemic disorientation when faced with unexpected success. Analogously, incremental theorists may display such symptoms when faced with unexpectedly rigid performance. Thus, the present research extends the existing literature on self-verification by asking "What beliefs about the self—beyond a generalized sense of goodness or badness—do people strive to confirm?"

More generally, the present model draws from the writings of the psychologist Robert White. White (1959) highlighted the motivation to explore and manipulate one's environment in order to establish one's competence at extracting stable regularities. More important, White conceived of "effectance" as a basic motivation rather than as a means to such ends as safety or satiety. More recent research by Weary and colleagues has extended this idea by documenting stable individual differences in the desire to avoid a sense of prediction and control confusion, or "causal uncertainty" (for a review, see Weary & Edwards, 1996).

In the present studies, we extend these ideas to the realm of achievement motivation. We propose that in learning and achievement situations, people not only ask themselves "Will I look good?" and "What will I learn from this?" (Dweck, 1999) but also "How well can I predict my own behavior?" If the outcome indicates that they have predicted badly, then even objectively positive outcomes (e.g., acing an exam) may yield signs of anxiety and confusion. However, if the outcome suggests that they have predicted well, then even negative outcomes (bombing an exam) may yield comparative signs of relief (a comforting sense of "I knew it!"). In these studies, we measured the hypothesized construct of prediction confidence indirectly via thoroughness of post hoc compensatory processing. It is worth noting that although researchers have used this strategy for some time (e.g., Pittman & Pittman, 1980), future researchers might consider devising a more direct and online way to assess this important construct.

Why Do People Care So Much About Confirming Their Theories?

Why might people be so heavily invested in confirming their working theory? That is, why do people not regard their theory as a mere rule of thumb that may be jettisoned when violated? One reason may be the basic motivation to maintain cognitive consistency. That is, a discrepancy between one's theory and one's behavior may elicit the same type of dissonant anxiety as a discrepancy between one's attitude and one's behavior (Elliot & Devine, 1994).

A second pertinent perspective on this issue was proposed by Abelson and Prentice (Abelson, 1986). According to their "beliefs as possessions" approach, mental entities, such as attitudes and beliefs, share many formal properties with physical possessions. Just as people are loath to part with their possessions, they are similarly reluctant to part with their beliefs. In fact, the very fact of "ownership" may elevate a belief's value beyond its generic value—the so-called endowment effect (Kahneman, Knetsch, & Thaler, 1990).

Third, people may desire to confirm their theories because they generate concrete standards to which outcomes may be compared. Indeed, the literature on control motivation has generally not specified what people use as a standard to assess their success at prediction and control, aside from a global, generalized sense of certainty about outcomes, or what Pittman (1998) has termed, somewhat abstractly, an "understanding of the way things work" (p. 552). The present research concretizes this idea by nominating a fundamental type of standard that people may use: lay theories. These studies suggest, moreover, that when incoming feedback implies an ineffective theory, and thus poor self-understanding, anxiety and compensatory processing are likely to ensue.

If, as these data suggest, lay theories truly serve as frameworks through which people interpret the meaning of their behavior (Molden & Dweck, 2006), then similar effects should be evident for other beliefs and theories that are central to structuring people's social understanding (e.g., free will vs. determinism; Viney, McIntyre, & Viney, 1984; just world theories, Hafer, 2000; in-group status; Major, Kaiser, O'Brien, & McCoy, in press). That is, whenever people encounter feedback that violates the theory guiding their current self-cognition, they should experience a constellation of symptoms similar to those found here (increased anxiety,

increased compensatory effort, impaired performance). In fact, there is evidence that, in extreme cases, the violation of core assumptions about the world leads to severe mental health consequences (e.g., Janoff-Bulman, 1992). We are presently investigating the question of whether the effects found in the present studies extend to other types of self-theories.

Moreover, there are likely to be systematic individual differences in the degree to which people value prediction and control and are thus disturbed by theory-violating information. That is, not all entity theorists will be made equally anxious when their performance changes, and not all incremental theorists will be made equally anxious when their performance remains “stuck.” Present research in our laboratory is aimed at isolating such individual differences.

Relation to Decision Affect Theory (DAT)

Recent research on DAT has found that people’s feelings about outcomes are determined at least in part by their mental representation of the counterfactual alternative (e.g., Mellers, Schwartz, Ho, & Ritov, 1997). According to the DAT approach, the effect of a positive or negative outcome is amplified (i.e., more pain after failure, more pleasure after success) when the outcome exceeds the counterfactual alternative. Shepperd and McNulty (2002) proposed that disconfirmed performance expectancies represent such a case. Thus, unexpected failure should feel worse than expected failure, but unexpected success should feel better than expected success. Shepperd and McNulty (2002, Study 3) found this pattern in one study in which participants received either expected or unexpected positive or negative news on a (bogus) medical test. The authors explicitly contrasted these results with a cognitive consistency-based perspective, which would predict that unexpected feedback should always feel worse than expected feedback, regardless of whether it is positive or negative (e.g., Carlsmith & Aronson, 1963). The present studies, however, appear to support the consistency-based perspective. Is there a conflict between the present perspective and the Shepperd and McNulty (2002) work?

We believe not. The present studies differ from the DAT work in several respects. First, participants in each of the present studies, unlike the Shepperd and McNulty studies, were provided with explicit and detailed learning experiences intended to improve performance, thus significantly altering the psychology of the situation. Second, in the present studies, we assessed (or manipulated) participants’ intuitive theories about improvement and found clear individual differences in what outcomes people expected and how they reacted. Thus, rather than assuming uniformity in participants’ expectancies, we found that people spontaneously generated different expectancies on the basis of different underlying assumptions about stability or change. Third, whereas Shepperd and McNulty’s measure of affect was a global summary across six affect labels (*upset, distressed, good, happy, elated, and depressed*), in the present studies, we distinguished between anxiety and nonanxiety and found the predicted effects only with anxiety. In summary, rather than conflicting with prior studies in the DAT tradition, the present studies complement that work by beginning to specify (a) when and for whom unexpected positive feedback will represent an epistemic threat and (b) the nature of that threat (i.e., an anxiety-inducing threat to prediction confidence).

Practical Applications

The lay theories approach has a proven track record in promoting effective learning and motivation in a range of fields, including education (e.g., Blackwell et al., 2007; Butler, 2000; Grant & Dweck, 2003), interpersonal relationships (e.g., Beer, 2002), athletics (Cury, Da Fonseca, Rufo, & Sarrazin, 2002), and organizational management (e.g., Heslin, Latham, & VandeWalle, 2005; Taberero & Wood, 1999). The present studies take this approach an important step further by highlighting a largely underexamined element (i.e., the motivation for theory confirmation) that may further enhance the efficacy of lay theory-based learning methods. In so doing, some costs to endorsing an incremental theory—namely, in situations when improvement is slow in coming—are discussed for the first time. Because there are costs and benefits associated with each theory, an effective intervention approach may be to emphasize that although one theory may seem appropriate to explain a given outcome, the alternative may, upon reflection, be equally appropriate. By making individuals aware of the advantages and pitfalls of each theory, they may become even better equipped to flexibly activate alternative theories to explain life’s challenges, rather than relying on a single model. Such a method may help to optimize reactions to emphatic change or nonchange in their performance or circumstances.

Beyond the classroom and the workplace, the present approach may have implications for clinical practice as well. The systematic impact of clients’ theories about the fixedness of their personality may represent a crucial element that clinicians must recognize in order to tailor their treatment most effectively. For example, it may be prudent for a clinician to be careful when touting a client’s dramatic improvement when the client is an entity theorist. Why? The perception of great change (even in the “right direction”) may itself induce a theory-violating sense of anxiety (e.g., “Do I even know myself?” “Can I keep up this unexpected performance?”). Similarly, a clinician may be advised to downplay evidence of static performance when the client is an incremental theorist. Such a client may take such news especially badly due to its violation of the incremental theory’s assumption that change is attainable. In summary, a mismatch between the client’s understanding or expectation of his or her progress trajectory and the evidence presented by his or her own behavior—or a mismatch between client theory and the clinician’s theory—may, in specifiable cases, engender a form of progress anxiety that could hamper outcomes. Thus, rather than focusing solely on one theory, the ability to flexibly consider both theories may be most adaptive.

Conclusion

In the present studies, participants exhibited a motivation to confirm their working lay theory and even reacted in potentially self-defeating ways after experiencing an outcome that violated that theory. This work highlights an important, largely overlooked, metacognitive component of the psychology of hardiness in the face of unexpected success and failure. These findings may be informative to educators, organizational managers, clinicians, and others focused on optimizing human performance.

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