

Implicit theories and IQ test performance: A sequential mediational analysis [☆]

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Abstract

The mediational role of worry and practice time in explaining the relationship between implicit theories of ability and performance was examined in two studies. It was hypothesized that holding an implicit theory of ability as fixed and unchangeable would impair test performance. Worry and time invested in practicing prior to taking a test were predicted to mediate the direct effect of implicit theories on performance. These predictions were supported, using both correlational (Study 1) and experimental (Study 2) methods. The results also suggest that entity beliefs lead to decreased practice and performance even when initial failure is not encountered. The theoretical and practical implications of these findings are discussed.

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Introduction

It is common in contemporary society to view performance excellence as naturally emerging from genius or genes. However, research in a variety of achievement contexts such as sports (Hodges, Kerr, Starkes, Weir, & Nananidou, 2004) music (Ericsson, Krampe, & Tesch-Romer, 1993), and academics (Kulik, Kulik, & Bangert, 1984), clearly indicates that factors other than innate ability contribute to achievement. Identifying such factors is of great importance, not only for advancing our conceptual understanding, but also for developing practical strategies and interventions to facilitate skill development and growth. In the present research we examine the proposal

that performance in achievement contexts is influenced by individuals' underlying assumptions about the nature of ability, their affective response to achievement evaluation, and their willingness to engage in practice for an upcoming achievement event.

The social-cognitive model and performance

Dweck (1986) and colleagues (Dweck & Leggett, 1988) have proposed a social-cognitive model of achievement and motivation that has garnered considerable empirical support (see Dweck & Molden, 2005, for a review). A central premise of the model is that individuals differ in their implicit theories about the nature of ability. Entity theorists believe that ability is stable and cannot be altered; this belief is posited to lead to maladaptive responses in achievement settings, including “helpless” responses to failure. Incremental theorists believe that ability is malleable and can be developed; this belief is posited to promote adaptive responses in achievement contexts (Dweck, Chiu, & Hong, 1995).

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The proposal that entity theory leads to maladaptive outcomes, whereas incremental theory leads to adaptive outcomes, has received a good deal of empirical support. Previous studies have found that entity beliefs, relative to incremental beliefs, negatively predict challenge seeking (Hong, Chiu, Dweck, Lin, & Wan, 1999), effort attributions (Robins & Pals, 2002), and intrinsic motivation (Li, Lee, & Solmon, 2005; Wang & Biddle, 2003). The proposal that entity theory has negative implications for performance has received strong empirical support (Aronson, Fried, & Good, 2002; Cury, Elliot, Da Fonseca, & Moller, 2006; Gonida, Kiosseoglou, & Leondari, 2006; Good, Aronson, & Inzlicht, 2003; Stipek & Gralinski, 1996; Thompson & Musket, 2005). A few studies (Dupeyrat & Marine, 2005; Leondari & Gialamas, 2002) have not found support for this relationship, but the bulk of the available evidence tends to support Dweck's (1986) proposal that entity theory, relative to incremental theory, has negative implications for performance.

While the link between implicit theories and performance is well established, little is known about the processes responsible for this effect. This process issue is important, both from a theoretical standpoint of acquiring a clear and detailed understanding of the link between implicit theories and performance, and from an applied standpoint of knowing how to support and facilitate achievement. In the present research we examined the roles of test anxiety (specifically, worry) and willingness to practice in mediating the implicit theory–performance relation. While additional factors such as performance-avoidance goal adoption also appear to be involved (Cury et al., 2006), there are strong theoretical grounds for the proposal that worry and willingness to practice play key roles in explaining why holding an entity theory can result in sub-optimal performance.

Worry and practice as mediators of the implicit theory → performance relation

Test anxiety represents apprehension experienced during competence evaluation (Spielberger & Vagg, 1995). Test anxiety theorists distinguish between two components of anxiety: worry, which is a concern about failure and its implications, and emotionality, which is a physiological reaction involving nervousness and accelerated heart rate (Liebert & Morris, 1967). Worry, but not emotionality, has been shown to undermine optimal self-regulation in achievement contexts (Deffenbacher, 1980; Elliot & McGregor, 1999).

Practice represents an effortful attempt to advance one's learning and preparation, and reflects an investment in competence (Ericsson, 2002). Theorists in the achievement motivation (Covington & Beery, 1976) and self (Berglas & Jones, 1978) literatures alike have noted that practice time may be used strategically to protect self-esteem. Specifically, not availing oneself of practice time is one form of self-handicapping, in that it provides a clear external attri-

bution for failure (i.e., lack of preparation) that weakens the perceived link between poor performance and low ability. Although forgoing practice may indeed protect the self from an internal attribution for failure (McCrea & Hirt, 2001), it is also likely to have negative implications for performance attainment. Practice has been clearly shown to be a strong positive predictor of performance outcomes (Ericsson, 2002; Krampe & Ericsson, 1996). Despite the clear importance of practice, individuals sometimes forgo opportunities to improve their skills and abilities, a decision that is likely to have predictable consequences for subsequent performance (Elliot, Cury, Fryer, & Huguet, 2006).

We posit that entity theory, relative to incremental theory, leads to more worry and less practice time in achievement contexts. Entity theory focuses individuals on the demonstration of ability (Dweck, 1986), and this focus would appear to produce a sort of double jeopardy for entity theorists. First, it promotes ability (rather than effort) attributions for achievement outcomes, and second, the ability in question is viewed as a stable characteristic of the person. As such, achievement situations are likely to be highly threatening events for entity theorists, because they are at risk of being exposed as immutably incompetent in such situations (Dweck, 1986; Elliot & McGregor, 2001). Accordingly, entity theorists are likely to experience worry about the negative implications of failure (Robins & Pals, 2002). Moreover, we propose that entity theorists should be more worried about the implications of their performance even when they expect to do well, quite simply because more is “on the line” if one believes that the ability being assessed is unchangeable. That is, an entity theorist who believes her intelligence is being assessed is facing an assessment with long-term, global implications, and this is likely to evoke worry about performance outcomes.

Because more is at stake in evaluative settings, and this increased pressure is likely to increase worry about achievement outcomes, entity theorists should be more likely to employ strategies that protect them from internal attributions for failure (Ommundsen, Haugen, & Lund, 2005), as well as those that promote ability attributions for success; avoiding practice can serve both of these functions. Consistent with this reasoning, recent research (Hong et al., 1999) has found that entity beliefs are positively related to the belief that effort and ability are inversely related. Thus for entity theorists, practice is of dubious benefit, because while it might improve performance, it cannot improve ability, and it is likely to result in lower judgments of ability.

In contrast, holding an incremental theory of ability should be associated with relatively less worry, because from the incremental perspective one's performance does not necessarily have long-term implications. Viewing ability as malleable, therefore, should lead to less worry, and less use of strategies (such as avoiding practice) aimed at avoiding demonstrations of low ability.

Our proposal, therefore, is that entity theory evokes worry, which, in turn, prompts individuals to embrace the self-protective strategy of avoiding practice. This lack of practice is likely to undermine performance attainment, and this sequence from entity theory to worry to lack of practice to performance is expected to explain (i.e., mediate) the direct relation between entity theory and performance. There are clear theoretical grounds for these predictions (as we detailed above), and they are consistent with Dweck's (1986) social-cognitive model. However, it is easy to derive competing predictions if one starts with different theoretical assumptions. For example, one might suppose that because holding an entity theory implies that more is at stake in evaluative settings, those who hold this view will work harder and practice more in order to attain positive performance outcomes. The present research provides a direct test of these competing predictions by examining the novel hypothesis that worry and practice time jointly account for the effect of implicit theories on performance.

Study 1

Our first study was a prospective correlational study in which we sought to validate the direct relation between implicit theories and performance attainment, taking care to assess theories about a specific ability. We examined worry and practice as sequential mediators of the implicit theory–performance relation in the context of a highly important achievement context: an IQ assessment.

Method

Participants

Forty-seven (23 male, 24 female) individuals voluntarily participated in the study, which was conducted in Marseille, France. The average age of participants was 13.3 years old (range: 13–15).

Procedure

Participants were run individually by an experimenter blind to the hypotheses. Upon arrival at the laboratory, participants were introduced to the target task and informed that the test was commonly used to assess the IQ of teenagers. Participants were then given 2 min to complete the Coding test; feedback was not provided. Next, participants completed an implicit theory measure.

Participants were then informed that they would be taking the test again, but that first they would be given 5 min to practice on similar coding problems. They then completed a questionnaire assessing worry about the upcoming performance. Following the questionnaire, the experimenter left the room and a hidden observer used a stopwatch to record the time that participants solved coding problems.

Following the practice period, participants were given 2 min to complete the Coding test again. The experimenter then scored the test and presented positive feedback to all prior to debriefing.

Measures

Implicit theory. Cury et al.'s (2006) six-item measure was used to assess implicit theory. Three items assess entity theory (e.g., "In this session, I think that even if I put in a lot of effort, it's difficult for me to change my performance on the intelligence task") and three assess incremental theory (e.g., "In this session, I think I can change my performance on the intelligence task easily") using a 1 (no agreement at all) to 7 (agree completely) scale. A principal-components analysis on the items yielded a single eigenvalue exceeding unity, therefore the incremental scores were reversed and added to the entity scores, and the total was averaged ($\alpha = .93$) to form an implicit theory index.

Worry. Morris, Davis, and Hutchings (1981) five-item worry subscale from the Revised Worry–Emotionality Scale was used to assess worry about the test (e.g., "I feel that others will be disappointed in me") using a 1 (does not describe my condition right now) to 5 (describes my condition right now very well) scale. Responses were averaged for form the worry index ($\alpha = .92$).

Practice time. The number of seconds participants solved coding problems during the practice period was the indicator of practice time.

Performance. Scores on the Coding test of the WISC III (Wechsler, 1996) at T1 and T2 were used as the indicator of IQ performance. This test entails transcribing a digit-symbol code as quickly as possible during a 2-min period. It is designed to assess visual-motor coordination, concentration, speed of information processing, and rote learning.

Results and discussion

Overview

Simultaneous multiple regression was used to analyze the data. The basic regression model was comprised of implicit theory and time 1 (T1) performance. Preliminary analyses revealed no gender main or interactive effects, so gender was excluded from the final analyses. Descriptive statistics and correlations are presented in Table 1.

Implicit theory \rightarrow time 2 (T2) performance

Regressing T2 performance on the basic model yielded an effect for the model, $F(2,44) = 18.23$, $p < .01$ ($R^2 = .45$). T1 performance was a positive predictor of T2 performance, $F(1,44) = 18.40$, $p < .01$ ($R^2 = .48$). Implicit theory was a negative predictor of T2 performance, $F(1,44) = 13.18$, $p < .01$ ($R^2 = -.41$), indicating that the more participants endorsed entity theory, relative to incremental theory, the lower their performance on the test.

Table 1
Study 1: descriptive statistics and intercorrelations among the primary variables

Variable	<i>M</i>	<i>SD</i>	Observed range	Possible range	Variable				
					1	2	3	4	5
1. Time 1 performance	11.02	1.19	8–13	0–20	—	—	—	—	—
2. Implicit theories endorsement	4.60	1.62	1–7	1–7	-.13	—	—	—	—
3. Worry	2.59	1.15	1–5	1–5	.05	.47**	—	—	—
4. Practice time	236.70	69.01	80–300	0–300	-.11	-.41**	-.45**	—	—
5. Time 2 performance	14.11	1.22	8–15	0–20	.54**	-.47**	-.43**	.49**	—

Note. ** $p < .01$.

Implicit theory → process variables

Having established the direct relation between implicit theory and performance, we next examined the link between implicit theory and the process variables.

Worry. The worry analysis yielded an effect for the basic model, $F(2, 44) = 6.15$, $p < .01$ ($R^2 = .22$). Implicit theory was a positive predictor of worry, $F(1, 44) = 12.18$, $p < .01$ ($R^2 = .47$), indicating that the more participants endorsed entity theory, relative to incremental theory, the more they worried about the test.

Practice time. The practice time analysis yielded an effect for the basic model, $F(2, 44) = 4.45$, $p < .05$ ($R^2 = .17$). Implicit theory was a negative predictor of practice time, $F(1, 44) = 8.20$, $p < .01$ ($R^2 = -.40$), indicating that the more participants endorsed entity theory, relative to incremental theory, the less they practiced the coding problems.

Having established the first link in the mediational chain, we next examined worry as a mediator of the relation between implicit theory and practice time (see Baron & Kenny, 1986, for the requirements for documenting mediation). Regressing practice time on the basic model with worry included yielded a significant overall model, $F(3, 43) = 5.01$, $p < .01$ ($R^2 = .26$). Worry was a negative predictor of practice time, $F(1, 43) = 5.24$, $p < .05$ ($R^2 = -.34$). The R^2 for the direct influence of implicit theory on practice time was reduced 40.0% from $-.40$ ($p < .01$) to $-.24$ (ns), and MacKinnon, Lockwood, Hoffman, West, and Sheets's (2002) z' test documented that worry mediated the relation between implicit theory and practice time, $z' = 1.92$, $p < .01$.

Final mediational analysis

The final link in the mediational chain was examined by regressing T2 performance on the basic model with worry and practice time included. The overall model was significant, $F(4, 42) = 13.60$, $p < .01$ ($R^2 = .57$). T1 performance was a positive predictor of T2 performance, $F(1, 42) = 20.79$, $p < .01$ ($R^2 = .47$). Practice time was also a positive predictor of T2 performance, $F(1, 42) = 4.93$, $p < .05$ ($R^2 = .27$); a null finding was obtained for worry. The R^2 for the direct influence of implicit theory on T2 performance was reduced 46.4% from $-.41$ ($p < .01$) to $-.22$ (ns), and the z' test documented that practice, via worry,

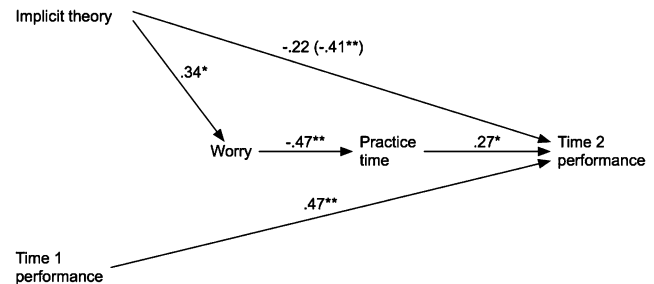


Fig. 1. Worry and practice time as mediators of the relationship between implicit theory and time 2 test performance controlling for time 1 test performance. Path values are standardized coefficients from the regression analyses. Note. * $p < .05$, ** $p < .01$.

mediated the relation between implicit theory and T2 performance, $z' = 1.93$, $p < .01$ (see Fig. 1).

In sum, the results provided strong support for our predictions. Implicit theory predicted test performance such that entity theory, relative to incremental theory, was associated with lower test scores. Further, our predictions with regard to worry and practice were also supported. Entity theory, relative to incremental theory, was associated with greater worry. Worry was a negative predictor of practice time, which was in turn a positive predictor of IQ test performance. These results indicate that worry and time invested in practice jointly account for the relation between implicit theory and IQ test performance.¹

Study 2

In our second study we used an experimental design in which implicit theory was manipulated rather than assessed using self-report. Experimental manipulations of implicit theories have been employed in numerous studies over the years (e.g., Bempechat, London, & Dweck, 1991; Butler, 2000; Cury et al., 2006) and experimentally induced implicit theories consistently show the same effects with other variables that self-reported implicit theories show (Molden & Dweck, 2006). We sought to again validate the direct relation between implicit theory and performance attainment in the context of an IQ assessment, and to test

¹ All mediational findings remained the same with T1 Performance \times Theory added to the equation, and no interaction effect attained significance.

the sequential mediational model involving worry and practice. We also included a manipulation of initial feedback (positive or negative) to test the hypothesis that entity theory is particularly deleterious for performance following a failure experience (Dweck & Leggett, 1988). Viewing ability as a fixed characteristic can be expected to lead to greater worry about performance outcomes even following success, because more is at stake when one views ability as a fixed characteristic. Studies that have explicitly examined the hypothesis that entity theory leads to poorer performance only after an initial failure have tended not to yield support (Cury et al., 2006; Thompson & Musket, 2005), and we likewise expected our findings to hold across levels of initial feedback.

Method

Participants and design

Eighty-six (41 male, 45 female) individuals voluntarily participated in the experiment, which was conducted in Marseille, France. The average age of participants was 13.8 years old (range: 13–15). Participants were blocked on gender and randomly assigned to condition in a 2 (Implicit Theory: entity vs. incremental) \times 2 (Initial Feedback: positive vs. negative) between-subjects factorial design.

Procedure and manipulations

Participants were run individually by an experimenter blind to the hypotheses. Upon arrival at the laboratory, participants were introduced to the target task and informed that the test was commonly used to assess the IQ of teenagers. Participants were then given 2 min to complete the Coding test, while the experimenter consulted a note regarding assignment to initial feedback condition. After the test period, the experimenter scored the test and gave participants norm-based feedback that varied in valence. Participants in the *positive feedback* condition were told: “Your score is X (actual score) correct associations between the symbols and the figures in 2 min, and this score represents good performance, in the 90th percentile, compared to that of other teenagers.” Participants in the *negative feedback* condition were told the same, but with “poor” replacing “good” and “10th” replacing “90th”.

The experimenter then gave participants a form containing the implicit theory manipulation. It stated that the test assessed an important type of ability, and was commonly used to assess the IQ of teenagers. Then, in the *entity theory* condition, participants were informed:

In many studies, scientists have shown that: (1) everyone has a certain level of this type of ability, and there is not much that can be done to really change it, (2) this type of ability depends on gifts or qualities that one has from birth, (3) even if one makes an effort, one cannot really change one’s ability level, and (4) this type of ability is not really modifiable.

A figure was then shown that contained longitudinal data on coding performance that supported the stability position.

In the *incremental theory* condition, participants were informed:

In many studies, scientists have shown that: (1) everyone has a certain level of this type of ability, but there are a lot of ways to substantially change it, (2) this type of ability does not depend on gifts or qualities that one has from birth, (3) if one makes an effort, one can change one’s ability level, and (4) this type of ability is quite modifiable.

A figure was then shown that contained longitudinal data on coding performance that supported the malleability position.

Next, all participants were informed that they would take the test again. Participants in the entity (incremental) condition were provided with the following summary statement: “In sum, today we want to test you on a type of ability that is part of the intelligence of teenagers. This ability is relatively stable (unstable), so it is very difficult (possible) to change it.” The experimenter remained blind to implicit theory condition throughout the session.

Following this manipulation, participants completed an implicit theory manipulation check, and a questionnaire assessing their degree of worry about the upcoming test. Participants were then given 5 min to practice the coding problems. The experimenter left the room, and a hidden observer used a stopwatch to record the time that participants solved coding problems.

After the practice period, participants were given 2 min to complete the Coding test again. The experimenter then scored the test and provided positive feedback to all prior to debriefing.

Measures

The effectiveness of the implicit theory manipulation was assessed with one entity item (“The purpose of this session is to test an ability that is relatively stable and difficult to change”) and one incremental item (“The purpose of this session is to test an ability that is relatively unstable and not that difficult to change”) using a 1 (no agreement at all) to 7 (agree completely) scale. The items were highly correlated ($r = -.79$), therefore, the incremental score was reversed and added to the entity score, and the total was averaged ($\alpha = .93$). Worry, practice time, and performance were assessed as in Study 1.

Results

Overview

Simultaneous multiple regression was used to analyze the data. The experimental design was represented by an *implicit theory* contrast (entity = -1 , incremental = $+1$), an *initial feedback* contrast (negative = -1 , positive = $+1$),

Table 2
Study 2: descriptive statistics and intercorrelations among the primary variables

Variable	<i>M</i>	<i>SD</i>	Observed range	Possible range	Variable						
					1	2	3	4	5	6	
1. Implicit theory	—	—	—	—	—	—	—	—	—	—	—
2. Initial feedback	—	—	—	—	—	—	—	—	—	—	—
3. Time 1 performance	10.85	2.15	4–16	0–20	-.07	.36**	—	—	—	—	—
4. Worry	2.87	1.16	1–5	1–5	.40**	-.12	-.02	—	—	—	—
5. Practice time	207.24	67.04	60–300	0–300	-.34**	-.09	.04	-.34**	—	—	—
6. Time 2 performance	13.90	2.33	8–19	0–20	-.48**	.20	.54**	-.45**	.44**	—	—

Note. Dashes indicate that data were not applicable. ** $p < .01$.

and the *Theory* × *Feedback* interaction created from the mean-centered main effects. The basic regression model was comprised of these three variables and the main effect of T1 performance. Preliminary analyses revealed no gender main or interactive effects, so gender was excluded from the final analyses. Descriptive statistics and correlations are presented in Table 2.

Manipulation check

Regressing the manipulation check measure on the basic model revealed an effect for the model, $F(4, 81) = 56.58$, $p < .01$ ($R^2 = .74$). Only the main effect of implicit theory was significant, $F(1, 81) = 220.82$, $p < .01$ ($R^2 = .85$); participants in the entity theory condition had higher scores on the measure than those in the incremental theory condition.

Implicit theory, initial feedback, and Theory × Feedback → time 2 (T2) performance

Regressing T2 performance on the basic model yielded an effect for the model, $F(4, 81) = 19.11$, $p < .01$ ($R^2 = .49$). T1 performance was a positive predictor of T2 performance, $F(1, 81) = 32.26$, $p < .01$ ($R^2 = .49$). The implicit theory effect was also significant, $F(1, 81) = 30.69$, $p < .01$ ($R^2 = -.44$), indicating that participants in the entity theory condition performed worse than those in the incremental theory condition. The Theory × Feedback interaction was not significant.

Implicit theory, initial feedback, and Theory × Feedback → process variables

Having established the direct relation between implicit theory and performance, we next examined the link between implicit theory and the process variables.

Worry. The worry analysis yielded an effect for the basic model, $F(4, 81) = 5.99$, $p < .01$ ($R^2 = .23$). The implicit theory effect was significant, $F(1, 81) = 17.39$, $p < .01$ ($R^2 = .41$), indicating that participants in the entity theory condition experienced more worry about the test than those in the incremental theory condition. The Theory × Feedback interaction was also significant, $F(1, 81) = 4.75$, $p < .05$ ($R^2 = .21$). Predicted values indicated that participants in the entity theory/negative feedback condition were particu-

larly worried about the test ($\hat{Y} = 3.52$), relative to those in the entity theory/positive feedback ($\hat{Y} = 2.68$), incremental theory/negative feedback ($\hat{Y} = 2.08$), and incremental theory/positive feedback ($\hat{Y} = 2.24$) conditions.

Practice time. The practice time analysis yielded an effect for the basic model, $F(4, 81) = 2.92$, $p < .05$ ($R^2 = .13$). The implicit theory effect was significant, $F(1, 81) = 10.18$, $p < .01$ ($R^2 = -.33$), indicating that participants in the entity theory condition practiced less than those in the incremental theory condition. The Theory × Feedback interaction was not significant.

Having established the first link in the mediational chain, we next examined worry as a mediator of the relation between implicit theory and practice time. Regressing practice time on the basic model with worry included yielded a significant overall model, $F(5, 80) = 3.67$, $p < .01$ ($R^2 = .19$). Worry was a negative predictor of practice time, $F(1, 80) = 5.95$, $p < .05$ ($R^2 = -.28$). The R^2 for the direct influence of implicit theory on practice time was reduced 36.4% from $-.33$ ($p < .01$) to $-.22$ ($p < .05$), and the z' test documented that worry mediated the relation between implicit theory and practice time, $z' = 2.11$ ($p < .01$).

Final mediational analysis

The final link in the mediational chain was examined by regressing T2 performance on the basic model with worry and practice time included. The overall model was significant, $F(6, 79) = 21.47$, $p < .01$ ($R^2 = .62$). T1 performance was a positive predictor of T2 performance, $F(1, 79) = 41.86$, $p < .01$ ($R^2 = .49$). Practice time was also a positive predictor, $F(1, 79) = 10.56$, $p < .01$ ($R^2 = .25$), and worry was a negative predictor, $F(1, 79) = 9.99$, $p < .01$ ($R^2 = -.26$). The R^2 for the direct influence of implicit theory on T2 performance was reduced 43.2% from $-.44$ ($p < .01$) to $-.25$ ($p < .01$), and the z' test documented that practice, via worry, mediated the relation between implicit theory and T2 performance, $z' = 2.28$, $p < .01$ (see Fig. 2).

These results conceptually replicate those of Study 1, and extend them in important ways. Implicit theories were manipulated rather than measured, and the results indicated that these manipulations produced the same processes and outcomes observed in Study 1. Entity theory

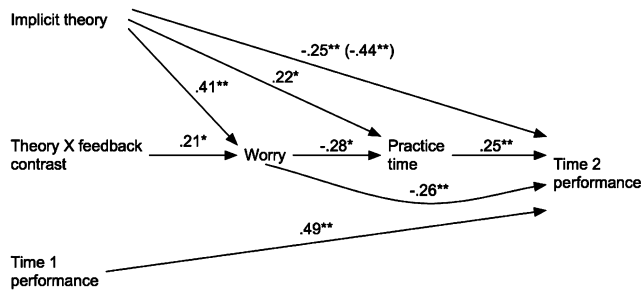


Fig. 2. Worry and practice time as mediators of the relationship between implicit theory and time 2 test performance controlling for time 1 test performance. Path values are standardized coefficients from the regression analyses. Note. * $p < .05$, ** $p < .01$.

resulted in lower test performance relative to the incremental theory. As in Study 1, sequential mediational analysis indicated that this effect was accounted for by worry and practice time. These results were not moderated by initial feedback.²

General discussion

The present research investigated the influence of implicit theories on performance, and examined processes that may account for this influence. We reasoned that entity theory focuses individuals on avoiding demonstrations of inability, and predicted that entity beliefs would lead to decreased performance. We further predicted that worry about the test, and subsequent reductions in practice time, would account for this effect. Our results provided strong support for these predictions. Moreover, the predicted processes and outcomes were demonstrated in a context with important real-world implications, i.e., in the context of an IQ assessment.

Our findings clearly indicate that entity theory, relative to incremental theory, has a detrimental impact on performance. Some studies (Dupeyrat & Marine, 2005; Leondari & Gialamas, 2002) have not found this effect, and some researchers (Bempechat et al., 1991; Pomerantz & Saxon, 2001) have speculated that implicit theories may primarily influence affective outcomes rather than behavioral outcomes such as performance. However, the present results, in conjunction with a good deal of other research (e.g., Aronson et al., 2002; Cury et al., 2006; Good et al., 2003) clearly indicate that implicit theories can affect cognitive and behavioral processes and outcomes.

The primary focus of the present work was on the processes by which implicit theories influence performance outcomes, an issue that has received a dearth of research attention. We not only showed that worry and practice time mediate the relation between implicit theories and per-

formance, but also documented a specific mediational sequence. It appears that viewing ability as unchangeable prompts concern about the implications of failure, and this worry leads to decreased practice, which directly undermines actual performance. Although it may seem intuitive that entity beliefs might lead to greater practice in order to perform well and thereby document one's ability, our results clearly suggest that the opposite is true. These findings also provide additional support for Dweck's (1986) proposal that entity theory gives rise to concerns about avoiding the implication that one has low ability, and that this concern is at the heart of entity theorists' maladaptive responses in achievement settings. As prior research has shown, there are other processes involved in the link between implicit theories and performance, including performance-avoidance goal pursuit (Cury et al., 2006). The present findings extend such work by documenting the role that worry and practice play in accounting for this link. In so doing, the present work advances knowledge about the consequences of implicit theories, and provides perhaps the most detailed and specific explanation of the implicit theory–performance relation to date.

Researchers have recently contemplated the possibility that entity theory is negatively related to performance because entity theorists believe that effort and practice are futile (Hong et al., 1999; Robins & Pals, 2002). However, the empirical evidence does not seem to support this view; Hong et al. (1999) reported that entity theorists are less likely to take remedial action even when explicitly informed that such action will be effective in improving performance. Likewise, our results indicate that the negative relation between entity theory and practice is not strictly the result of a rational cognitive process in which practice is avoided because it is presumed to have little effect on performance. Specifically, the present findings indicate that worry mediates the relation between implicit theory and practice time. This suggests that affectively-based self-protective processes play a key role in explaining why entity theory leads to less practice, and, ultimately, lower performance.

The possibility that entity theory will result in performance decrements only following failure was also examined in Study 2. In line with suggestions that initial success may not do much to buffer entity theorists from concerns about the implications of their performance (Dweck et al., 1995), initial success feedback did not moderate the effect of implicit theories on performance. This finding suggests that the inimical effects of holding an entity theory are not limited to maladaptive responses to failure, and in so doing raise questions as to the precise circumstances under which entity beliefs will have negative implications for performance. One possibility is that entity theory will tend to impair performance only in situations that arouse worry. That is, our results suggest that if the worry entity theorists tend to experience in evaluative settings can be alleviated, self-defeating behaviors like avoiding practice or withdrawing effort might be reduced.

² The null effects for Theory \times Feedback were not due to insufficient sample size (Cohen's $f^2 = .002$ and $.0001$ for the T2 performance and practice time regressions, respectively). Furthermore, all mediational findings remained the same with T1 performance interactions added to the equation, and no interaction effect attained significance.

In addition to these theoretical implications, the present work also suggests practical steps that can be taken to promote achievement. First, our findings highlight the benefits of directly communicating that abilities are malleable and can be increased. However, implicit theories tend to be stable over time (Dweck et al., 1995), and/or may be difficult to alter for other reasons, such as conflicting messages from the culture at large (Covington, 1992). In such cases, our mediational analyses suggest that interrupting the processes leading from entity theory to performance outcomes may be beneficial. One may speculate that affirming other valued aspects of the self (Steele, 1988) may alleviate the worry entity theorists experience in evaluative settings, and thereby improve achievement outcomes. Even providing opportunities to protect against negative ability judgments by claiming a handicap may take some of the pressure off the performer, and thereby reduce the tendency to create actual handicaps as participants in the present studies appeared to do. Although this strategy may not be optimal, it could provide at least some benefit insofar as claiming a handicap should be less detrimental than behavioral self-handicapping (Leary & Shepperd, 1986).

In conclusion, the present research represents an advance in understanding the relation between implicit theories and performance. The results of two studies strongly supported our hypotheses that worry and practice time explain this relation. These findings provide a more precise account of the processes underlying the effect of implicit theories on performance than heretofore available, and have potentially important practical implications.

References

- Aronson, J., Fried, C. B., & Good, C. (2002). Reducing the effects of stereotype threat on African American college students by shaping theories of intelligence. *Journal of Experimental Social Psychology, 38*, 113–125.
- Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51*, 1173–1182.
- Bempechat, J., London, P., & Dweck, C. S. (1991). Children's conceptions of ability in major domains: An interview and experimental study. *Child Study Journal, 21*, 11–36.
- Berglas, S., & Jones, E. E. (1978). Drug choice as a self-handicapping strategy in response to noncontingent success. *Journal of Personality and Social Psychology, 36*, 405–417.
- Butler, R. (2000). Making judgments about ability: The role of implicit theories of ability in moderating inferences from temporal and social comparison information. *Journal of Personality and Social Psychology, 78*, 956–978.
- Covington, M. V. (1992). *Making the grade: A self-worth perspective on motivation and school reform*. New York, NY: Cambridge University Press.
- Covington, M. V., & Beery, R. G. (1976). *Self-worth and school learning*. New York, NY: Holt, Rinehart & Winston.
- Cury, F., Elliot, A. J., Da Fonseca, D., & Moller, A. C. (2006). The social-cognitive model of achievement motivation and the 2 × 2 achievement goal framework. *Journal of Personality and Social Psychology, 90*, 666–679.
- Deffenbacher, J. (1980). Worry and emotionality in test anxiety. In I. Sarason (Ed.), *Test anxiety: Theory, research, and applications* (pp. 111–128). Hillsdale, NJ: Erlbaum.
- Dupeyrat, C., & Marine, C. (2005). Implicit theories of intelligence, goal orientation, cognitive engagement, and achievement: A test of Dweck's model with returning to school adults. *Contemporary Educational Psychology, 30*, 43–59.
- Dweck, C. S. (1986). Motivational processes affecting learning. *American Psychologist, 41*, 1040–1048.
- Dweck, C. S., Chiu, C., & Hong, Y. (1995). Implicit theories and their role in judgments and reactions: A world from two perspectives. *Psychological Inquiry, 6*, 267–285.
- Dweck, C. S., & Leggett, E. L. (1988). A social-cognitive approach to motivation and personality. *Psychological Review, 95*, 256–273.
- Dweck, C. S., & Molden, D. C. (2005). Self-theories: Their impact on competence and acquisition. In A. J. Elliot & C. S. Dweck (Eds.), *The handbook of competence and motivation* (pp. 122–140). New York: Guilford Press.
- Elliot, A. J., Cury, F., Fryer, J. W., & Huguet, P. (2006). Achievement goals, self-handicapping, and performance attainment. *Journal of Sport and Exercise Psychology, 28*, 344–361.
- Elliot, A. J., & McGregor, H. A. (1999). Test anxiety and the hierarchical model of approach and avoidance achievement motivation. *Journal of Personality and Social Psychology, 76*, 1999.
- Elliot, A. J., & McGregor, H. A. (2001). A 2 × 2 achievement goal framework. *Journal of Personality and Social Psychology, 80*, 501–519.
- Ericsson, K. A. (2002). Attaining excellence through deliberate practice: Insights from the study of expert performance. In M. Ferrari (Ed.), *The pursuit of excellence in education* (pp. 21–55). Hillsdale, NJ: Erlbaum.
- Ericsson, K. A., Krampe, R. T., & Tesch-Romer, C. (1993). The role of deliberate practice in the acquisition of expert performance. *Psychological Review, 100*, 363–406.
- Gonida, E., Kiosseoglou, G., & Leondari, A. (2006). Implicit theories of intelligence, perceived academic competence, and school achievement: Testing alternative models. *American Journal of Psychology, 119*, 2006.
- Good, C., Aronson, J., & Inzlicht, M. (2003). Improving adolescents' standardized test performance: An intervention to reduce the effects of stereotype threat. *Applied Developmental Psychology, 24*, 645–662.
- Hodges, N. J., Kerr, T., Starks, J. L., Weir, P. L., & Nananidou, A. (2004). Predicting performance times from deliberate practice hours for triathletes and swimmers: What, when, and where is practice important? *Journal of Experimental Psychology: Applied, 10*, 219–237.
- Hong, Y., Chiu, C., Dweck, C. S., Lin, D., & Wan, W. (1999). Implicit theories, attributions, and coping: A meaning system approach. *Journal of Personality and Social Psychology, 77*, 588–599.
- Krampe, R. T., & Ericsson, K. A. (1996). Maintaining excellence: Deliberate practice and elite performance in young and older pianists. *Journal of Experimental Psychology: General, 125*, 331–359.
- Kulik, J. A., Kulik, C. C., & Bangert, R. L. (1984). Effects of practice on aptitude and achievement test scores. *American Educational Research Journal, 21*, 435–447.
- Leary, M. R., & Shepperd, J. A. (1986). Behavioral self-handicaps versus self-reported handicaps: A conceptual note. *Journal of Personality and Social Psychology, 51*, 1265–1268.
- Leondari, A., & Gialamas, V. (2002). Implicit theories, goal orientations, and perceived competence: Impact on students' achievement behavior. *Psychology in the Schools, 39*, 279–291.
- Li, W., Lee, A. M., & Solmon, M. A. (2005). Relationships among dispositional ability conceptions, intrinsic motivation, perceived competence, experience, persistence, and performance. *Journal of Teaching in Physical Education, 24*, 51–65.
- Liebert, R. M., & Morris, L. W. (1967). Cognitive and emotional components of test anxiety: A distinction and some initial data. *Psychological Reports, 20*, 975–978.

- MacKinnon, D. P., Lockwood, C. M., Hoffman, J. M., West, S. G., & Sheets, V. (2002). A comparison of methods to test mediation and other intervening variable effects. *Psychological Methods, 7*, 83–104.
- McCrea, S. M., & Hirt, E. R. (2001). The role of ability judgments in self-handicapping. *Personality and Social Psychology Bulletin, 27*, 1378–1389.
- Molden, D. C., & Dweck, C. S. (2006). Finding “meaning” in psychology: A lay theories approach to self-regulation, social perception, and social development. *American Psychologist, 61*, 192–203.
- Morris, L. W., Davis, M. A., & Hutchings, C. H. (1981). Cognitive and emotional components of anxiety: Literature review and a revised worry-emotionality scale. *Journal of Educational Psychology, 73*, 541–555.
- Ommundsen, Y., Haugen, R., & Lund, T. (2005). Academic self-concept, implicit theories of ability, and self-regulation strategies. *Scandinavian Journal of Educational Research, 49*, 461–474.
- Pomerantz, E. M., & Saxon, J. L. (2001). Conceptions of ability as stable and self-evaluative processes: A longitudinal examination. *Child Development, 72*, 152–173.
- Robins, R. W., & Pals, J. L. (2002). Implicit self-theories in the academic domain: Implications for goal orientation, attributions, affect and self-esteem change. *Self and Identity, 1*, 313–336.
- Spielberger, C. D., & Vagg, P. R. (1995). *Test anxiety: Theory, assessment, and treatment*. Philadelphia, PA: Taylor & Francis.
- Steele, C. M. (1988). The psychology of self-affirmation: Sustaining the integrity of the self. In L. Berkowitz (Ed.), *Advances in experimental social psychology: Social psychological studies of the self: Perspectives and programs* (pp. 261–302). San Diego, CA: Academic Press.
- Stipek, D., & Gralinski, J. H. (1996). Children’s beliefs about intelligence and school performance. *Journal of Educational Psychology, 88*, 1996.
- Thompson, T., & Musket, S. (2005). Does priming for mastery goals improve the performance of students with an entity view of ability? *British Journal of Educational Psychology, 75*, 391–409.
- Wang, C. K. J., & Biddle, S. J. H. (2003). Intrinsic motivation towards sports in Singaporean students: The role of sport ability beliefs. *Journal of Health Psychology, 8*, 2003.
- Wechsler, D. (1996) *Eschelle d’Intelligence de Wechsler pour enfants Troisieme Edition* (Wechsler Intelligence Scale for Children—III). Paris: ECPA (Original work published 1971).