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ABSTRACT

Goal theory has become one of the most prominent perspectives in the study of academic motivation. Prior studies have found conflicting results regarding the relationship of goal orientation to cognitive engagement, academic achievement, and ability perceptions. Two hundred thirty-nine students from a large state university participated in this study. Results indicate that ability perceptions are significant predictors of students' goals, cognitive engagement, and grades, and that they indirectly contributed to performance on depth of processing, even when verbal ability was controlled. Furthermore, cognitive engagement mediated the effect of both performance-approach and mastery goals on depth of processing. This model fills in the gap in goal theory by answering the question why individuals choose goals by providing a powerful explanation for students' choices. (Contains 3 tables, 2 figures, and 20 references.) (Author/SLD)

# The Role of Prior and Perceived Ability in Influencing the Relationship of Goal Orientation to Cognitive Engagement and Academic Achievement

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Abstract

Goal theory has become one of the most prominent perspectives in the study of academic motivation. Prior studies have found conflicting results regarding the relationship of goal orientation to cognitive engagement, academic achievement, and ability perceptions. Two hundred thirty-nine students from a large state university participated in this study. Results indicate that ability perceptions were significant predictors of students' goals, cognitive engagement, and grades, and indirectly contributed to performance on depth of processing, even when verbal ability was controlled. Furthermore, cognitive engagement mediated the effect of both performance-approach and mastery goals on depth of processing. This model fills in the gap in goal theory by answering the question why individuals choose goals by providing a powerful explanation for students' choices.

The Role of Prior and Perceived Ability in Influencing the Relationship of Goal Orientation to Cognitive Engagement and Academic Achievement

In recent years goal theory has become one of the most prominent perspectives in the study of academic motivation. According to the basic tenets of achievement goal theory, students with mastery or learning goals are concerned with learning for its own sake, and students with a performance goal orientation are extrinsically motivated by grades or a need to be favorably compared with others (Covington, 2000). Mastery goals are hypothesized to lead to active cognitive engagement in learning; conversely, according to normative goal theory (Pintrich, 2000), performance goals are hypothesized to result in decreased engagement in academic tasks. Prior studies (Greene & Miller, 1996; Kaplan & Midgley, 1997; Meece, Blumenfeld, & Hoyle, 1988) have found conflicting results regarding these hypothesized relations. Consistent with recent research on achievement goal theory, performance-approach goals—those concerned with a positive, yet extrinsic motivation to succeed—have been found to be positively related to important student outcomes such as academic achievement, whereas performance-avoidant goals—those focused on avoiding failure—have been related to maladaptive student outcomes. Furthermore, mastery goals, although related to more adaptive strategy use and self-regulation, were unrelated to measures of academic achievement such as grades (Harackiewicz, Barron, & Elliot, 1998). On the other hand, Meece and her colleagues (1988) found that students who adopted performance goals had lower cognitive engagement than students who adopted mastery goals. Nevertheless, strong overall support exists for a tripartite model of goal orientation in which goals affect cognitions (strategies, self-regulation), which in turn affect achievement (Covington, 2000). Furthermore, both normative and revised goal theory may be reconciled if one takes into account the approach-avoidance dichotomy that comprises performance goals (Elliot, McGregor, & Gable, 1999).

Research on individual differences in goal orientation may help to clarify these relationships. In particular, the association between goal orientation and perceived ability has been the target of a great deal of recent research, in part due to the powerful explanation provided by theories of learned helplessness. For example, Dweck and Leggett (1988) proposed that performance goals are only maladaptive for students with low ability perceptions because under these conditions, performance goals lead to feelings of learned helplessness. Harter (1992) proposed a similar affective explanation for students high in self-perceptions of competence for a particular subject, finding that these students were more likely to have high interest and positive affect for that subject, which in turn predisposed them to adopt mastery, or learning goals. Kaplan and Midgley (1997), on the other hand, found evidence that perceived ability only moderated the relationship between mastery goals and behavior, rather than performance goals and behavior. Similarly, Greene and Miller's (1996) study of the effects on achievement due to goals, perceived ability, and engagement found that perceived ability influenced the relation between mastery goals and meaningful cognitive engagement, but did not have any influence on performance goals. Finally, Meece et al. (1988) found no relation between perceived competence and engagement in learning.

It is clear that further research is needed to clarify the relations among self-perceptions of ability, goal orientation, strategy use, and achievement. It is particularly important to use measures of cognitive engagement besides self-reported strategy usage to determine if such strategies make a difference in practice. There are a variety of means of assessing engagement, such as experimental tasks in which choice was monitored (e.g., Harter, 1992) or measures of self-reported interest (e.g., Harackiewicz et al., 1997), but most commonly, research on goal theory has relied on course or test grades (e.g., Kaplan & Midgley, 1997 or Greene & Miller, 1996) or self-reports of strategy usage and self-regulation (see, for example, Pintrich, 2000). The use of measures of actual engagement, such as depth of processing as described by Kirby and Woodhouse (1994), offer promise as a means of examining engagement in learning via students' cognitive processing. Although the question of whether memory research based on levels of processing is open to debate (see, for example, Baddeley, 1978), analysis of text summarizations, because they are similar to work done in classrooms and can be evaluated according to guidelines associated with deep as opposed to superficial processing, provides an ecologically valid means of assessing the degree to which students are able to reframe their existing knowledge and make connections with preexisting knowledge (Kirby & Woodhouse, 1994).

The purpose of our study was to improve our understanding of the effect of goals on classroom performance by (a) using a measure of actual academic engagement in addition to self-reported strategy usage and self-regulation, (b) analyzing causal relationships using structural equation modeling that controls for measurement error to specify relationships among latent variables, (c) controlling for verbal ability due to its probable correlation with perceptions of ability, and (d) estimating and comparing results for competing models. LISREL was used for all analyses, thus addressing issues of measurement error not taken into account in previous studies. Several hypotheses of interest were tested:

1. Relations among self-reported variables would be much stronger than with measures of actual cognitive engagement.

2. Perceived ability would be related to mastery but not performance goals.

3. Mastery and performance-approach goals would have a positive effect on cognitive engagement, and cognitive engagement would have a positive effect on depth of processing (actual cognitive engagement).

4. Performance goals, verbal ability, and perceived ability would be related to course grade, with the two ability items stronger predictors of grade than goals.

5. Verbal ability would attenuate relations that existed in models that accounted for perceived ability but not verbal ability.

## Method

### Participants

Two hundred thirty-nine undergraduate students (32% juniors, 28% seniors, 26% sophomores, 14% freshman) from 9 classes (6 in human development and 3 in measurement and evaluation) at a large, southern state university completed all measures related to the present study. SAT or ACT verbal scores were missing for 41 students. Comparisons of scores on all measures for the sample with and without verbal ability scores revealed slight differences (usually within a few hundredths of a point) on any of the measures. Furthermore, Lisrel analyses comparing models for both the larger sample ($N = 239$) and reduced sample ($N = 198$) produced the same parameter estimates, thus the reduced sample was deemed comparable to the sample with verbal ability scores and was the one reported in this study. Of these students, 46 were undergraduate preservice teachers, 83% were females, and 87% were Caucasian or Asian students. Five instructors chose to give their students extra credit for completing the measures, and two allowed them to complete the measures in lieu of another assignment.

### Procedure

Students were asked to complete a 72-item questionnaire on the first day, of which 26 items were used in the present study. They were then asked to read and summarize a passage concerning psychological theories of aggression for homework. Two days later (except in one class where due to instructor conflict they were seen one week later), one of the researchers returned to collect the homework and give a 10-item comprehension test on the aggression passage (results of which were not included in the present analyses due to low reliability of the test).

Measures

Response options for each of the 26 items on the subscales were 7-point Likert-type scales, ranging from 1 (not at all true of me) to 7 (very true of me). To account for measurement error in observed variables (Kline, 1998), each scale was divided into 2 or 3 indicators per construct. Exploratory factor analyses were used to guide the construction of the indicators.

Perceived Ability. Eight items ($\alpha$ = .87) obtained from Greene and Miller (1996) were used to assess students' class-specific perception of their ability. This scale focused on students' evaluation of their ability in either the measurement course or human development course and included comparisons with other students as well as independent self-ratings. An example item was "If I were to take another psychology (measurement) course, I'm sure I would do well." Indicators formed from this scale were PAT1 and PAT2.

Mastery Goal Orientation. ($\alpha$ = .84) Items on this and the performance goal orientation scale were obtained from Harackiewicz et al. (1997). The mastery goal scale focused on students' general and class-specific engagement in learning for its own sake. A sample item was "In a class like this, I prefer course material that really challenges me so I can learn new things." Indicators formed from this scale were MGT1 and MGT2.

Performance Goal Orientation. ($\alpha$ = .72) This scale contained items that emphasized motivators for learning other than intrinsic interest. Exploratory factor analyses yielded a one factor solution, but only items related to performance goals based on grades and testing loaded strongly on that factor. The remaining items shared very low correlations and represented a disparate group of ego-comparison (e.g., "My goal in this class is to get a better grade than most of the other students.") as well as avoidance goals (e.g., "My fear of performing poorly this semester is what motivates me."); therefore, only the items that related to the performance-approach goals that loaded on the first factor were used in this study (e.g., "The main reason I attend lecture and do work in this class is because we get tested on it.") Three items from this scale (PG1, PG4, PG8) were used as single item indicators of performance-approach goals.

Self-Reported Cognitive Engagement. ($\alpha = .80$) Items from Pintrich and his colleagues' Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich et al., 1991) that reflected deep processing strategies and adaptive strategy use formed this composite. Examples include "When I study, I put important ideas into my own words." "I ask myself questions to make sure I know the material I have been studying." Indicators formed from this scale were STRAT1 and STRAT2.

The following measures were also obtained.

Depth of processing. For homework, students read a short passage on aggression, adapted from Schommer's dissertation research (1989), but which could have come from any introductory psychology text. In order to represent a typical assignment in the undergraduate program at this university, instructions on the first page directed students to "please study this chapter as if you were preparing for a test," to work independently, and to underline or write in the booklet if desired. On the final page, students were asked to write a summary of the passage. In the passage, different theories of aggression were presented without any conclusions being drawn as to their merit. To evaluate these summaries, two of the researchers developed rubrics, based on Kirby and Woodhouse's (1994) criteria for assessing deep processing of texts. Students' scores ranged from 1 (no coherence, writing does not summarize passage) to 7 (summary reconceptualizes the passage according to a relational framework that includes all key ideas in the passage but does not strictly follow the sequence of the text). Interrater reliability was 92%. Kappa's coefficient for interrater agreement was .70.

Verbal ability. Students provided their scores on the verbal portion of the SAT or ACT (a linear transformation of ACT scores was used to make ACT and SAT scores comparable). Scores ranged from 270 to 740.

Grades. Students' final grades in their course were obtained from their instructors. The range of grades was from 2 to 8, with 2 being a D; 3 a D+; to 8 being an A.

Analysis

A two-step process of structural equations modeling (SEM) recommended by Kline (1998) for investigating latent variable models was used to analyze the relationships among the variables according to theory and research on goals, engagement, and achievement. Latent variable models have the advantage over path analyses with observed variables of correcting for measurement error in the observed variables. Maximum likelihood estimation was used in all analyses. Two models were of interest—Model A, similar to prior research on goal theory, and Model B, which included verbal ability. First, a confirmatory factor analysis was conducted to assess whether the initial factor structure fit the data well. Because single item indicators (e.g., depth of processing and verbal ability) are estimated by Lisrel as free of measurement error, we used reliability estimates to get external estimates of error for these fixed parameters. Next, a series of simultaneous equation models among the latent variables was specified in order to test our hypotheses about the direction of effects on each variable. Even if a well-fitting model is obtained, this is not proof that a causal relationship exists among the latent variables. Rather, it provides a reasonable test of the researcher's assumptions and works best as a means for rejecting poor fitting models than as an unqualified endorsement of a good-fitting model (Kline, 1998).

For this study, goodness-of-fit was assessed in a variety of ways according to the guidelines specified by Hu and Bentler (1998). Specifically, error variances were examined for irregularity, specifically for evidence of negative estimates, a sign of a problem with the model. Next, goodness-of-fit indices, in particular the Standardized Root Mean Residual (SRMR) and the Comparative Fit Index (CFI), were analyzed according to the index choice and cutoff criteria recommended by Hu and Bentler. Notably for our study, the SRMR is less affected by violations of nonnormality than are other goodness of fit indices. Cutoff criteria of .08 for the SRMR and .95 for the CFI were deemed reasonable. In addition, the $\chi^2/df$ statistic, recommended by Kline (1998) was examined, with a cutoff of 3 or greater indicating poor fit. LISREL 8 (Jöreskog & Sörbom, 1993) was used to perform all stages of the structural analysis.

## Results

### Descriptive Statistics and Correlational Analyses

Correlations, means, standard deviations, and reliability estimates for the indicators are presented in Table 1. On all of the self-report measures besides depth of processing, undergraduate students scored above the mid-point for the 7-point scale. Most of the data exhibited some degree of skewness. Students' grades were the only variable to demonstrate kurtosis as well. Because the standard errors for nonnormal data may be underestimated in analyses like Lisrel that assume normality, the asymptotic covariance matrix, which does not assume normality when used to calculate standard errors, was included in the Lisrel analyses.

An examination of the zero-order correlation matrix revealed that all of the performance goal items were negatively correlated with all of the other indicators and measures, with the largest negative correlations occurring between mastery and performance goal indicators. The largest positive correlations were those between two indicators of the same construct, as they should be to support the construct validity of the measures.

### Model A

Fit statistics for the first measurement model, in which each indicator was set to load on its respective factor (i.e., PAT1 and PAT2 on perceived ability, etc.), are presented in row 1 of Table 2. Standardized factor loadings ranged from a .63 (PG1 on performance goals) to .95 (PAT1 on perceived ability). All loadings were large, positive, and significant; the error variances were positive and significant as well. The fit of the model was sound: The hypothesis that the data fit the model exactly was not rejected ($p = .93$), and the goodness-of-fit indices were well within the criteria specified by Hu and Bentler (1998).

Next the initial model was estimated based on a review of the literature on goal theory and perceived ability. Perceived ability was specified as an exogenous variable; all other variables were endogenous. This model is depicted in Figure 1 and includes the paths represented by dashed lines, but not the path from perceived ability to self-reported cognitive engagement. Error variances for mastery and performance goals were allowed to correlate to account for shared common causes of these two types of "approach" goals that were not specified in the model. This correlation was significant ($r = -.55$, $p < .05$) for all of the models estimated , and thus was retained in each subsequent analysis. The $X^2_{difference}$ statistic was used to determine if fit between a more simpler model with less paths nested in a more complex model significantly depreciated once parameters were removed from the model. If the difference in the chi-squares between the two models is not significant, then that is evidence that the simpler model does not fit the data any worse than the more complex model, and thus is usually desirable for reasons of parsimony, if the simpler model makes theoretical sense.

Although the general fit of the initial model was adequate (see row 2 of Table 2), this model fit significantly worse than the measurement model; in addition, it contained a large modification index for the relation between perceived ability and cognitive engagement and a number of nonsignificant effects. Another model was estimated, taking into account these findings. We considered that it was quite conceivable that perceived ability exerted a direct effect[1] on self-reported cognitive engagement, so that path was added to the second model. Paths representing nonsignificant direct, indirect, and total effects were eliminated from the model, according to basic model trimming guidelines (Kline, 1998).

Results for the final model estimated for A are presented in row 3 of Table 2. This model did not fit significantly worse than the measurement model or the initial model, which, combined with its robust fit statistics, was an indicator of its adequacy as a structural model that sufficiently accounted for relationships among the latent constructs. Large effects (Kline, 1998) were found between mastery goals and perceived ability ($\beta = .48$), mastery goals and self-reported cognitive engagement ($\beta = .79$), and perceived ability and grade ($\beta = .57$). Unstandardized path coefficients and their standard errors are presented in Figure 1.

In sum, according to this model, our hypothesis that self-reported cognitive engagement and actual cognitive engagement would be positively related to each other was not supported, neither were the findings by Greene and Miller (1996) of no relation between ability perceptions and performance goals or between performance goals and meaningful cognitive engagement, nor their finding of a positive relationship between cognitive engagement and midterm grade. Rather, in the final model for A, perceived ability was the only factor associated with course grade, and it had both direct and indirect effects on self-reported cognitive engagement and depth of processing. Additionally, in support of Harackiewicz and Elliot's (Elliot & Harackiewicz, 1996; Harackiewicz et al., 1998) research on achievement goals, performance-approach goals were positively related to self-reported cognitive engagement.

Model B

In light of our interest in the effect of verbal ability on the relationships discussed above, model B was estimated with verbal ability included as an observed variable. As part of the two-step process of specifying latent variable models, the measurement model was estimated first. Fit statistics are presented in row 4 of Table 2. Again, the measurement model demonstrated good fit with the data. Standardized factor loadings are presented in the bottom panel of the table. All indicators have moderate to high and significant, positive loadings on their respective latent variables.

The first structural model that was estimated is presented Figure 2 and included the 3 paths marked by dotted lines to course grade, but not the bold-faced path for the effect of verbal ability on mastery goals. Verbal ability was thought to directly impact perceived ability, depth of processing, and course grade, but to have indirect if any effects on goals and cognitive engagement. Row 5 of Table 2 presents the fit statistics for this initial model. Fit was satisfactory and did not worsen when compared with the measurement model. An examination of the modification indices, however, indicated that a path from verbal ability to mastery goals might be warranted. This path was added, and a t test indicated that the relationship between the 2 variables was significant ($t = -2.43$, $p < .05$). Results for this second model are presented in Row 6 of the table. Note that the $X^2_{\text{difference}}$ test revealed that the initial model fit the data worse than this second, less parsimonious model.

In both the initial and second versions of model B, paths between course grade and self-reported cognitive engagement ($t = -.93$, $p < .05$), performance goals ($t = -.32$, $p < .05$), and depth of processing ($t = 1.17$, $p < .05$) were nonsignificant. In addition, none of these latter 3 variables had significant total or indirect effects with grade, thus they were deleted from the final model. The fit of this model was also satisfactory (see row 7 of Table 2), and fit did not significantly decrease with the deletion of these paths. Standardized direct, indirect, and total effects are presented in Table 3. Most of the effects were similar in size and direction to those presented in Figure 1 for Model A with the exception of two latent variable relationships. First, the path from perceived ability to depth of processing was nonexistent in Model B; instead, the relationship from verbal ability to depth of processing became significant. Next, in Model B, there was a significant direct effect of self-reported cognitive engagement on depth of processing as hypothesized.

The only puzzling effect was the one between verbal ability and mastery goals. Although the indirect effect was positive (via perceived ability), the direct effect of verbal ability on mastery goals was negative, thus rendering the total effect nonsignificant. Therefore according to this model, the higher an undergraduate student's verbal ability, the less likely it was that he or she endorsed mastery (learning) goals in class. Other relevant effects include the greater proportion of variance accounted for in depth of processing in model B (.07 in Model A compared to .15 in B) and that verbal ability only accounts for 9% of the variance in perceived ability. Additionally, the structural models accounted for a large percentage of the variance in self-reported cognitive engagement ($R^2$ = .55), but accounted for more modest proportions of variance in the other endogenous variables. The largest discrepancy, or noncausal correlation in this model, was between mastery and performance goals, and was expected due to allowing the error covariances to vary between these two factors.

Although performance goals had a positive effect on self-reported cognitive engagement, perceived ability had a negative relationship to performance goals. Finally, whereas in Model A, only perceived ability had a direct effect on depth of processing, in Model B, not only do self-reported cognitive engagement and verbal ability have direct effects with depth of processing, but perceived ability ($\underline{t} = 2.83$, $\underline{p} < .05$), mastery goals ($\underline{t} = 2.65$, $\underline{p} < .05$), and performance goals ($\underline{t}$ = 2.00, $\underline{p} < .05$) each have significant indirect relationships with this measure of actual student performance on classroom tasks.

Results of Hypothesis Testing

The first hypothesis, that relations among the self-reported variables would be much stronger than those among the behavioral measures of engagement and achievement was supported in both models for the effects between mastery goals and self-reported cognitive engagement. On the other hand, the relation between ability perceptions and mastery goal orientation was about equal to the effect of perceived ability and grade. The second half of the next hypothesis, that perceived ability would be have an effect on mastery but not performance goals, was rejected. Perceived ability had a moderate negative effect on performance goals. The third hypothesis, that mastery and performance-approach goals would have a positive effect on cognitive engagement, and cognitive engagement would have a positive effect on depth of processing, was supported only in Model B. Moreover, there was no effect on course grades via performance goals in either model. As predicted, both verbal and perceived ability had an effect on course grade with the greater effect being due to ability perceptions, probably because they were more course specific. Lastly, verbal ability did attenuate relations that existed in Model A, specifically, the effect on depth of processing via perceived ability became nonsignificant in Model B. On the other hand, a previously non-existent relationship in Model A, that between self-reported cognitive engagement and depth of processing, became significant once verbal ability was accounted for in Model B.

## Discussion

The present study supports previous findings in the literature concerning the relationships between mastery goals, perceived ability, and self reports of cognitive strategy use and self-regulation. In addition, we found evidence that self-reports of engagement and actual engagement were related, and that the effects of goals and ability perceptions on actual engagement were mediated by cognitive strategy usage. Knowing that both mastery and performance-approach goals were related to more than self-reported strategy use strengthens the usefulness of both the revised and normative versions of achievement goal theory as described by Pintrich (2000). Furthermore, in his recent review of goal theory, Covington (2000) pointed out that "goal theory leaves largely unaddressed the question of why individuals choose one goal over the other" (p. 172). The model supported in this study helps to fill in this gap in goal theory by indicating a potent explanation for students' choices. Perceptions of ability, that is, students' efficacy beliefs, were a significant predictor of both mastery and performance-approach goals. Students who differed by one standard deviation in their ability perceptions differed on average by a half-standard deviation on their mastery goal orientation. In our sample, undergraduates with low perceptions of their ability were more likely to be motivated by grades and testing than by the intrinsic desire to learn for its own sake.

Concerning students' academic achievement as indexed by their course grade, goals had neither indirect nor direct effects on grade; rather, only prior ability and perceived ability were significant predictors of course grade. This was probably due to the general emphasis in these 2 undergraduate courses on more superficial learning and rote memorization of content. Interestingly, verbal ability only accounted for 9% of the variance in perceived ability; therefore, one cannot claim that efficacy beliefs are solely based on true perceptions of ability. Both the human development and measurement courses focused on understanding of text rather than mathematical ability, thus one would expect that verbal ability would have an effect on their grades, which, indeed it did. However, the effect of ability perceptions on grade was more than twice that of verbal ability, leading us to suspect that finding ways to increase students' beliefs in their competence—the primary way of doing so being to facilitate their experiences of mastering course content, according to Bandura (1997)—should be emphasized when teaching undergraduate students.

There were several limitations of this study, one being that performance-avoidant goals were unable to be included in the study due to problems with the instrument. In the future, an instrument with several items relating to all the different aspects of performance goals (concern with testing, with social comparisons, and with work avoidance) should be used, then different indicators could be specified to load on each of the different aspects of performance goals. Unlike previous research that was able to distinguish between approach and avoidance aspects of performance goals (see, for instance, Elliot et al., 1999), exploratory factor analyses failed to find such a two factor solution. Rather, performance goals associated with grades were distinct from those concerned with social comparisons, and both were distinct from avoidance goals. Another limitation was the unexpected finding that verbal ability had a negative direct relationship to mastery goals but a positive indirect one via perceived ability. Moreover, ability perceptions had a large positive direct relationship to mastery goals. More research is needed to see if these results would be replicated in a different sample of undergraduate students, particularly ones with more variance on their grades. This relates to another limitation of the study—the lack of diversity of the sample. Not only was the sample predominantly white and female, but the majority of students (68%) scored between a B and an A on their grade for the course. Therefore, this study should be replicated with a sample of students more diverse in performance and demographic characteristics.

Besides addressing the limitations of this study, an important question for future research is what other individual differences are related to goal adoption in school? Harackiewicz and her colleagues (1997) have begun to address this question in their experimental research by investigating personality characteristics, such as competitiveness, but other differences, such as beliefs and implicit theories, are also worthy of investigation. Dweck and her colleagues (1988) have investigated the relation between goals and motivational beliefs, such as theories of intelligence, but subject matter and epistemological beliefs seem likely to influence goal orientation as well (Eccles, Wigfield, & Schiefele, 1998).

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Table 1

Correlation Matrix, Standard Deviations, Means, and Factor Loadings of the Observed Variables

| Indicators | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | α |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. PAT1 | 1.00 | | | | | | | | | | | .76 |
| 2. PAT2 | .86 | 1.00 | | | | | | | | | | .73 |
| 3. MGT1 | .42 | .42 | 1.00 | | | | | | | | | .79 |
| 4. MGT2 | .39 | .37 | .77 | 1.00 | | | | | | | | .66 |
| 5. PG1 | -.27 | -.25 | -.43 | -.43 | 1.00 | | | | | | | -- |
| 6. PG4 | -.29 | -.26 | -.49 | -.47 | .43 | 1.00 | | | | | | -- |
| 7. PG8 | -.27 | -.25 | -.47 | -.51 | .51 | .59 | 1.00 | | | | | -- |
| 8. Strat1 | .42 | .40 | .44 | .49 | -.20 | -.19 | -.15 | 1.00 | | | | .64 |
| 9. Strat 2 | .41 | .35 | .46 | .49 | -.23 | -.24 | -.19 | .68 | 1.00 | | | .68 |
| 10. Depth | .22 | .23 | .10* | .17 | -.15 | -.13* | -.20 | .20 | .18 | 1.00 | | -- |
| 11. GPA | .54 | .52 | .21 | .18 | -.22 | -.17 | -.19 | .22 | .15 | .23 | 1.00 | -- |
| 12. SAT[a] | .27 | .26 | .07* | .02* | -.23 | .00* | -.13* | .02* | -.02* | .27 | .34 | -- |
| M | 5.07 | 5.22 | 4.47 | 4.61 | 4.96 | 5.03 | 5.86 | 5.32 | 4.90 | 3.45 | 7.12 | |
| SD | 1.08 | 1.06 | 1.24 | 1.01 | 1.67 | 1.75 | 1.34 | 1.03 | 1.05 | 1.39 | 1.21 | |
| Factor Loadings | .95 | .90 | .86 | .89 | .64 | .72 | .80 | .84 | .81 | -- | -- | |

Note. N = 198. PAT = perceived ability indicators; MGT = mastery goal indicators; PG =performance goal item; Strat = cognitive engagement indicators. α = Cronbach's alpha: Dashed lines indicate reliability or loading was not available (e.g., for single item measures).

*$p > .05$ [a] For SAT: M = 534.31, SD = 84.78

Table 2

Fit Statistics for Models of Engagement and Academic Achievement

| Model | $\chi^2$ | *df* | $\chi^2/ df$ | $\Delta\chi^{2a}$ | $\Delta df$ | CFI | SRMR |
|---|---|---|---|---|---|---|---|
| | | | Base Model A (without verbal ability) | | | | |
| 1. Measurement | 20.36 | 31 | .66 | -- | -- | 1.00 | .024 |
| 2. Initial Model A | 37.26 | 35 | 1.07 | 16.9*(1) | 4 | 1.00 | .045 |
| 3. Final Model A | 32.05 | 38 | .84 | 5.21(2) | 3 | 1.00 | .038 |
| --compared to 1 | | | | 11.69(1) | 7 | | |
| | | | Target Model B (with verbal ability) | | | | |
| 4. Measurement | 32.56 | 36 | .90 | -- | -- | 1.00 | .030 |
| 5. Initial Model B | 43.59 | 43 | 1.01 | 11.03(4) | 7 | 1.00 | .043 |
| --5 nested in 6 | | | | 5.70*(6) | 1 | | |
| 6. Second Model B | 37.89 | 42 | .90 | 5.33(4) | 6 | 1.00 | .036 |
| 7. Final Model B | 39.66 | 45 | .88 | 1.77(6) | 3 | 1.00 | .038 |
| --compared to 4 | | | | 7.10(4) | 9 | | |

Note. SRMR = Standardized Root Mean Residual. CFI = Comparative Fit Index. All models exceed the criteria established by Hu & Bentler, 1998 (CFI $\geq$ .95; SRMR $\leq$ .08) and Kline, 1998 ($\chi^2/ df < 3$) for good fit. Furthermore, hypotheses tests of each of the above model chi-squares fail to reject the null hypothesis of exact fit.

[a] Numbers in parentheses signify the model in which the given model was nested.

*p < .05: This indicates that model fits significantly worse than the model in parentheses.

Table 3

Decomposition of Standardized Effects for Academic Engagement and Achievement

| Latent Variable Relationships | r | DE | IDE | Total | Disc. |
|---|---|---|---|---|---|
| On Perceived Ability (.09)[a] | | | | | |
| • of Verbal Ability | .30 | .30 | .00 | .30 | .00 |
| On Mastery Goals (.25) | | | | | |
| • of Verbal Ability | .01 | -.15 | .16 | .01 | .00 |
| • of Perceived Ability | .48 | .52 | .00 | .52 | .04 |
| On Performance Goals (.15) | | | | | |
| • of Verbal Ability | -.12 | .00 | -.12 | -.12 | .00 |
| • of Perceived Ability | -.39 | -.39 | .00 | -.39 | .00 |
| • Mastery Goals | -.74 | .00 | .00 | .00 | .74 |
| On Cognitive Engagement (.55) | | | | | |
| • of Verbal Ability | .05 | .00 | .05 | .05 | .00 |
| • of Perceived Ability | .52 | .28 | .27 | .56 | .04 |
| • of Mastery Goals | .65 | .80 | .00 | .80 | .15 |
| • of Performance Goals | -.32 | .38 | .00 | .38 | .06 |
| On Depth of Processing (.15) | | | | | |
| • of Verbal Ability | .31 | .30 | .01 | .31 | .00 |
| • of Perceived Ability | .21 | .00 | .13 | .13 | .08 |
| • of Mastery Goals | .16 | .00 | .19 | .19 | .03 |
| • of Performance Goals | -.11 | .00 | .09 | .09 | .02 |
| • of Cognitive Engagement | .25 | .24 | .00 | .23 | .02 |

| | r | DE | IDE | Total | Disc. |
|---|---|---|---|---|---|
| On Grade (.36) | | | | | |
| • of Verbal Ability | .36 | .21 | .15 | .36 | .00 |
| • of Perceived Ability | .56 | .50 | .00 | .50 | .06 |
| • of Mastery Goals | .24 | .00 | .00 | .00 | .24 |
| • of Performance Goals | -.22 | .00 | .00 | .00 | .22 |
| • of Cognitive Engagement | .27 | .00 | .00 | .00 | .27 |
| • of Depth of Processing | .17 | .00 | .00 | .00 | .17 |

Note. DE = direct effect of one latent variable on another according to the final estimated structural model. IDE = indirect effect. Total = total of DE and IDE. Disc. = Discrepancy, or non-causal correlation unaccounted for by model. R = model-estimated correlation between the latent variables. [a] ($R^2$) = the proportion of variance accounted for in the latent variable by the structural equations.

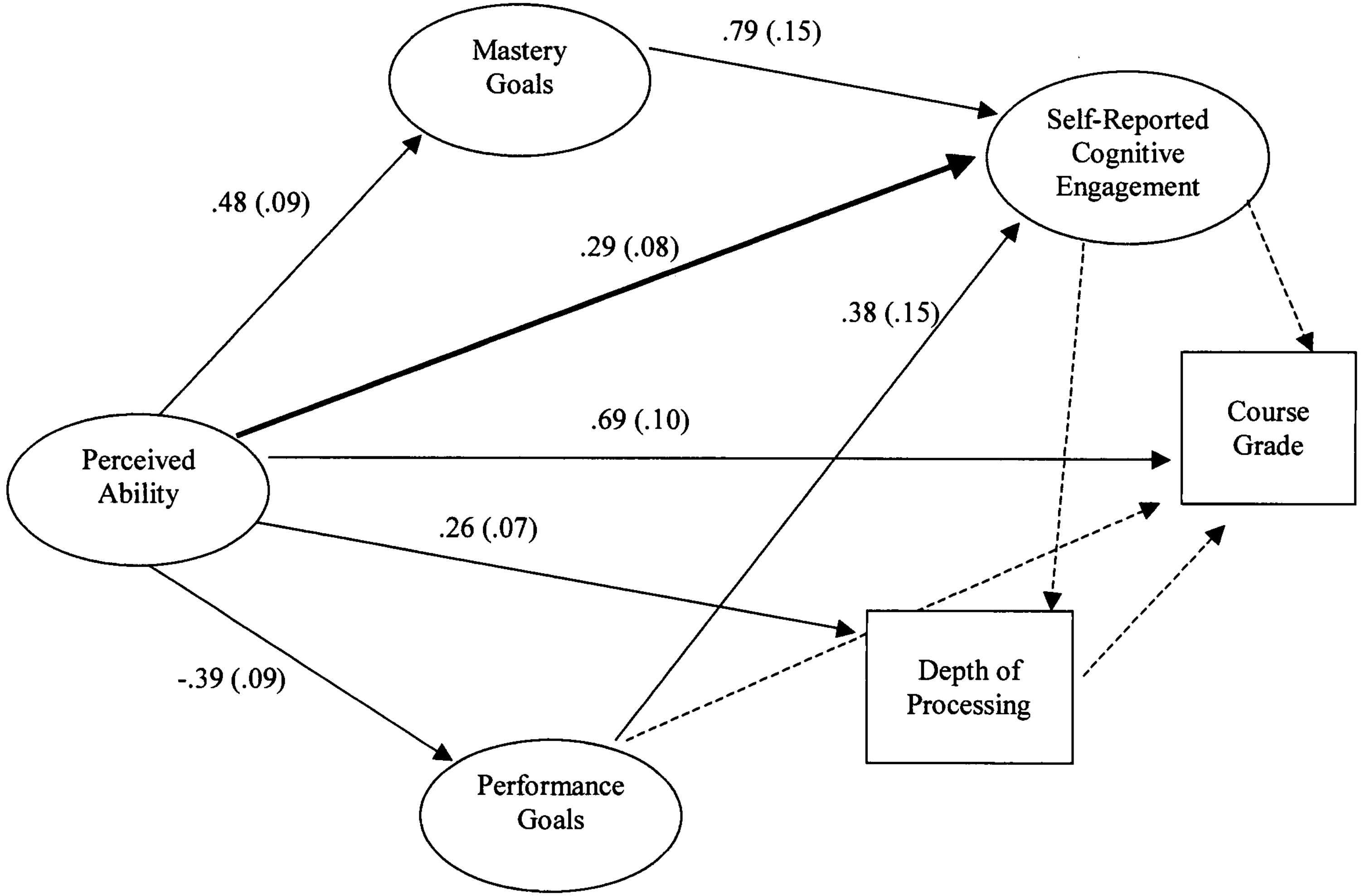
## Figure Captions

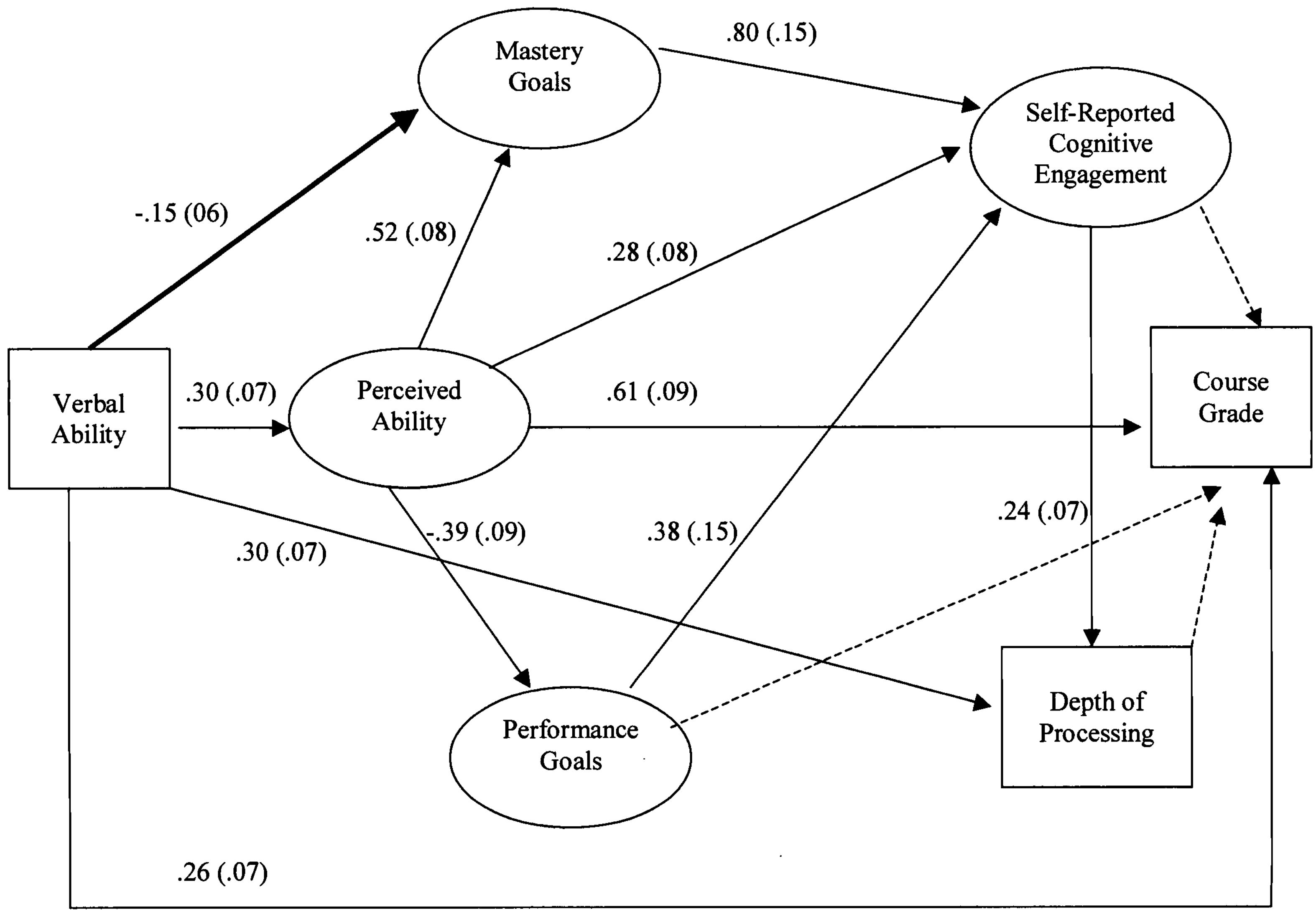
Figure 1. Initial and final versions of structural equation model. Dashed lines indicate paths that were initially estimated in the theoretical model but which were found to be nonsignificant and deleted in the final model. The path in boldface indicates a path that was added to the final model. Numbers in parentheses are standard errors for the final model. Numbers not in parentheses are the unstandardized path coefficients for the final model. All paths marked by a continuous arrow are significant at $\alpha = .05$.

Figure 2. Path coefficients for the final structural equation model B. Dashed lines indicate paths that were initially estimated in the theoretical model but which were found to be nonsignificant and deleted in the final model. The path in boldface indicates a path that was added to the second and third versions of this model. Numbers in parentheses are standard errors. Numbers not in parentheses are the unstandardized path coefficients. All paths marked by a continuous arrow are significant at $\alpha = .05$.

## Footnotes

[1] Although the term "effects" is standard usage in Lisrel analyses, we are not claiming causal effects when we use this language.


Mastery Goals
Self-Reported Cognitive Engagement
Perceived Ability
Course Grade
Depth of Processing
Performance Goals
.79 (.15)
.48 (.09)
.29 (.08)
.38 (.15)
.69 (.10)
.26 (.07)
-.39 (.09)


Mastery
Goals
.80 (.15)
Self-Reported
Cognitive
Engagement
-.15 (06)
.52 (.08)
.28 (.08)
Verbal
Ability
.30 (.07)
Perceived
Ability
.61 (.09)
Course
Grade
.24 (.07)
-.39 (.09)
.38 (.15)
.30 (.07)
Performance
Goals
Depth of
Processing
.26 (.07)

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