



## Time-on-task mediates the conscientiousness–performance relationship

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### Abstract

The relationships between conscientiousness, time-on-task, and academic performance were investigated in a mediation model. When simple summated conscientiousness scores were analyzed, relationships with performance and time-on-task were not significant. When factor scores estimated in the context of a model assuming common method bias were analyzed, conscientiousness was a significant predictor of test performance, and time-on-task fully mediated the conscientiousness–performance relationship. The relationships held for conscientiousness alone and for conscientiousness controlling for cognitive ability.

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### 1. Introduction

Previous research has consistently shown conscientiousness to be both a singly valid and incrementally valid predictor of performance in a wide variety of occupational groups (e.g., Barrick & Mount, 1991; Hurtz & Donovan, 2000; Mount & Barrick, 1998; Schmidt & Hunter, 1998). Conscientiousness also predicts performance in academic settings (e.g., Chamorro-Premuzic &

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Furnham, 2003; Conard, 2004; Wolfe & Johnson, 1995). In spite of the large amount of research investigating the conscientiousness–performance relationship, “very little research has examined the mechanisms through which personality traits influence performance” (Barrick, Stewart, & Piotrowski, 2002, p. 43). Although at least four mediating mechanisms have been proposed for the conscientiousness–performance relationship including self-efficacy (Chen, Casper, & Cortina, 2001; Klein & Lee, 2006), performance expectancy (Gellatly, 1996), accomplishment striving via striving for job performance (Barrick et al., 2002), and selective optimization with compensation (Bajor & Baltes, 2003) it is possible that there might be other mechanisms explaining the processes by which conscientiousness influences various job-related outcomes. One such process is time spent on planning for and attempting to accomplish the task at hand. Since there is evidence that such time is positively related to performance in a learning context (Vancouver & Kendall, 2006), it seems worthwhile to investigate time-on-task as a possible channel through which conscientiousness predicts performance.

Since training in organizations is often analogous or even identical to classroom education, the conscientiousness–performance relationship in academic settings is relevant to organizations. In particular, factors that lead to better training performance should be expected to be important for better job performance after training (e.g., Arthur, Bennett, Edens, & Bell, 2003). For these reasons, we investigated the efficacy of time-on-task as a mediator of the conscientiousness–performance relationship in an academic setting.

The positive linkage between conscientiousness and time-on-task can be drawn from two successful self-regulation theories: social cognitive (Bandura, 1991), and control theory (Powers, 1973). First, according to Bandura’s (1991) social cognitive theory of self-regulation, individuals are motivated by a self-regulatory mechanism which includes the judgment of one’s behavior in relation to personal standards and situational constraints. In the academic performance context, the self-regulation process will influence individuals’ proactive behavior of setting challenging goals and subsequently spending time studying in order to achieve desired goals. One meta-analytic estimate shows conscientiousness having an average correlation of .22 with both goal difficulty and performance motivation viewed under Bandura’s social cognitive theory (Judge & Ilies, 2002, Tables 1 and 2; pp. 801–802). Recently, researchers found that student homework and goal setting behavior were both positively related to conscientiousness – students scoring high on conscientiousness were found to spend more time doing their homework and to set harder

Table 1  
Means, standard deviations, and correlations

	<i>M</i>	<i>SD</i>	1	2	3	4	5	6
1 Summated conscientiousness	4.75	0.86	(.79)					
2 Conscientiousness factor scores	−0.02	0.69	.76 <sup>b</sup>	(.86)				
3 Study time	3.28	0.69	.14	.20 <sup>a</sup>	(.79)			
4 Wonderlic	21.83	6.16	.02	.08	.21 <sup>a</sup>			
5 Test	76.25	15.21	.09	.20 <sup>a</sup>	.39 <sup>b</sup>	.45 <sup>b</sup>		
6 Method bias factor scores	0.00	0.13	.66	.12	.05	.01	−.03	(.92)

Values on diagonal are coefficient alpha values for summated scales, factor determinacies for factor scores.

<sup>a</sup>  $p < .05$ .

<sup>b</sup>  $p < .001$ .

goals as well as being more committed to the goals than their low conscientious peers (Klein & Lee, 2006; Trautwein & Lüdtke, 2007). These studies suggest that the self-regulating process is more prominent in those high in conscientiousness.

Viewed under control theory, (Powers, 1973) conscientious individuals are better at planning for preparation needs, thus, better job performers. Whereas Bandura's (1991) social cognitive theory views goal difficulty that regulates behavior as an external specification, Powers' control theory views goal level as an internal specification. Specifically, control theory postulates that individuals constantly compare the perceived external situation (e.g., preparedness for an exam) and an inner specification (e.g., desired goal level) in self-regulation. The difference of the two states drives behavior. Accordingly, in an academic learning context, in some studies students were found to be motivated to allocate resources (e.g., time-on-task) towards job tasks which they had not mastered based on their subjective assessment of preparedness (e.g., Vancouver & Kendall, 2006). In other words, it is students' subjective assessment of preparedness rather than actual or objective reality of preparedness that drives resources allocation. Thus, both social cognitive theory and control theory postulate that individuals high in conscientiousness will be more likely to achieve their goals through a self-regulation process.

Reported time-on-task might be an indicator of time management. Previous research has found effective time management behavior to be related to academic performance (Zimmerman, Bandura, & Martinez-Pons, 1992). Further, Gettinger and White (1979) found students' study time to be incrementally predictive of standardized test performance over IQ. Thus we expect that study time will be positively related to course performance.

Given the above results, it was expected that time-on-task, operationalized here as reported study time, would at least partially mediate the conscientiousness–performance relationship in an academic setting.

## 2. Method

### 2.1. Measures

#### 2.1.1. Conscientiousness

The 50-item questionnaire assessing the Big Five dimensions from the IPIP web site was used to measure conscientiousness (Goldberg, 1999). Items were rated on how accurately they represented the respondent using a seven-point scale ranging from 1 (completely inaccurate) to 7 (completely accurate). All 50 items were administered though only the 10 conscientiousness items were scored. Coefficient alpha for the conscientiousness scale was .79.

A second measure consisting of factor scores from a confirmatory factor analysis of the Big Five items was also investigated. It is discussed below.

#### 2.1.2. Study time

Study time was measured using a scale developed for this research consisting of nine questions related to study and test-taking habits, and the number of hours spent studying for the first test.

An exploratory factor analysis of responses to 18 items and the logarithm of self-reported number of hours spent studying was conducted using maximum likelihood factor extraction. Based on a scree test and parallel analysis (O'Connor, 2000), three factors accounting for 40% of the variance were retained and subjected to oblique rotation. Twelve items referring to test preparation had largest loadings on the first factor. Two other factors, one indicated by items referring to study habits not related to time and the other indicated by items related to test-taking behavior were excluded from consideration. Two items were excluded from the first factor because the activities to which they referred were judged to be too nonspecific. A third was dropped because its loading was less than .2, leaving nine items to define the study-time scale. Coefficient alpha for the study time scale was .79. Items and factor loadings are available from the first author.

### 2.1.3. Performance

Performance was measured as the score on the first test of the semester in an introductory psychology course. The test consisted of multiple choice questions with an essay component. No estimate of reliability was available for the test.

### 2.1.4. Control variables

Scores on the Wonderlic personnel test (WPT; Wonderlic, 2005) were included to allow assessment of incremental validity in the mediation analyses described below. Internal consistency reliabilities of .88–.94 have been reported for the WPT (Wonderlic, 2005).

## 2.2. Participants

Participants were 188 undergraduates enrolled in an introductory psychology course at a southeastern university in the USA participating for extra credit. Two participants were lost due to failure to complete the WPT; two were lost due to large numbers of missing responses on the Big Five questionnaire; 18 failed to take the midterm test, and 39 failed to respond to an email requesting study time information. Exclusions for one or more of the above reasons left the sample size for tests of mediation at 135 while sample size for analyses involving only the Big Five data was 184. Eleven participants omitted one item when filling out the Big Five questionnaire. Little's (1988) test suggested that the data were missing at random ( $\chi^2(441) = 611.165, p < .001$ ), so we imputed the 11 missing values using a method described by Schafer & Graham (2002, p. 161) as essentially unbiased under MAR. This method involved a regression imputation in which imputed values were selected from a conditional distribution of the missing variable given the available items. The mean age was 19.5 (SD = 2.9); 52 were male; 82 were Caucasian, 41 African American, five Asian/Pacific Islander and seven Hispanic, Native American, or other.

## 2.3. Procedure

Participants were administered the Big Five questionnaire followed by the WPT in the first three weeks of the fall semester. They were then asked if they would like to continue in the study for additional extra credit points. On the day of the first test, those who agreed were emailed the

study habits questionnaire and instructed to respond to the items on the email and return it to the researcher. Study habits emails were returned before students saw reports of their scores on the test. Thus the independent variable (conscientiousness) was measured prior to the potential mediator (study time) which was obtained prior to participant knowledge of the criterion (test) results (Miller, Triana, Reutzler, & Certo, 2006).

### 3. Results

Correlations, means and standard deviations of all variables are presented in Table 1. Two parallel mediation models were evaluated. Both are presented in Fig. 1. In the first, only conscientiousness was included in the mediation analyses. The simple correlation of the predictor to the criterion, labeled total effect in the figure, and the mediated relationship, labeled mediated effect, were tested. For the second model shown at the bottom of Fig. 1, the WPT was added as a predictor and partialled in all the analyses. The models were evaluated using bootstrap methods (e.g., Bollen & Stine, 1990) implemented in Amos Version 6.0 (Arbuckle, 1995–2005). Estimates of the coefficients of the mediation model along with bias corrected limits of 95% confidence intervals are presented in Table 2.

Inspection of Table 2 indicates that the summated conscientiousness measure was only weakly related to the test (path c in Fig. 1) and to the study time measure (path a in Fig. 1). In both cases, the 95% confidence interval included zero, suggesting that the hypothesis of no relationship in the population cannot be rejected. Thus, there is little to mediate in the relationship of summated conscientiousness to test scores.

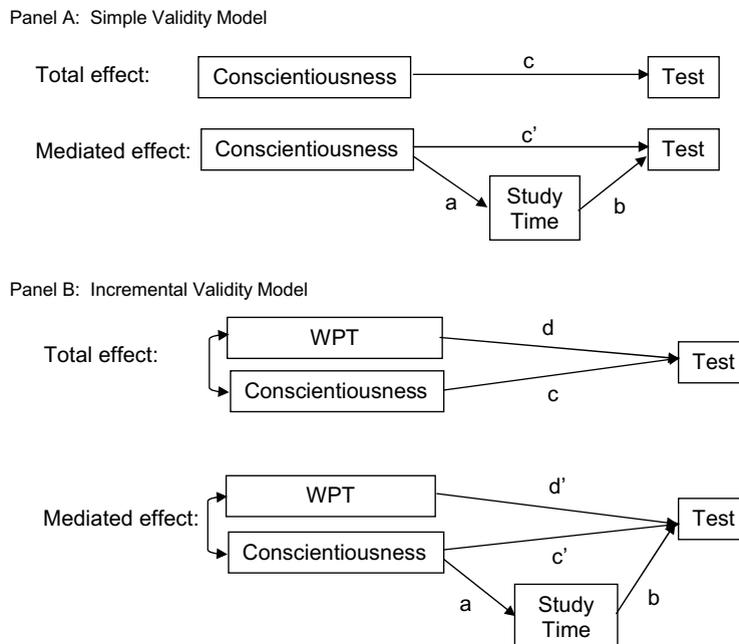


Fig. 1. Simple validity and incremental validity mediation models.

Table 2

Mediation model estimates (boldfaced) and bias corrected limits of 95% confidence intervals for standardized coefficients

Coefficient	Summated scale			Factor scores		
	Lower bound	Estimate	Upper bound	Lower bound	Estimate	Upper bound
<i>Simple validity</i>						
c: Conscientiousness–test	–.063	<b>.086</b>	.222	.050	<b>.196</b>	.327
a: Conscientiousness–study time	–.002	<b>.140</b>	.285	.033	<b>.193</b>	.366
b: Study time–test conscientiousness	.221	<b>.388</b>	.538	.211	<b>.369</b>	.516
c': Conscientiousness–test study time	–.098	<b>.032</b>	.171	–.010	<b>.125</b>	.254
<i>Incremental validity</i>						
c: Conscientiousness–test WPT	–.052	<b>.075</b>	.185	.036	<b>.164</b>	.288
d: WPT–test conscientiousness	.313	<b>.450</b>	.569	.308	<b>.439</b>	.562
a: Conscientiousness–study time	–.002	<b>.140</b>	.285	.033	<b>.193</b>	.366
b: Study time–test conscientiousness, WPT	.157	<b>.315</b>	.479	.145	<b>.298</b>	.459
c': Conscientiousness–test study time, WPT	–.085	<b>.035</b>	.142	–.010	<b>.114</b>	.227
d': WPT–test conscientiousness, study time	.265	<b>.396</b>	.518	.264	<b>.391</b>	.513

Refer to Fig. 1 for explanation of coefficient symbols. Variables controlled for are listed following a vertical line.

Four potential explanations for the nonsignificant relationships involving conscientiousness were considered. First, the conscientiousness–test scatterplot revealed no outliers. Second, following LaHuis, Martin, and Avis (2005), adding a quadratic component to the conscientiousness–performance relationship did not result in a significant increase in  $r^2$  ( $t = 1.745$ ,  $p > .05$ ). Third, power of the test of the conscientiousness–test correlation was computed. Assuming the population value to be .2, a conservative estimate of the conscientiousness–performance relationship from previous studies, power was found to be .65. None of these considerations provided a definitive explanation for the small correlations shown in Table 2.

The fourth explanation stemmed from the fact that the small correlations all involved the conscientiousness variable. It is based on the possibility that the correlations were suppressed as a result of contamination due to the presence of variance in the summated scale unrelated to conscientiousness. In this case, we suspected contamination due to common method bias. There is considerable evidence that self-report measures such as the Big Five may be affected by the presence of such bias (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). If that bias is unrelated to a personality dimension, the relationships involving contaminated measures of that dimension to other variables may be suppressed relative to what purer measures of the dimension would have been. To examine this possibility, a confirmatory factor analysis was conducted of the 50 Big Five questionnaire items using MPLUS Version 4.0 (Muthén & Muthén, 1998–2006). In the CFA, the 10 items from each dimension were required to load on the appropriate Big Five dimension. In addition, all 50 items were required to load on a method factor which was constrained to be orthogonal to the Big Five latent variables. This type of factor analysis is analogous to that labeled 3A in Table 5 in Podsakoff et al. (2003, p. 896). Mardia's (1970) test of multivariate kurtosis indicated possible nonnormality, so we used the method of maximum likelihood with corrections to chi-square statistics and standard errors as implemented in MPLUS V4.0 (Muthén & Muthén, 1998–2006; Satorra & Bentler, 2001).

Two CFAs were conducted – one with the method factor and one without. Because of the instability of analyses of this type (e.g., Lance, Noble, & Scullen, 2002), the factor analyses were performed on the data of all 184 persons who completed the Big Five questionnaire. Fit of the model without a method factor was less than perfectly acceptable, with Satorra–Bentler adjusted  $\chi^2(104) = 206.531$ ,  $p < .001$ , CFI = .632, RMSEA = .073, SRMR = .100. Although the fit of the CFA to the Big Five items left much to be desired, given the extensive development of the Big Five items on the IPIP web site, we proceeded on the assumption that the lack of fit was due to unmodeled aspects of individual items rather than fundamental misspecification of the model. Fit of the model with a method factor was better than that of the original CFA, with  $\chi^2(103) = 188.827$ , CFI = .692, RMSEA = .067, and SRMR = .081. Because the model without a method factor was nested within the more general model with a method bias factor by restricting the loadings to 0, a chi-square difference test was appropriate for assessing the difference in fit of the two models. A Satorra–Bentler chi-square difference test indicated that removing the method latent variable resulted in a significant decrement in model fit ( $\chi^2(25) = 130.819$ ,  $p < .001$ ). Moreover, adding the method latent variable substantially reduced the mean intercorrelation of the Big Five latent variables from .31 to .03. Both the improvement in fit and reduction in mean correlation due to addition of an orthogonal method factor are in keeping with the hypothesis that method bias added common variance to the Big Five items.

In order to use the results of the CFA for the mediation analyses for which there were fewer participants than for the factor analysis, factor scores were computed for the conscientiousness factor. As a check on the assumptions underlying these analyses, they were also computed for the method bias latent variable. The factor score determinacies were .86 for conscientiousness and .92 for method bias, indicating that the factor scores were representative of the factors from the CFA (Grice, 2001). In a fashion analogous to what has been used in testing consumer attitudes in market research (e.g., Wilson, Mathews, & Harvey, 1975), factor scores of those 135 participants used in the analyses reported above were added to the data file containing the WPT, study time, and test scores. Correlations of the factor scores are presented in Table 1. Note that even though method bias was estimated as orthogonal to all the Big Five dimensions, the correlation of the method bias factor scores with the conscientiousness factor scores is .12. This is due to the slight indeterminacy of the factor scores and to the fact that the statistics in Table 1 are from a subset of the data used for the CFAs.

The conscientiousness factor scores were then included in the mediation models of Fig. 1. Coefficients from those mediation models are presented on the right side of Table 2. Inspection of the table shows that, in contrast to the summated conscientiousness scale scores, the confidence interval for path c excluded zero, indicating that the conscientiousness factor scores were valid predictors of test performance. Confidence intervals for both paths a and b excluded zero indicating that study time was related to conscientiousness and that study time predicted test performance. These results suggest that study time is at least a partial mediator of the conscientiousness–performance relationship. But Table 2 also shows that the confidence interval for path c' in the table includes 0, suggesting that the mediation is complete.

The lower right portion of the table indicates that conscientiousness factor scores were also incrementally valid in the prediction of test performance and further indicates that the incremental relationship was also completely mediated by study time.

#### 4. Discussion

Our initial findings using summated conscientiousness scale scores suggested that there was no significant relationship of conscientiousness to performance and no relationship of conscientiousness to its purported mediator. However, investigation of the possibility that the summated conscientiousness scores were contaminated by method bias proved enlightening. In contrast to the results using the summated scale, conscientiousness factor scores were related to performance and to the mediating variable, providing evidence that there was a conscientiousness–performance relationship and that time-on-task represented by self-reported study time did mediate that relationship. The data also supported the tentative conclusion that the mediation is complete although failure of complete mediation would not contradict the finding of mediation here, since it is certainly possible that conscientiousness is broad enough to encompass paths to performance other than through time-on-task.

This study contributes to two sets of findings and provides the first look at a third. First, it adds to the body of literature suggesting that conscientiousness has both simple and incremental validity for prediction of academic performance. The effect sizes for simple and incremental validity were about what has been found in meta-analyses of validity of conscientiousness. For completeness, factor scores from the other Big Five dimensions were computed and correlated with test performance. Only the openness factor scores predicted test performance ( $r = .208$ ,  $p < .01$ ). The other correlations were  $-.035$ ,  $.107$ , and  $.017$  ( $p > .05$ ) for extraversion, agreeableness, and stability, respectively.

Second, this study adds to literature suggesting that method bias can have an effect on conclusions regarding relationships involving substantive variables. In this instance, method bias appeared to be a noisy contaminant, suppressing the relationship between summated conscientiousness scores and other variables. In other settings it is possible that method bias augments observed relationships, making them stronger than would be relationships among variables with method effects removed (e.g., Williams & Brown, 1994).

Finally, this study provides a first look at a potential mediator of the conscientiousness–performance relationship. The analyses suggest that the cognitive state associated with high conscientiousness has its immediate impact on time spent on the task at hand. This study provides further support for both the self-regulatory views of Bandura's (1991) social cognitive theory and the control theory of Powers (1973). The results are in line with what most academicians already know: more time spent studying leads to better grades.

Further study of the source of method bias is needed. It is possible that it represents a very mild form of faking such as that estimated by Biderman and Nguyen (2004). Or it might represent systematic differences in the use of the response scale, with some participants favoring one end of the scale and others favoring the opposite end. Since it was estimated as a first order factor constrained to be orthogonal to the Big Five dimensions, it seems that it cannot represent a higher order Big Five dimension. In this situation it did not appear to be a substantive variable since Table 1 shows that it is uncorrelated with study time, intelligence, and the test criterion. Podsakoff et al. (2003) listed several situations in which method bias could be expected. The results of this study suggest that the list provided there should be considered by researchers using self-report data and that the analysis of self-report data should not be viewed as complete until the possibility of distortion due to method variance has been investigated. Several lines of research have

routinely incorporated such tests (e.g., Carlson & Kacmar, 2000; Conger, Kanungo, & Menon, 2000; Elangovan & Xie, 1999).

Although a complete characterization of the method bias estimated here is beyond the scope of this investigation, we believe that it was probably confined to the personality test. The study time measure was taken many days after the personality test was administered and used an email-response format different from the format of the Big Five questionnaire. We doubt that any response “set” that was operative while taking the personality test carried over to the study time measure. Similarly, the test was a composite of essay questions and four-choice multiple choice knowledge items, a format quite unlike the format of the Big Five questionnaire.

The estimation of the method latent variable here required a design assessing multiple constructs that were not highly correlated and that method bias affected in a common fashion. The Big Five dimensions fit this requirement nicely. Thus, even though the interest here was on conscientiousness, the inclusion of items indicating the other Big Five dimensions in the present study allowed the estimation of a method bias latent variable and the estimation of conscientiousness unconfounded by method bias. If only conscientious items had been administered, separate estimation of method bias would not have been possible because the CFA model would have been underidentified. Thus, an implication of these results is that researchers who expect method bias should include items in their questionnaires that will allow them to measure it, even though those items may represent dimensions that have no bearing on the theory or the purposes of the study.

#### 4.1. Limitations

With a larger sample size there may have been no need to partial method effects from the relationship being tested to show mediation. Of course, we feel that the result of the investigation spurred by the inconclusive results of the first analysis was certainly enlightening.

Since study time responses were solicited after the test was taken, it is possible that they were influenced to some extent by respondents’ subjective impressions of their test performance, thus inflating the study time–performance relationship. The research presented here was nonexperimental and therefore is subject to the limitations in demonstrating causality and causal mediation discussed by Stone-Romero and Rosopa (2005). Although we do not see how conscientiousness could be manipulated, it is conceivable that opportunity for study time could be. The effect of such a manipulation on the pattern of correlations would provide additional evidence regarding the validity of the conclusions of this study.

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