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Different Forces, Same Consequence: Conscientiousness and Competence Beliefs Are Independent Predictors of Academic Effort and Achievement

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Conscientiousness and domain-specific competence beliefs are known to be highly important predictors of academic effort and achievement. Given their basis in distinct research traditions, however, these constructs have rarely been examined simultaneously. Three studies with 571, 415, and 1,535 students, respectively, found a moderate association between conscientiousness and competence beliefs. Both conscientiousness and competence beliefs meaningfully predicted academic effort, irrespective of how academic effort was measured (single-measurement questionnaire or diary data). The associations of competence beliefs with academic effort were highly domain specific, whereas conscientiousness was predictive of academic effort across a wide range of academic subjects. Conscientiousness and competence beliefs were also associated with academic achievement. Figural and verbal reasoning ability, although associated with academic achievement, only loosely predicted academic effort.

Keywords: conscientiousness, competence beliefs, academic effort, academic achievement

> Genius is 1% inspiration and 99% perspiration.
> —Thomas Edison, 1847–1931

Typically, success does not happen overnight but is the result of hard work. As Edison put it, genius is predicted by "perspiration" or—to use the labels preferred by psychologists—by perseverance, effort, practice, and determination (Baumeister, Gailliot, DeWall, & Oaten, 2006; Duckworth, Peterson, Matthews, & Kelly, 2007; Trautwein, 2007). This does not apply only to genius, however. To put it rather simply, above-average success typically requires above-average effort. Be it success at work, in sports, or in the academic domain, the "no pain, no gain" principle is stronger than some strands of hedonistic philosophy might lead us to believe.

Given that effort plays a crucial role in explaining achievement, the next logical question addresses the antecedents of effort. What predicts the intensity of an athlete's exercise program? What predicts the amount of effort a student puts into his or her homework? What predicts the care and perseverance an employee invests in his or her work? Depending on their area of specialization, psychologists tend to give surprisingly different answers to these questions. In this article, we draw on two very rich and highly influential traditions. One, personality psychology in the tradition of the five-factor model (Costa & McCrae, 1992), highlights the role of conscientiousness as a domain-general trait that predicts conscientious behavior across a broad class of achievement-related situations. The other, motivational and educational psychology, emphasizes among other constructs the role of domain-specific competence beliefs (Eccles & Wigfield, 2002; Pintrich, 2003). It is interesting that although both approaches are important within their fields, they have rarely been integrated theoretically or investigated simultaneously in empirical studies. This article contributes to closing this research gap by simultaneously studying the impact of conscientiousness and competence beliefs on academic effort and achievement in a series of three studies.

Conscientiousness: Effortful Behavior Across Situations

The Big Five framework has been widely adopted as a description of the structure of personality (Digman, 1990; Funder, 2000; Goldberg, 1993; John, 1990). Factor analyses have consistently identified the five factors of neuroticism, extraversion, conscientiousness, agreeableness, and openness to experience (the last is sometimes labeled imagination, intellect, or culture). The Big Five factors have been at the center of a tremendous number of studies, and the empirical data yield support for their stability and predictive validity (see McCrae & Costa, 1999).

Of the Big Five factors, conscientiousness seems particularly relevant for success in life domains such as school and work. Conscientious persons are characterized as being industrious, systematic, dutiful, high on achievement striving, and hardworking.

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Not surprisingly, conscientiousness has repeatedly been found to be the Big Five factor most closely associated with many favorable outcomes. For instance, a meta-analysis by Barrick and Mount (1991) showed that people with high conscientiousness scores typically perform better in their jobs than people with low conscientiousness scores. In a study by Judge, Higgins, Thoresen, and Barrick (1999), conscientiousness was found to be associated with higher job satisfaction and career success. Similarly, on the basis of a systematic review of more than 50 empirical studies, Roberts, Kuncel, Shiner, Caspi, and Goldberg (2007) concluded that conscientiousness was positively associated with high occupational attainment but also with low mortality and low likelihood of divorce.

Studies of educational attainment also attest to the positive effects of conscientiousness (De Raad & Schouwenburg, 1996). Noftle and Robins (2007) recently summarized the results of 20 studies examining the association between conscientiousness and grade point average (GPA) or course grade in college students. Conscientiousness was significantly positively related to the academic outcome variable in 15 of these 20 studies; the mean effect size was .26. In addition, Noftle and Robins presented their own analyses of four additional data sets, in all of which conscientiousness proved to be associated with higher college grades. This association held when other important predictor variables (gender, SAT scores, and high school GPA) were statistically controlled. Although relatively few in number, studies with high school students have generally also found positive associations between conscientiousness and achievement (e.g., Lounsbury, Sundstrom, Loveland, & Gibson, 2003; Preckel, Holling, & Vock, 2006).

Why is conscientiousness positively associated with academic outcomes? It is assumed that the positive effects of conscientiousness on academic outcomes are mediated by academic effort (see De Raad & Schouwenburg, 1996). Indeed, Noftle and Robins (2007) found academic effort (measured by two self-report items tapping time on school work and effort on school work) to mediate the predictive effect of conscientiousness on college GPA. Similarly, Bidjerano and Dai (2007) found that effort regulation, as assessed by a self-report instrument, fully mediated the predictive effects of conscientiousness on GPA in an undergraduate student sample. Conscientiousness has been found to predict GPA even when cognitive abilities are controlled. In fact, although cognitive abilities are associated with achievement, the association between conscientiousness and academic effort is closer than that between cognitive abilities and academic effort (e.g., Noftle & Robins, 2007).

Competence Beliefs: Predicting Domain-Specific Behavior

The Big Five have been described as the "core" of personality and juxtaposed with "surface" characteristics such as student self-views (Asendorpf & van Aken, 2003). In this article, we investigate a surface characteristic that has received much attention from motivational and educational researchers and is considered highly useful for predicting academic effort and for improving pedagogical practice more generally—namely, competence beliefs (Eccles, 2005; Elliot & Dweck, 2005; Pintrich, 2003). Unlike core personality traits, surface characteristics are thought to be influenced by context, environment, and life events (Eccles & Wigfield, 2002; Trautwein, Lüdtke, Marsh, Köller, & Baumert, 2006; Wigfield, Eccles, & Pintrich, 1996). In fact, one of the prime goals of motivational science is to develop interventions that foster adaptive competence beliefs and values (Pintrich, 2003).

Competence beliefs answer the question, "Can I succeed on this task or activity?" (Wigfield & Wagner, 2005, p. 224). The various conceptions of competence beliefs include self-efficacy beliefs, expectancy beliefs, and self-concept (Bandura, 1997; Eccles & Wigfield, 2002; Marsh, Craven, & McInerney, 2005). These conceptions differ to a certain degree in their theoretical assumptions and operationalizations (see Bandura, 1997; Pajares & Schunk, 2005), but they all agree that people who are confident of their competence in a specific field are more likely to invest effort, to persist, and to succeed than are people with less belief in their competence. Not surprisingly, researchers have demonstrated that specific components of self-concept are substantially associated with students' subsequent academic performance (e.g., Trautwein, Lüdtke, Köller, & Baumert, 2006).

In marked contrast to conscientiousness, which predicts behavior over a broad range of domains, competence beliefs are highly domain specific. Using confirmatory factor analyses, Marsh (1990) showed that it was possible to reliably differentiate between competence beliefs regarding 15 school subjects. Correlations between competence beliefs are typically much lower than correlations between the corresponding grades or test scores (Marsh & Shavelson, 1985; Marsh, Trautwein, Lüdtke, Köller, & Baumert, 2006). In particular, there is a strong distinction between more verbal and more mathematical subjects, with zero or low positive–negative correlations between competence beliefs regarding mathematics and English, for example, despite moderate to high correlations between achievement outcomes in these subjects (e.g., Brunner, Lüdtke, & Trautwein, 2008).

Associations Between Conscientiousness, Competence Beliefs, and Academic Effort

Only a few empirical studies have considered conscientiousness and academic competence beliefs together. Fewer still have attempted to predict academic achievement by a combination of conscientiousness, competence beliefs, and academic effort. Instead, most researchers have concentrated either on conscientiousness (e.g., in personality research) or on competence beliefs (e.g., in educational research) for a variety of reasons (theoretical and methodological rationales; research traditions). Conceptually, there are two ways to bring these constructs together.

Classic trait models (e.g., McCrae & Costa, 1999) claim that traits are basic tendencies that are endogenous to all other variables. This perspective holds that contextualized motivations, such as competence beliefs, are manifestations of conscientiousness, although external influences may also play a role in accounting for competence beliefs (McCrae & Costa, 2008). Contextualized behaviors, such as academic effort and performance, should be influenced by traits. However, because competence beliefs can be seen as analogous to specific or narrow traits, they can be expected to mediate the relationship between conscientiousness and achievement outcomes, thereby possibly outpredicting the broader, more general personality factor that contributes much of the variance in the achievement criterion. We call this model the *mediated effects model*.

In contrast, other theories have highlighted the relative independence of motivational constructs from traits (e.g., Roberts & Wood, 2006; Winter, John, Stewart, Klohnen, & Duncan, 1998). For instance, several personality theories propose that motivational tendencies as encapsulated in motives and traits are each hierarchically arranged—but separate—domains of personality (McAdams, 1995). Similarly, conceptual models of self-concept posit some form of hierarchy among domain-specific self-concepts (Marsh, 1990; Shavelson, Hubner, & Stanton, 1976) but highlight that the learning environment and the accompanying frames of reference heavily impact these competence beliefs (see Harter, 1998; Trautwein, Lüdtke, Marsh, et al., 2006). In the present investigation, this would mean that competence beliefs would predict academic outcomes independently of conscientiousness and that conscientiousness would predict academic effort even if competence beliefs were included as predictor variables. We use the term *independent effects model* to label this theoretical stance. For clarity's sake, it must be emphasized that the independent effects model does not postulate a zero correlation between conscientiousness and competence beliefs.

The few available studies paint a mixed picture with regard to the appropriateness of the mediated or independent effects models. In the study by Noftle and Robins (2007), conscientiousness was statistically significantly associated with perceived academic ability in two college student samples ($r = .19$ and $r = .25$, respectively). Furthermore, when used as a mediator variable, perceived academic ability substantially mediated the predictive effects of conscientiousness on later academic achievement.

In contrast, the results of a study by Trautwein, Lüdtke, Schnyder, and Niggli (2006) can be interpreted as yielding some preliminary evidence for the independent effects model. Domain-specific competence beliefs predicted academic effort in the respective domain (e.g., math self-concept predicted effort in math, English self-concept predicted effort in English), whereas conscientiousness proved to be a good predictor for a broad range of outcomes. Even when competence beliefs, gender, cognitive ability, and parental homework support were controlled, conscientiousness predicted academic effort, with only a small portion of the effect on academic effort being mediated by competence beliefs. Competence beliefs also made an independent contribution to explaining academic effort.

However, the Trautwein, Lüdtke, Schnyder, and Niggli (2006) study said little about the association between competence beliefs and conscientiousness or their unique power to predict academic outcomes. First, the study made no attempt to theoretically clarify the similarities and differences of conscientiousness and competence beliefs. Second, it did not seek to determine whether the mediated model or the independent effects model was superior. In fact, the authors did not comment on this issue at all, although their graphical model seemed to suggest a mediated effects perspective, whereas their results were more in line with the independent effects model. Third, further relevant limitations of the Trautwein, Lüdtke, Schnyder, and Niggli (2006) study include the single-measurement design, the failure to include academic achievement as an outcome variable, and the decision to specify separate models for various academic domains (i.e., mathematics, English, and French) instead of a model integrating more than one domain.

The Present Investigation

All three studies reported in this article investigated the association between conscientiousness and domain-specific competence beliefs and between these constructs and academic effort. In each study, we tested whether the mediated effects model or the independent effects model provided a better account of the data. We used the conscientiousness scale of the NEO Five Factor Inventory (NEO-FFI; Costa & McCrae, 1992) in all three studies.

There is evidence that some facets of conscientiousness are more closely associated than others with specific outcomes (e.g., Gray & Watson, 2002; Noftle & Robins, 2007). Gray and Watson (2002) found the goal-striving (or "achievement-striving"), self-control, and dependability (or "dutifulness") facets to be closely associated with achievement. As described by Saucier (1998), researchers using the NEO-FFI can distinguish between goal striving, orderliness, and dependability as three lower-order facets of conscientiousness. It is possible that support for the models examined in this article also depends on the specific facet of conscientiousness investigated. For this reason, we conducted all analyses at the facet level of conscientiousness as well as at the global level.

Furthermore, we included figural reasoning (Studies 1 and 2) and verbal reasoning (Study 3) as measures of cognitive ability. We speculated that cognitive ability, although associated with academic achievement, would only loosely predict academic effort. In addition to these general issues, each study addressed specific research questions.

Study 1

A large sample of high school students participated in Study 1. In addition to conscientiousness and figural reasoning as an indicator of cognitive ability, our study included measures of competence beliefs and domain-specific academic effort in two subjects (mathematics and English as a foreign language). The study addresses three questions. First, the student sample allowed us to test the degree to which conscientiousness is associated with academic effort at high school. To date, most research on the relationship between conscientiousness and academic effort has been conducted with college students (e.g., Noftle & Robins, 2007) or college-track students (Lüdtke, Trautwein, Nagy, & Köller, 2004). We expected to find a positive association between conscientiousness and academic effort in both subjects considered.

Second, we examined whether the mediated effects model or the independent effects model better explained the data. To this end, we specified two regression models within the framework of structural equation modeling. In the first step, we used prior achievement in mathematics and English as well as figural reasoning and conscientiousness to predict academic effort. In the second step, we further included domain-specific competence beliefs. According to the mediated effects model, inclusion of competence beliefs can be expected to mediate most of the predictive power of conscientiousness on academic effort. Conversely, the independent effects model predicts both conscientiousness and competence beliefs to emerge as statistically significant predictor variables with unique predictive power regarding academic effort.

Third, we included measures of two domain-specific competence beliefs. One of the striking results of research on competence beliefs (e.g., Marsh et al., 2006) is the weak association between

competence beliefs in verbal and mathematical domains, despite a considerable overlap in achievement scores. This weak association corresponds with the idea that both internal and external comparison processes contribute to intrapersonal profiles of competence beliefs (Marsh, 1986; Marsh & Hau, 2004). As described in Marsh's (1986) internal–external frame of reference model (I/E model), students compare their own achievement in a domain (e.g., verbal achievement) both with the perceived achievement of other students in that domain and with their own achievement in other domains (e.g., mathematics). This internal frame of reference results in a negative influence from achievement in one domain to competence beliefs in the other (e.g., the better my achievement in math, the lower my verbal competence beliefs, when verbal achievement is controlled). Interestingly, the influence of internal comparison processes on academic effort has not yet been examined. How strongly can academic effort across domains be expected to correlate? On the one hand, if conscientiousness is an important predictor of academic effort and predicts behavior across domains, academic effort in different domains should be positively correlated. On the other hand, given their domain-specificity, one might speculate that high competence beliefs in one subject positively affect academic effort in that domain (say mathematics) but undermine academic effort in another domain (say English). This latter pattern would not be in line with the mediated effects model but would correspond to the independent effects model.

Method

Sample

A total of 571 (51.5% female) students from Grades 8 (50.1%) and 9 (49.9%) participated in this study. Their mean age was $M = 14.72$ years ($SD = 0.79$). Students were sampled from 44 classes (10 schools) in one federal state. All schools were located in or around a major German city. Within all classes, students were randomly assigned to participate in the present study or in another research project. The study was conducted during regular school hours during the second semester of the 2003–2004 school year. Student participation was voluntary, and written consent was obtained from parents. The participation rate was >.90 in each class. All participating students were entered in a prize draw, with one cinema voucher worth €10 (approximately U.S. $13) being awarded in each class.

Instruments

Academic effort. Academic effort was assessed by parallel items for mathematics and English as a foreign language. Six items (e.g., "I really work hard on classwork assignments in mathematics [English]") focused on students' academic effort at school; another six items (in which the word classwork was replaced by homework) assessed academic effort at home. A 4-point Likert-type scale (from 1 = *completely disagree* to 4 = *completely agree*) was used for all items. With Cronbach's alphas ranging from .78 to .84, internal consistency was satisfactory for both scales in both mathematics and English.

Competence beliefs. Competence beliefs were also assessed using parallel items for mathematics and English as a foreign language and for homework and classwork, yielding four reliable subscales of three items each (e.g., "If I make an effort, I can do all of my math [English] homework [classwork]"; Cronbach's alpha was between .73 and .85).

Conscientiousness. Conscientiousness was measured with the German version of the NEO Five Factor Inventory (NEO-FFI; Borkenau & Ostendorf, 1991; original version by Costa & McCrae, 1992). One of the 12 items ("I'm not a very systematic person") was discarded due to its low item–total correlation. For the subsequent analyses, four item parcels were created (i.e., four scores were used, each representing the average of two or three items). Items 1, 5, and 9 formed Parcel 1; Items 2, 6, and 10 formed Parcel 2; Items 7 and 11 formed Parcel 3; and items 4, 8, and 12 formed Parcel 4. Parceling means that fewer model parameters are estimated, which in turn results in a better ratio of variables to sample size and more stable parameter estimates (Bandalos, 2002; Kishton & Widaman, 1994). Moreover, parceling meant that we had a more similar number of indicators for our core constructs (conscientiousness and competence beliefs). Internal consistency was good ($\alpha = .83$). Following the detailed analyses by Saucier (1998, Table 2), we also created facet-level subscales for goal striving (three items; $\alpha = .60$), orderliness (four items; $\alpha = .68$), and dependability (four items; $\alpha = .68$). The correlations between the three facets were $.79 \leq r \leq .87$ (latent variable modeling approach) and $.49 \leq r \leq .58$ (manifest approach), indicating a considerable overlap between the three facets.

Prior achievement. School grades awarded on the midterm report card were used as an indicator of prior achievement. The grades were coded such that high scores indicated good learning outcomes.

Figural reasoning. The Figure Analogies subscale from the Cognitive Ability Test 4–12 + R (Heller & Perleth, 2000) was used to tap cognitive ability. Because the figural analogies scale taps highly *g*-loaded ability components, it is frequently used as a parsimonious test of basic cognitive abilities. Whereas school grades were used to measure domain-specific achievement, we used the figural reasoning test to measure abilities that are relatively independent of schooling. The internal consistency of the figural reasoning test was .87. Five item parcels of five items each were created for the subsequent analyses. Parcel 1 consisted of Items 1, 6, 11, 16, and 21; Parcel 2 consisted of Items 2, 7, 12, 17, and 22, and so on.

Statistical Analyses

We used latent variable modeling throughout this study. All constructs except school grades were measured by at least two indicators, allowing us to correct for the effects of measurement error in the correlation analyses as well in the structural equation models specified. For instance, two indicators (the classwork effort and homework effort scales) were used to measure the latent construct of academic effort in mathematics; likewise, two indicators were used to measure the latent construct of academic effort in English. The Mplus 4.0 package (L. K. Muthén & Muthén, 1998–2006) was used for all calculations.

In most studies conducted in school settings, individual student characteristics are confounded with classroom or school characteristics because individuals are not randomly assigned to groups.

For instance, the effort of a specific student might be affected by individual-level variables such as intelligence, but also by class-level variables such as teacher expertise. The class-level variable introduces a clustering effect and, in turn, problems related to appropriate levels of analysis, aggregation bias, and heterogeneity of regression. When the hierarchical nature of a data set is not taken into account, the estimation of standard errors of means and of beta coefficients is typically downwardly biased (Raudenbush & Bryk, 2002). Hence, we controlled for cluster effects in all statistical analyses by using the "type = complex" option in Mplus 4.0 (L. K. Muthén & Muthén, 1998–2006). When the complex option is used, estimates of standard errors are automatically corrected for clustering effects (see B. Muthén & Satorra, 1995).

Missing data represent a potentially serious methodological problem in many empirical studies. For the constructs considered here, the average percentage of missing data was below 4%. In the methodological literature on missing data (Schafer & Graham, 2002), there is growing consensus that multiple imputation or full information maximum likelihood estimations are preferable to casewise or listwise deletion. We therefore used the missing values option built into the Mplus 4.0 package. Mplus applies a model-based approach to missing data, which builds on a full information maximum likelihood estimation.

Results

Intercorrelations between Study 1 variables are reported in Table 1. Conscientiousness was statistically significantly related to all other variables in the study. Specifically, it was substantially associated with academic effort in both mathematics and English. Hence, the data confirm that conscientiousness is already associated with academic effort at high school. In line with prior research, there was clear empirical support for the domain-specificity of mathematics and English competence beliefs. Mathematics competence beliefs correlated substantially with prior mathematics achievement and mathematics effort, but the correlations with prior English achievement, English effort, and English competence beliefs were weak or nonexistent. Similarly, English competence beliefs did not correlate statistically significantly with prior mathematics achievement or mathematics effort. It is interesting that figural reasoning was weakly positively associated with mathematics competence beliefs and mathematics effort ($r = .17$ and $r = .13$, respectively) but not with the corresponding constructs for English.

We next specified structural equation models in which academic effort in mathematics and English were used as outcome variables and the other variables were successively introduced as correlated predictor variables. A total of five models were run; all models evidenced a good fit to the data. In Model 1, $\chi^2(49, N = 571) = 56.89$, Tucker-Lewis index (TLI) = .995, root-mean-square error of approximation (RMSEA) = .017, we used figural reasoning, prior mathematics achievement, and conscientiousness to predict mathematics effort. In Model 2, $\chi^2(68, N = 571) = 76.26$, TLI = .996, RMSEA = .015, we also included mathematics competence beliefs. Paralleling this approach with English, we used figural reasoning, prior English achievement, and conscientiousness to predict English effort in Model 3, $\chi^2(49, N = 571) = 58.03$, TLI = .995, RMSEA = .018, and also included English competence beliefs in Model 4, $\chi^2(68, N = 571) = 85.08$, TLI = .992, RMSEA = .021. Finally, we simultaneously predicted academic effort in both English and mathematics and included the whole set of predictor variables in Model 5, $\chi^2(126, N = 571) = 170.56$, TLI = .985, RMSEA = .025.

In Model 1 (see Table 2), prior mathematics achievement, figural reasoning, and conscientiousness predicted mathematics effort, explaining a total of 50% of the variance. The largest regression coefficient was found for conscientiousness. In Model 2, we included mathematics competence beliefs, which also proved to be a statistically significant predictor of mathematics effort. Moreover, comparison of the regression coefficients for prior mathematics achievement, figural reasoning, and conscientiousness indicated that mathematics competence beliefs functioned as a mediator variable only to some extent. It is important to note that the regression coefficient of conscientiousness was .59 in Model 1 and .48 in Model 2. Moreover, the inclusion of mathematics competence beliefs added an additional 9% of explained variance, and both conscientiousness and mathematics competence beliefs were strong independent predictors of mathematics effort ($\beta = .48$, $p < .001$, and $\beta = .34$, $p < .001$). This pattern of results is in line with the predictions of the independent effects model.

In the next two models (Models 3 and 4), the mathematics constructs were replaced by the corresponding English constructs. Overall, the results from these two models again seem to favor the

Table 1
Intercorrelations of Study 1 Constructs

Variable	1	2	3	4	5	6	7	8
1. Figural reasoning	—	−.10*	.26***	.14***	.05	−.03	.10	−.07
2. Conscientiousness	−.12*	—	.13**	.28***	.16***	.18***	.50***	.40***
3. Mathematics school grades	.28***	.15**	—	.26***	.32***	.05	.37***	−.01
4. Mathematics competence beliefs	.17**	.34***	.29***	—	−.07	.14**	.46***	−.08
5. English school grades	.06	.16**	.32***	−.08	—	.43***	.10	.35***
6. English competence beliefs	−.03	.19***	.05	.16**	.46***	—	−.02	.49***
7. Mathematics effort	.13**	.62***	.41***	.58***	.11	−.02	—	.19***
8. English effort	−.08	.47***	−.01	−.10	.37***	.56***	.23***	—

Note. $N = 571$. Correlations below the diagonal involving multi-indicator constructs are correlations between latent variables; correlations above the diagonal are correlations between manifest variables.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 2
Predicting Academic Effort in Mathematics and English: Results From Structural Equation Modeling

	Outcome variable				Combined model (Model 5)	
	Mathematics effort		English effort		Outcome variables	
Predictors	Model 1	Model 2	Model 3	Model 4	Mathematics effort	English effort
Mathematics prior achievement	0.29***	0.22***			0.18***	−0.04
Mathematics competence beliefs		0.34***			0.39***	−0.35***
Figural reasoning	0.12**	0.07*	−0.04	−0.02	0.06	0.07
Conscientiousness	0.59***	0.48***	0.42***	0.37***	0.50***	0.51***
English competence beliefs				0.44***	−0.23***	0.51***
English prior achievement			0.30***	0.10**	0.09	0.03
R^2	0.50	0.59	0.31	0.46	0.63	0.56

Note. All multi-indicator constructs were modeled as latent variables. Values reported are fully standardized regression coefficients.
* $p < .05$. ** $p < .01$. *** $p < .001$.

independent effects model. Specifically, the inclusion of English competence beliefs added substantially to the explained variance (from .31 to .46). Furthermore, both English competence beliefs and conscientiousness independently predicted English effort. There was only weak evidence for a mediation effect: The regression coefficient for conscientiousness dropped from .42 (Model 3) to .37 (Model 4). Hence, there was again good support for the independent effects model.

In the final Model 5, we used the complete set of predictor variables to simultaneously predict both mathematics and English competence beliefs. Several results can be highlighted. First, inspection of the path coefficients shows that conscientiousness was the only predictor variable that consistently positively predicted academic effort in both mathematics and English, with standardized regression coefficients of about .50. Second, mathematics competence beliefs and English competence beliefs were statistically significant predictors of effort in the respective domain. Third, and perhaps most important in the present context, mathematics competence beliefs were negatively related to academic effort in English ($\beta = -.35$) and vice versa ($\beta = -.23$), and the overall percentage of explained variance in mathematics and English effort was higher than in Model 2 and Model 4. Hence, domain-specific competence beliefs in mathematics and English not only contribute to effort in the same domain, but are also associated with lower effort in the other domain—unlike conscientiousness, which is positively associated with effort in both domains. Overall, this pattern of results is at odds with the mediation model and supports the independent effects model.

In three additional sets of analyses, we replaced the four randomly composed item parcels of the global conscientiousness scale with the facet-level items for goal striving, orderliness, and dependability (three to four items each) and reran Models 1 to 5 (i.e., a total of 15 additional models were estimated). It was not surprising that, given the high intercorrelation of the three facets, the results of these additional models were closely in line with the results reported in Table 2. Of the 18 regression coefficients for conscientiousness, 16 were slightly smaller than in the original models ($M = 0.05$; median = 0.04; mode = 0.04). For instance, in the final Model 5, the regression coefficient for the facet-level operationalization of conscientiousness predicting mathematics effort was $\beta = .45$ (goal striving), $\beta = .48$ (orderliness), and $\beta = .46$ (dependability). Likewise, the regression coefficient predicting English effort was $\beta = .41$ (goal striving), $\beta = .50$ (orderliness), and $\beta = .47$ (dependability). (The complete table of results is available on request from Ulrich Trautwein.)

Summary

There are three major conclusions from Study 1. First, conscientiousness is indeed already associated with academic effort at high school. Second, competence beliefs mediated only a small portion of the predictive effects of conscientiousness on academic effort, and additional variance in domain-specific academic effort was explained by the inclusion of domain-specific competence beliefs, with regression coefficients of substantial size for both conscientiousness and competence beliefs. Third, mathematics competence beliefs negatively predicted academic effort in English (and vice versa). These findings indicate that academic effort is not simply determined by a trait (conscientiousness) but also is a reflection of the individual student's motivational profile. The moderate intraindividual consistency of academic behavior seems to be the result of an interplay between (the centripetal force of) conscientiousness and (the centrifugal force of) domain-specific competence beliefs. Overall, the pattern of results is in line with the independent effects model.

Study 2

Study 2 examined conscientiousness and competence beliefs as predictors of academic effort and academic achievement in mathematics, with a special focus on out-of-school academic effort. A longitudinal design was used, allowing the effects of academic effort on academic achievement to be modeled over time. We had three primary hypotheses. First, conscientiousness and mathematics competence beliefs were expected to be moderately associated with each other. Second, both conscientiousness and competence beliefs were expected to be statistically significantly associated with academic effort. Based on the results of Study 1, we expected stronger support for the independent effects model than for the mediated effects model. Third, academic effort was expected to mediate the predictive effects of conscientiousness and competence beliefs on Time 2 mathematics achievement.

Method

Sample

A total of 415 Grade 8 students (58.5% female; mean age: $M = 13.45$, $SD = 0.58$) from 20 classes in eight academic-track (*Gymnasium*) schools in Berlin, Germany, participated in this study. The study was conducted during the 2003–2004 school year, with one measurement point at the beginning and one measurement point at the end of the school year. Conscientiousness, competence beliefs, and academic effort were all measured at the first measurement point and figural reasoning ability—which is known to exhibit very high interindividual stability—at the second measurement point. The study took about 45 min to complete and was administered to classes selected by the respective head teachers based on availability of testing time. Trained research assistants administered the materials during regular lesson time.

Instruments

Academic effort. Two scales were used to tap students' self-reported academic effort. *Homework compliance* was measured by six items (sample item: "I always try to complete my mathematics homework"). Students high on homework compliance complete their homework assignments carefully and do not copy from others. Internal consistency (Cronbach's alpha) was adequate ($\alpha = .85$). *Persistence* was measured by three items (sample item: "Even if my mathematics homework is difficult, I don't give up quickly"). Internal consistency (Cronbach's alpha) was adequate ($\alpha = .79$).

Conscientiousness. Conscientiousness was again measured using the 12 conscientiousness items from the German version of the NEO Five Factor Inventory (Borkenau & Ostendorf, 1991; original version by Costa & McCrae, 1992). One item—the same as in Study 1—was discarded due to its low item–total correlation. We again created four item parcels for the subsequent analyses. Internal consistency (Cronbach's alpha) was satisfactory ($\alpha = .84$). Internal consistency for the facet-level scales was .66 (goal striving), .68 (orderliness), and .70 (dependability), respectively. The correlations between the three facets were $.81 \leq r \leq .95$ (latent variable modeling approach) and $.56 \leq r \leq .64$ (manifest approach), indicating a considerable overlap between the three facets.

Competence beliefs. Six items were used to assess competence beliefs (sample item: "I often feel completely lost when I'm doing my math homework," reverse scored). Internal consistency (Cronbach's alpha) was satisfactory ($\alpha = .87$).

School achievement. Grades awarded on the report card at the end of Grade 7 and on the Grade 8 midterm report card were used as indicators of achievement. The grades ranged from 0 to 15, with higher scores indicating good learning outcomes.

Figural reasoning. The Figure Analogies subscale from the Cognitive Ability Test 4–12 + R (Heller & Perleth, 2000), consisting of 25 items in multiple-choice format, was used to tap cognitive ability. The internal consistency (Cronbach's alpha) was .90. For the subsequent analyses, five item parcels of five items each were created to reduce the complexity of the model (i.e., five scores were used, each representing the average of five items).

Statistical Analyses

We again used latent variable modeling. Because all constructs except school grades were measured by at least two indicators, we were able to specify these constructs as latent variables to correct for measurement error in the correlation analyses as well as in the structural equation models. Finally, we again dealt with missing values (average percentage of missing data = 6%) by using the full information maximum likelihood estimator implemented in Mplus 4.0.

Results

Table 3 reports the intercorrelations for all constructs in Study 2. There was a moderate association between mathematics competence beliefs and conscientiousness. Both mathematics competence beliefs and conscientiousness were associated with academic effort. Competence beliefs showed the strongest association with academic effort. Mathematics achievement was statistically significantly associated with all other variables under study. As expected, Time 1 mathematics achievement was the strongest predictor of Time 2 mathematics achievement (an indicator of the stability of achievement), but strong associations were also found with competence beliefs and academic effort. Figural reasoning was relatively weakly associated with all other variables (all rs $\leq .16$) except mathematics achievement.

In the next step, we specified two structural equation models (see Figures 1a and 1b). In both models, Time 1 mathematics achievement, figural reasoning, and conscientiousness were used as predictor variables. Furthermore, academic effort was specified as mediator variable, and Time 2 mathematics achievement was used as the outcome variable. In the second model, we added competence beliefs as another predictor variable. In both models, all possible direct as well as indirect effects were freely estimated. Model fit for both models was acceptable, with $\chi^2(57, N = 415) = 76.34$, TLI = .988, RMSEA = .028 for the first model, and $\chi^2(139, N = 415) = 218.96$, TLI = .977, RMSEA = .37 for the second model.

The standardized regression coefficients resulting from the estimated structural equation models are depicted in Figures 1a and 1b. Paths that were not statistically significant at $p < .05$ are depicted as dotted lines. Not surprisingly, Time 1 mathematics achievement was the most powerful predictor of Time 2 mathe-

Table 3
Intercorrelations of Study 2 Constructs

Variable	1	2	3	4	5	6
1. Time 1 mathematics achievement	—	.31	.25	.47	.44	.67
2. Figural reasoning	.32	—	*.09*	*.12*	.14	.26
3. Conscientiousness	.25	.10	—	.23	.42	.23
4. Mathematics competence beliefs	.51	.13	.23	—	.62	.46
5. Mathematics effort	.48	.16	.51	.73	—	.46
6. Time 2 mathematics achievement	.67	.28	.23	.49	.51	—

Note. $N = 415$. Correlations below the diagonal involving multi-indicator constructs are correlations between latent variables; correlations above the diagonal are correlations between manifest variables. Correlations are statistically significant at $p < .05$ unless italicized.

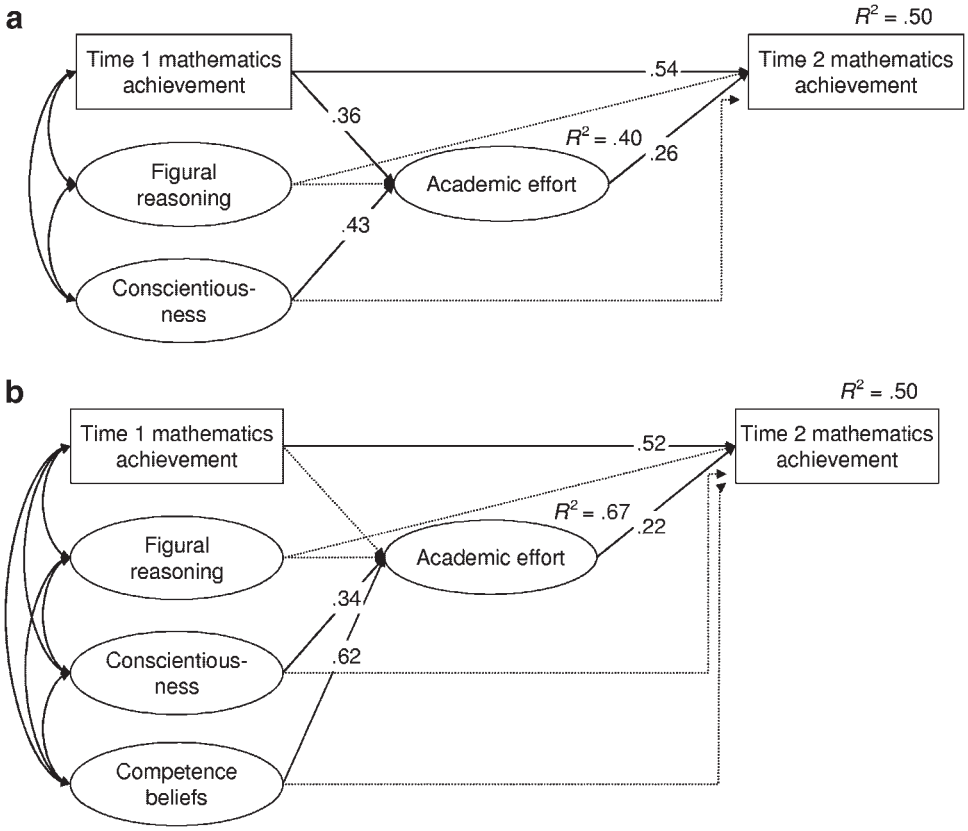

Figure 1. Academic effort in mathematics as a mediator variable (Study 2). Dotted lines indicate regression coefficients that were not statistically significant.

matics achievement in both models. In line with our expectations, however, academic effort also predicted Time 2 mathematics achievement. In other words, when Time 1 mathematics achievement was controlled, students had higher grades at Time 2 if they reported their academic effort to be comparatively high.

In both models, conscientiousness predicted academic effort. The standardized regression coefficient in the model without competence beliefs (see Figure 1a) was $\beta = .43$, falling moderately to $\beta = .34$ when competence beliefs were included (see Figure 1b). Competence beliefs significantly predicted academic effort, and—as indicated by nonoverlapping confidence intervals of the coefficients for explained variance—the percentage of explained variance in academic effort increased statistically significantly ($p < .001$) and substantially (from $R^2 = .40$ to $R^2 = .67$) when competence beliefs were included. Overall, this pattern of results is closely in line with the independent effects model.

In an additional step, we reran both models three times using the facet-level items (goal striving, orderliness, dependability) instead of the randomly composed item parcels. In the models without competence beliefs, academic effort was statistically significantly predicted by goal striving ($\beta = .36$), orderliness ($\beta = .42$), and dependability ($\beta = .48$). When competence beliefs were added to the model ($.60 \leq \beta \leq .62$), the regression coefficients decreased moderately to .29, .27, and .38, respectively. The inclusion of competence beliefs increased the overall percentage of variance explained in academic effort by 24% to 28%. Hence, the pattern of results for these models was again in line with the independent effects model.

Summary

The results of Study 2 were largely in line with our hypotheses. First, conscientiousness and mathematics competence beliefs were moderately associated with each other. Second, both conscientiousness and competence beliefs predicted academic effort, and the pattern of results was largely in line with the independent effects model. Third, academic effort mediated the predictive effects of conscientiousness and competence beliefs regarding Time 2 mathematics achievement.

Study 3

Studies 1 and 2 supported the hypothesis that both conscientiousness and competence beliefs are substantially associated with academic effort. Although conscientiousness predicted academic behavior across different school subjects, interindividual differences in domain-specific competence beliefs added substantially to the prediction of academic effort; nevertheless, the predictive power of conscientiousness diminished only moderately when competence beliefs were added to the models. Overall, Studies 1 and 2 thus provided strong support for the independent effects model. Study 3 went one step further, examining the degree to

which academic behavior is contingent on situational competence beliefs. To this end, diary data were collected from more than 1,500 Grade 8 students over a 2-week period.

In the diary method, students are asked to report their beliefs and behaviors at fixed intervals or during or after certain events. Many researchers (e.g., Möller & Husemann, 2006; Reis, Sheldon, Gable, Roscoe, & Ryan, 2000; Schmitz & Skinner 1993; Schmitz & Wiese, 2006; see also Kahneman, Krueger, Schkade, Schwarz, & Stone, 2004) have argued that—although the instruments used are typically single-item measures or very short scales—diary methods have good reliability and validity.

The introduction of the diary method contributed to the present article in two ways. First, by aggregating student-reported effort over a 2-week period, we obtained another, arguably highly valid measure of interindividual differences in academic effort that can be related to conscientiousness and competence beliefs and were able to check whether the results of Studies 1 and 2 were replicated on the basis of this measure.

Second, the diary measure made it possible to differentiate between the general level of academic effort and fluctuations in academic effort that were situationally contingent. Specifically, we were able to examine the extent to which academic effort varies from day to day (see Schmitz & Skinner, 1993) and to analyze whether day-to-day (or situational) variation in competence beliefs can help explain the fluctuation in academic effort. Prior research indicates that there is indeed meaningful variation in academic effort over the course of days or weeks (Schmitz & Skinner, 1993); the same seems to apply to competence beliefs (Tsai, Kunter, Lüdtke, & Trautwein, 2008). Tsai and colleagues administered a short diary instrument to more than 200 students directly after their lessons in German, mathematics, and a foreign language for roughly 3 weeks. When the authors decomposed the total variance found in their lesson-specific measures, they found a marked degree of intraindividual variation in competence beliefs. In fact, 45%–48% of the variance in competence beliefs was found at the within-person level, indicating that within-student (or situational) variation in these beliefs accounted for about one third to one half of the total variance in these measures, whereas between-student (stable) differences accounted for the rest of the variance. Moreover, Tsai et al. (2008) were able to show that situational competence beliefs were meaningfully affected by students' perceptions of the level of autonomy support provided by their teachers in the lesson preceding the measurement of competence beliefs.

We tested the following hypotheses. First, at the between-person level, we again expected to find a moderate association between conscientiousness and competence beliefs. Furthermore, the correlations of conscientiousness and competence beliefs with academic effort were expected to be of substantial size. Similarly, we expected to find a statistically significant association between competence beliefs and academic effort at the within-person level. Relative to their own baseline, students were expected to report more effort on days when they experienced relatively high competence beliefs. Second, we expected to find additional support for the independent effects model. In other words, we expected conscientiousness to predict academic effort, but also hypothesized that competence beliefs (as measured via a questionnaire) as well as situational competence beliefs (as reported in the diary instrument) would meaningfully add to the explanation of academic effort; furthermore, we expected competence beliefs to mediate only a small part of the predictive power of conscientiousness.

Method

Sample

The sample for Study 3 came from a large study (see Trautwein, Lüdtke, Schnyder, & Niggli, 2006) on French as a second language conducted in collaboration among researchers at the College of Teacher Education in Fribourg, Switzerland, the Max Planck Institute for Human Development in Berlin, Germany, and the University of Tuebingen, Germany. The study was conducted in three Swiss cantons during regular lesson time. All participating students were taking compulsory lessons in French as a foreign language. The instruments were administered by their French teacher, who was provided with detailed written instructions on data collection. Immediately after testing, all materials were mailed to the researchers. In the present study, we used data from the student questionnaire administered at the beginning (September/October 2003) and the end of the school year (May–June 2004) and from two 1-week diary components administered in January 2004 and April 2004. Students were asked to fill out the diary immediately after completing each of their homework assignments.

The total sample consisted of 1,915 students in 112 Grade 8 classrooms. One special education class was excluded from the present analyses. Furthermore, we excluded all classes and students who missed both administrations of the diary component and did not complete the student questionnaire at the end of the school year. The remaining sample consisted of 1,535 students (53.0% female; mean age at first measurement point: $M = 13.79$, $SD = 0.58$) in 89 classrooms.

Instruments

Academic effort and situational competence beliefs as measured by the diary instrument. Two items in the diary instrument are relevant for the present examination. The first describes students' homework effort: "I did my best to answer all of the questions." The second was used to infer competence beliefs: "I have the skills needed to solve these tasks." The diary data were used as both within-person variables and between-person variables. When aggregated to the between-person level, it is possible to use the intraclass correlation coefficient (.55 for academic effort and .56 for situational competence beliefs) and the average number of diary entries per person (5.88) to estimate the reliability of the person score (Lüdtke, Trautwein, Kunter, & Baumert, 2006; Snijders & Bosker, 1999). In the present study, the reliability of the between-person scores was high, at .88 (academic effort) and .88 (competence beliefs), respectively.

Verbal reasoning. Study 3 did not include the test of figural analogies used in Studies 1 and 2. Instead, the verbal subscales of the Cognitive Ability Test 4–13 (Heller, Gaedike, & Weinläder, 1976) were used to tap cognitive ability. A total of 95 verbal items in multiple-choice format (finding analogies, similarities, opposites, and missing words in a sentence) were administered. Internal consistency (Cronbach's alpha) was .89.

Prior French achievement. Students were asked to report the French grade they had received on their report card at the end of Grade 7.

Conscientiousness. Conscientiousness was measured using the 12 conscientiousness items from the German version of the NEO Five Factor Inventory (Borkenau & Ostendorf, 1991; original version by Costa & McCrae, 1992). Internal consistency (Cronbach's alpha) was satisfactory ($\alpha = .78$). Internal consistency for the facet-level scales was .60 (goal striving), .65 (orderliness), and .61 (dependability), respectively. The intercorrelations among the three facets were $.50 \leq r \leq .65$.

Competence beliefs. Ten items were used to assess competence beliefs regarding French homework assignments ($\alpha = .85$), a sample item being: "I often feel completely lost when I'm doing my French homework" (reverse scored).

Statistical Analyses

We used multilevel modeling to predict self-reported French homework effort as a within-student variable. In other words, we used the separate assignments rated in the homework diary as the Level-1 variable (within-student level) and the 1,535 students as the Level-2 variable (between-student level). On the first (within-person) level, regression equations were modeled for the diary variables: homework effort and situational competence beliefs. Situational competence beliefs were entered group-mean centered (i.e., in this case person-mean centered). At the second (between-person) level, regression equations were modeled for conscientiousness, verbal reasoning, French achievement, and competence beliefs. Finally, we included a third (between-classes) level to account for the hierarchical clustering of the students but did not include predictor variables at this level.

In the following, we illustrate our modeling approach in more detail, using the example of how academic effort was related to competence beliefs. The regression equation for a simple analysis with just one Level-1 predictor variable (situational competence beliefs) would be:

$$Y_{ijk} = \pi_{0jk} + \pi_{1jk} \times \text{situational competence beliefs} + e_{ijk},$$

where Y_{ijk} represents the academic competence score of the jth student in the kth class on the ith day, treated as a continuous variable, π_{1jk} represents the effects of situational competence beliefs on the academic effort of the jth student in the kth class, π_{0jk} represents the average academic effort score of the jth student in the kth class, and e_{ijk} denotes random error within students. All Level-1 variables were taken from the diary instrument.

Our analyses were not restricted to the within-student level, however. For instance, we also examined whether more general student characteristics (assessed in the student questionnaire) such as conscientiousness would predict academic effort scores. A second-level equation with conscientiousness was modeled:

$$\pi_{0jk} = \beta_{00k} + \beta_{01k} \times \text{conscientiousness} + r_{0jk}$$

$$\pi_{1jk} = \beta_{10k}$$

β_{00k} can be interpreted as the average academic effort across all students in Class *k*. β_{01k} represents the effect of conscientiousness on the student's specific intercept. r_{0jk} represents random error across students. The regression parameter, $\pi_{1jk,}$ is predicted by the coefficient β_{10k}. All Level-2 variables were entered grand-mean centered.

The Level-3 model represents the variability in academic effort among classes.

$$\beta_{00k} = \gamma_{000} + u_{00k}$$

$$\beta_{01k} = \gamma_{010}$$

$$\beta_{10k} = \gamma_{100}.$$

γ_{000} can be interpreted as the grand mean of academic effort across all classes. u_{00k} represents random error across classes. The class-specific regression parameters β_{01k} and β_{10k} are predicted by the coefficients γ_{010} and γ_{100}, both of which are treated as fixed effects. All models reported are random-intercept models estimated by full information maximum likelihood.

We assessed model fit using the deviance values provided by hierarchical linear modeling, which can be regarded as a measure of lack of fit between model and data (Snijders & Bosker, 1999). Deviance values are not usually interpreted directly; rather, differences in deviance values are calculated for several models for the same data set. The difference in deviance between two models has a chi-square distribution with degrees of freedom equal to the difference in the number of parameters estimated. Because we used the full maximum likelihood method, the chi-square statistic can be used to evaluate the change in model fit when either a fixed or a random effect is added. Large differences in the chi-square statistic between two models indicate that the model with more estimated parameters provides a better fit to the data than the more parsimonious model.

Results

We first calculated correlation coefficients for the within-person level. Because the 1,535 students in the sample reported an average of 5.94 homework assignments, these correlations were based on a total of 9,096 observations. In line with our expectations, we found a positive correlation of $r = .31$, $p < .001$, between situational competence beliefs and academic effort. The correlation coefficients for the between-person analyses are reported in Table 4. For these correlations, diary data were aggregated to the person level. For instance, we averaged the effort that each student reported across the diary period; the same procedure was applied for situational competence beliefs. As expected, the situational competence beliefs ($r = .44$, $p < .001$) measured in the diary component were statistically significantly associated with those reported in the questionnaire component. Furthermore, both the diary and the questionnaire reports of competence beliefs were statistically significantly associated with conscientiousness and

Table 4
Intercorrelations (Between-Person Level) of Study 3 Variables

Variables	1	2	3	4	5	6
1. Prior achievement	—					
2. Verbal reasoning	.22	—				
3. Conscientiousness	.20	*.02*	—			
4. Competence beliefs (questionnaire)	.40	.15	.27	—		
5. Situational competence beliefs (diary)	.33	.15	.28	.44	—	
6. Effort (diary)	.08	.06	.39	.24	.41	—

Note. Correlations are statistically significant at $p < .05$ unless printed in italics.

academic effort. Further in line with our expectations, conscientiousness was significantly related to academic effort. Verbal reasoning was only modestly related with most of the other variables in the study. Finally, the strongest association with prior achievement was found for competence beliefs.

We next specified a set of multilevel models. We first estimated the degree of within-student variance in academic effort relative to between-student variance, the so-called null model (also known as the empty model). It emerged that 55.4% of the variance in academic effort was at the within-student level and 40.5% at the between-student level; 4.1 % of variance was located at the class level. We subsequently introduced verbal reasoning, prior achievement, and conscientiousness as between-person predictor variables. As reported in Table 5 (Model 1), conscientiousness and verbal reasoning statistically significantly predicted academic effort. The between-person variables explained 17% of the between-person variance and about 53% of the between-class variance.

In Models 2a and 2b (see Table 5), we also included situational competence beliefs from the diary as a within-person predictor variable and either competence beliefs as assessed in the questionnaire (Model 2a) or the aggregated competence beliefs score from the diary (Model 2b) as an additional between-person predictor variable. Situational competence beliefs statistically significantly predicted academic effort. Students reported more academic effort on days when they had comparatively high competence beliefs than on days when their competence beliefs were comparatively low. A total of 4% of the Level-1 variance was explained by the inclusion of situational competence beliefs. Furthermore, competence beliefs were also statistically significantly associated with academic effort. The inclusion of these two parameters statistically significantly and considerably improved the fit of Model 2a and Model 2b relative to Model 1 ($\Delta\chi^2 = 344.2$, $df = 2$, $p < .001$, and $\Delta\chi^2 = 500.3$, $df = 2$, $p < .001$, respectively). The variance explained at the between-person level increased by up to 12%. The predictive power of conscientiousness was only slightly decreased by the inclusion of competence beliefs (from .21 to .19 in Model 2a and from .21 to .16 in Model 2b). When we included both measures of competence beliefs at the between-person level (model not shown in Table 5), competence beliefs as measured in the questionnaire did not statistically significantly predict academic effort. The other regression coefficients were virtually identical with those reported for Model 2b. Overall, these findings are again in line with the independent effects model.

In a final step, we again replaced the overall conscientiousness scale with the facet-level scales. The pattern of findings resulting from these additional analyses resembled the results reported in Table 5 very closely, with an identical pattern of statistically significant regression coefficients for conscientiousness and competence beliefs. The coefficients for the goal-striving facet were .11 (Model 1), .10 (Model 2a), and .08 (Model 2b). Similarly, the coefficients for the orderliness facet were .18, .16, and .14, respectively; those for the dependability facet were .20, .18, and .16, respectively.

Summary

Using a diary method to measure academic effort and situational competence beliefs, Study 3 extended Studies 1 and 2 in two ways. First, by aggregating student-reported effort in the diary across the 2 weeks, we obtained another, arguably highly valid measure of interindividual differences in academic effort. Second, we were able to differentiate between more stable and more situationally contingent aspects of academic effort. Overall, Study 3 again supported the independent effects hypothesis, as reflected by the increase in explained variance and the fairly stable regression coefficients for conscientiousness after the inclusion of competence beliefs. Furthermore, day-to-day variation in competence beliefs was statistically significantly related to academic effort. This pattern of results again points to the need for a broader conception of academic effort than would be suggested by the mediated effects model perspective or by a perspective that looked at only one of these constructs.

Table 5
Predicting Academic Effort: Results From Multilevel Modeling (Study 3)

	Model 1		Model 2a		Model 2b	
Predictor variables	*B*	*SE*	*B*	*SE*	*B*	*SE*
Between-person variables						
Verbal reasoning	0.03*	0.01	0.02	0.01	0.01	0.01
Prior achievement	0.00	0.02	−0.03	0.02	−0.06***	0.02
Conscientiousness	0.21***	0.02	0.19***	0.02	0.16***	0.02
Competence beliefs			0.08***	0.04	0.19***	0.02
Within-person variable						
Situational competence beliefs (diary)			0.21***	0.02	0.21***	0.02
Explained variance						
Level 3	0.53		0.62		0.50	
Level 2	0.17		0.18		0.29	
Level 1	0.00		0.04		0.04	
Deviance	17,424.3		17,080.1		16,924.0	
Estimated parameters	7		9		9	

Note. Competence beliefs as assessed via the questionnaire were used in Model 2a, whereas competence beliefs as reported in the diary component were aggregated across days and used as a between-person variable in Model 2b.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Discussion

Both conscientiousness and competence beliefs are believed to be highly important predictors of academic effort and achievement. Coming from quite different research traditions, however, these constructs have rarely been examined simultaneously. In three empirical studies, we made a coordinated effort to close this research gap. Specifically, we examined the ability of two models to explain our empirical data: the mediated effects model and the independent effects model. Overall, the pattern of results was largely in line with the independent effects model. We found a moderate association between conscientiousness and competence beliefs, but both constructs meaningfully and independently predicted academic effort, irrespective of how academic effort was measured (single-measurement questionnaire vs. diary instrument). Competence beliefs mediated only a small portion of the predictive effects of conscientiousness. The associations of competence beliefs with academic effort were highly domain specific, whereas conscientiousness was predictive of academic effort across a wide range of academic subjects. Cognitive ability as assessed by the figural and verbal reasoning subtests, although associated with academic achievement, only loosely predicted academic effort.

Conscientiousness and Competence Beliefs

One instantiation of trait theory proposes that, as a personality trait, conscientiousness constitutes a basic tendency that is endogenous to "characteristic adaptations" and "self-concept" (McCrae & Costa, 1999, 2008) or "surface characteristics" (Asendorpf & van Aken, 2003) such as competence beliefs. From the perspective of the mediated effects model, the trait of conscientiousness is of paramount interest when predicting academic effort. Whether a person has high or low competence beliefs is caused to a substantial degree by his or her trait level, even if external influences play a role in the development of competence beliefs. The paramount importance that is ascribed to traits for explaining human behavior in this theoretical paradigm might explain why many empirical studies in this tradition have paid comparatively little attention to characteristic adaptations such as competence beliefs. Likewise, adherents to the study of competency beliefs have tended to ignore personality traits because their perspective is partially derived from a belief that personality traits do not matter.

Conversely, other personality theories have stressed the relative independence of personality traits and motivational aspects of the self. The independent effects model holds that traits and motivational dispositions are distinct groups of variables that—despite some empirical overlap—independently predict academic outcomes. This paradigm highlights the role of motivational predictors including motives, competence beliefs, and value beliefs (e.g., Eccles & Wigfield, 2002; Roberts & Wood, 2006). According to this perspective, conscientiousness and domain-specific competence beliefs are quite distinct on a conceptual level. Conscientiousness is typically described as a relatively consistent, broad personality disposition. Competence beliefs, in contrast, exhibit considerable domain-specificity, yielding highly differentiated within-person profiles. This domain-specificity is believed to be the consequence of specific experiences in academic learning environments (Shavelson et al., 1976). In educational psychology, in particular, the role of domain-specific motivational predictors is stressed to such an extent that conscientiousness and other trait constructs are not routinely included in empirical studies.

Empirically, our results indicate that conscientiousness and competence beliefs are indeed qualitatively different constructs that predict the same outcomes. A perspective that focuses solely on traits or on competency beliefs in explaining academic behavior is at odds with our results in three respects. First, we found evidence for some empirical overlap that would be compatible with a mediated effects perspective, but with correlations of up to .34, the overlap was by no means perfect. Second, when both conscientiousness and competence beliefs were simultaneously used to predict academic effort, we found profound unique predictive effects for both constructs. Third, not only did competence perceptions positively predict academic effort in the corresponding domain, but they also had a (negative) predictive effect on academic effort in a different domain. Hence, competence perceptions texture individuals' profiles of achievement-related behavior. In addition, our study indicates not only that it is helpful to take relatively stable motivational dispositions such as competence beliefs into account but also that attending to situational elements as expressed in situational competence beliefs can provide additional insight into student effort.

Our findings were replicated when we used a facet-level approach based on Saucier's (1998) classification instead of the general conscientiousness scale from the NEO-FFI. It is interesting that the facet-level measures (goal striving, dependability, orderliness) did not systematically outpredict the overall conscientiousness measure. This finding stands in some contrast with the findings of studies in which facet-level measures of personality trait domains provided higher predictive validity than did global measures of traits across several (nonacademic) outcomes (Paunonen & Ashton, 2001). Similar patterns have been found for academic outcomes (e.g., Noftle & Robins, 2007), although in other studies (e.g., Gray & Watson, 2002) the global conscientiousness scale proved to be quite predictive. We largely attribute the pattern of results in our studies to the use of the NEO-FFI conscientiousness scale, which comprises only a rather narrow subset of the facets used in previous research (Roberts, Chernyshenko, Stark, & Goldberg, 2005). These facets were measured by only three to five items, resulting in scales with moderate internal consistency. A replication of our studies with a larger, more distinct set of conscientiousness facets is clearly warranted.

Limitations and Further Research

Some critical issues should be kept in mind when interpreting the results of this study. Conscientiousness and competence beliefs were measured by means of student questionnaires only. Although we believe student reports to be highly valid sources of information for these constructs, including reports from other sources has the potential to make the data even stronger. For example, acquaintance reports of conscientiousness have been shown to be solid predictors of academic success (Wagerman & Funder, 2007). With regard to academic effort, we used two different operationalizations (single-measurement questionnaire, diary data). Future studies might include additional sources, such as teacher reports, video data, or log files for computer-administered tasks.

A further potential limitation of our study is that our measures address different levels of specificity. Whereas conscientiousness was measured at a global level, competence beliefs and academic effort were measured at a domain-specific level. Indeed, conscientiousness and competency beliefs are typically operationalized at different levels of analysis. The challenge going forward is how

else to model and test the relations between traits and motivational constructs such as competence beliefs. One alternative would be to assess both traits and motives at varying levels of analysis (Bogg, Webb, Wood, & Roberts, 2008). This approach would mean assessing traits from broad to more narrow manifestations, in line with the idea of traits as density distributions (Fleeson, 2001), while simultaneously assessing competence beliefs in both context-specific and more general terms. In our view, modeling the full range of both traits and motives will further strengthen conclusions about their associations. Preliminary evidence suggests that results when traits and motives are assessed in this way also support the independent effects model (see Bogg et al., 2008).

The issue of causality also needs to be mentioned as a limitation. Strictly speaking, the word *effect* denotes *predictive effects* in the present study. Predictive effects do not necessarily imply causation, especially in studies with just one point of measurement. Although all of our models were based on theoretical considerations and most of our hypotheses were supported, it is always possible that other models—e.g., models with reversed causality, more measurement points, and/or additional variables—would paint a more accurate picture of reality. Finally, generalizability is also an issue. It is unclear to what extent cultural differences might affect the results. Although no previous studies have documented major differences between Germany and, for instance, the United States with regard to the associations between conscientiousness, competence beliefs, and academic effort, cross-cultural studies might detect such differences.

Taken together, although this article integrating results from three large studies opens a doorway to new avenues of research in an important field, it is evident that concerted efforts are needed to cast light on how conscientiousness and competence beliefs develop and predict academic effort and achievement in various domains.

References

Asendorpf, J. B., & van Aken, M. A. G. (2003). Personality–relationship transaction in adolescence: Core versus surface personality characteristics. *Journal of Personality, 71,* 629–662.

Bandalos, D. L. (2002). The effects of item parceling on goodness-of-fit and parameter estimate bias in structural equation modeling. *Structural Equation Modeling: A Multidisciplinary Journal, 9,* 78–102.

Bandura, A. (1997). *Self-efficacy: The exercise of control.* New York, NY: Freeman.

Barrick, M. R., & Mount, M. K. (1991). The Big 5 personality dimensions and job performance: A meta-analysis. *Personnel Psychology, 44,* 1–26.

Baumeister, R. F., Gailliot, M., DeWall, C. N., & Oaten, M. (2006). Self-regulation and personality: How interventions increase regulatory success, and how depletion moderates the effects of traits on behavior. *Journal of Personality, 74,* 1773–1801.

Bidjerano, T., & Dai, D. Y. (2007). The relationship between the big-five model of personality and self-regulated learning strategies. *Learning and Individual Differences, 17,* 69–81.

Bogg, T., Webb, M. L., Wood, D., & Roberts, B. W. (2008). A hierarchical investigation of personality and behavior: Examining neo-socioanalytic models of health-related outcomes. *Journal of Research in Personality, 42,* 183–207.

Borkenau, P., & Ostendorf, F. (1991). Ein Fragebogen zur Erfassung fünf robuster Persönlichkeitsfaktoren [A questionnaire for assessing five robust personality factors]. *Diagnostica, 37,* 29–41.

Brunner, M., Lüdtke, O., & Trautwein, U. (2008). The internal/external frame of reference model revisited: Incorporating general cognitive ability and general academic self-concept. *Multivariate Behavioral Research, 43,* 137–172.

Costa, P. T., & McCrae, R. R. (1992). *Revised NEO Personality Inventory (NEO PI-R) and NEO Five Factor Inventory (NEO-FFI) professional manual.* Odessa, FL: Psychological Assessment Resources.

De Raad, B., & Schouwenburg, H. C. (1996). Personality in learning and education: A review. *European Journal of Personality, 10,* 303–336.

Digman, J. M. (1990). Personality structure: Emergence of the five-factor model. *Annual Review of Psychology, 41,* 417–446.

Duckworth, A. L., Peterson, C., Matthews, M. D., & Kelly, D. R. (2007). Grit: Perseverance and passion for long-term goals. *Journal of Personality and Social Psychology, 92,* 1087–1101.

Eccles, J. S. (2005). Subjective task value and the Eccles et al. model of achievement-related choices. In A. J. Elliot & C. S. Dweck (Eds.), *Handbook of competence and motivation* (pp. 105–121). New York, NY: Guilford Press.

Eccles, J. S., & Wigfield, A. (2002). Motivational beliefs, values, and goals. *Annual Review of Psychology, 53,* 109–132.

Elliot, A. J., & Dweck, C. S. (Eds.). (2005). *Handbook of competence and motivation.* New York, NY: Guilford Press.

Fleeson, W. (2001). Toward a structure- and process-integrated view of personality: Traits as density distributions of states. *Journal of Personality and Social Psychology, 80,* 1011–1027.

Funder, D. C. (2000). Personality. *Annual Review of Psychology, 52,* 197–221.

Goldberg, L. R. (1993). The structure of phenotypic personality traits. *American Psychologist, 48,* 26–34.

Gray, E. K., & Watson, D. (2002). General and specific traits of personality and their relation to sleep and academic performance. *Journal of Personality, 70,* 177–206.

Harter, S. (1998). Developmental perspectives on the self-system. In N. Eisenberg (Vol. Ed.), *Handbook of child psychology* (Vol. 3, 5th ed., pp. 553–618). New York, NY: Wiley.

Heller, K., Gaedike, A.-K., & Weinläder, H. (1976). *Kognitiver Fähigkeitstest (KFT 4–13*) [Cognitive Ability Test 4–13]. Weinheim, Germany: Beltz.

Heller, K. A., & Perleth, C. (2000). *Kognitiver Fähigkeitstest für 4–12. Klassen, Revision* (KFT 4–12 + R) [Cognitive Ability Test, revised version (KFT 4–12 + R)]. Göttingen, Germany: Hogrefe.

John, O. P. (1990). The "Big Five" factor taxonomy: Dimensions of personality in natural language and in questionnaires. In L. A. Pervin (Ed.), *Handbook of personality: Theory and research* (pp. 66–100). New York, NY: Guilford Press.

Judge, T. A., Higgins, C. A., Thoresen, C. J., & Barrick, M. R. (1999). The Big Five personality traits, general mental ability, and career success across the life span. *Personnel Psychology, 52,* 621–652.

Kahneman, D., Krueger, A. B., Schkade, D. A., Schwarz, N., & Stone, A. A. (2004, December 3). A survey method for characterizing daily life experience: The day reconstruction method. *Science, 306,* 1776–1780.

Kishton, J. M., & Widaman, K. F. (1994). Unidimensional versus domain representative parceling of questionnaire items: An empirical example. *Educational and Psychological Measurement, 54,* 757–765.

Lüdtke, O., Trautwein, U., Kunter, M., & Baumert, J. (2006). Reliability and agreement of student ratings of the classroom environment: A reanalysis of TIMSS data. *Learning Environments Research, 9,* 215–230.

Lüdtke, O., Trautwein, U., Nagy, G., & Köller, O. (2004). Eine Validierungsstudie zum NEO-FFI in einer Stichprobe junger Erwachsener: Effekte des Itemformats, faktorielle Validität und Zusammenhänge mit Schulleistungsindikatoren [A validation of the NEO-FFI in a sample of young adults: Effects of the response format, factorial validity, and relations with indicators of academic achievement]. *Diagnostica, 50,* 134–144.

Lounsbury, J. W., Sundstrom, E., Loveland, J., & Gibson, L. W. (2003). Broad versus narrow personality traits in predicting performance of adolescents. *Learning and Individual Differences, 14,* 67–77.

Marsh, H. W. (1986). Verbal and math self-concepts: An internal/external frame of reference model. *American Educational Research Journal, 23,* 129–149.

Marsh, H. W. (1990). The structure of academic self-concept: The Marsh/Shavelson model. *Journal of Educational Psychology, 82,* 623–636.

Marsh, H. W., Craven, R. G., & McInerney, D. M. (Eds.). (2005). *International advances in self research: Vol. 2. New frontiers for self research*. Greenwich, CT: Information Age.

Marsh, H. W., & Hau, K.-T. (2004). Explaining paradoxical relations between academic self-concepts and achievements: Cross-cultural generalizability of the internal/external frame of reference predictions across 26 countries. *Journal of Educational Psychology, 96,* 56–67.

Marsh, H. W., & Shavelson, R. J. (1985). Self-concept: Its multifaceted, hierarchical structure. *Educational Psychologist, 20,* 107–125.

Marsh, H. W., Trautwein, U., Lüdtke, O., Köller, O., & Baumert, J. (2006). Integration of multidimensional self-concept and core personality constructs: Construct validation and relations to well-being and achievement. *Journal of Personality, 74,* 403–456.

McAdams, D. (1995). What do we know when we know a person? *Journal of Personality, 63,* 365–396.

McCrae, R. R., & Costa, P. T., Jr. (1999). A five-factor theory of personality. In L. A. Pervin & O. P. John (Eds.), *Handbook of personality: Theory and research* (2nd ed., pp. 139–153). New York, NY: Guilford Press.

McCrae, R. R., & Costa, P. T., Jr. (2008). Empirical and theoretical status of the Five-Factor model of personality traits. In G. J. Boyle, G. Matthews, & D. H. Saklofske (Eds.), *The Sage handbook of personality theory and assessment* (pp. 273–294). London, England: Sage.

Möller, J., & Husemann, N. (2006). Internal comparisons in everyday life. *Journal of Educational Psychology, 98,* 342–353.

Muthén, B., & Satorra, A. (1995). Complex sample data in structural equation modeling. *Sociological Methodology, 25,* 267–316.

Muthén, L. K., & Muthén, B. O. (1998–2006). *Mplus user's guide.* Los Angeles, CA: Muthén & Muthén.

Noftle, E. E., & Robins, R. W. (2007). Personality predictors of academic outcomes: Big Five correlates of GPA and SAT scores. *Journal of Personality and Social Psychology, 93,* 116–130.

Pajares, F., & Schunk, D. H. (2005). Self-efficacy and self-concept beliefs: Jointly contributing to the quality of human life. In H. W. Marsh, R. G. Craven, & D. M. McInerney (Eds.), *International advances in self research: Vol. 2. New frontiers for self research* (pp. 95–121). Greenwich, CT: Information Age.

Paunonen, S. V., & Ashton, M. C. (2001). Big Five factors and facets and the prediction of behavior. *Journal of Personality and Social Psychology, 81,* 524–539.

Pintrich, P. R. (2003). A motivational science perspective on the role of student motivation in learning and teaching contexts. *Journal of Educational Psychology, 95,* 667–686.

Preckel, F., Holling, H., & Vock, M. (2006). Academic underachievement: Relationship with cognitive motivation, achievement motivation, and conscientiousness. *Psychology in the Schools, 43,* 401–411.

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models* (2nd ed.). Thousand Oaks, CA: Sage.

Reis, H. T., Sheldon, K. M., Gable, S. L., Roscoe, J., & Ryan, R. M. (2000). Daily well-being: The role of autonomy, competence, and relatedness. *Personality and Social Psychology Bulletin, 26,* 419–435.

Roberts, B. W., Chernyshenko, O., Stark, S., & Goldberg, L. (2005). The structure of conscientiousness: An empirical investigation based on seven major personality questionnaires. *Personnel Psychology, 58,* 103–139.

Roberts, B. W., Kuncel, N. R., Shiner, R., Caspi, A., & Goldberg, L. R. (2007). The power of personality: The comparative validity of personality traits, socioeconomic status, and cognitive ability for predicting important life outcomes. *Perspectives in Psychological Science, 2,* 313–345.

Roberts, B. W., & Wood, D. (2006). Personality development in the context of the neo-socioanalytic model of personality. In D. Mroczek & T. Little (Eds.), *Handbook of personality development* (pp. 11–39). Mahwah, NJ: Erlbaum.

Saucier, G. (1998). Replicable item-cluster subcomponents in the NEO Five-Factor Inventory. *Journal of Personality Assessment, 70,* 263–276.

Schafer, J. L., & Graham, J. W. (2002). Missing data: Our view of the state of the art. *Psychological Methods, 7,* 147–177.

Schmitz, B., & Skinner, E. (1993). Perceived control, effort, and academic performance: Interindividual, intraindividual, and multivariate time-series analyses. *Journal of Personality and Social Psychology, 64,* 1010–1028.

Schmitz, B., & Wiese, B. S. (2006). New perspectives for the evaluation of training sessions in self-regulated learning: Time-series analyses of diary data. *Contemporary Educational Psychology, 31,* 64–96.

Shavelson, R. J., Hubner, J. J., & Stanton, G. C. (1976). Validation of construct interpretations. *Review of Educational Research, 46,* 407–441.

Snijders, T. A. B., & Bosker, R. J. (1999). *Multilevel analysis: An introduction to basic and advanced multilevel modeling.* London, England: Sage.

Trautwein, U. (2007). The homework–achievement relation reconsidered: Differentiating homework time, homework frequency, and homework effort. *Learning and Instruction, 17,* 372–388.

Trautwein, U., Lüdtke, O., Köller, O., & Baumert, J. (2006). Self-esteem, academic self-concept, and achievement: How the learning environment moderates the dynamics of self-concept. *Journal of Personality and Social Psychology, 90,* 334–349.

Trautwein, U., Lüdtke, O., Marsh, H. W., Köller, O., & Baumert, J. (2006). Tracking, grading, and student motivation: Using group composition and status to predict self-concept and interest in ninth grade mathematics. *Journal of Educational Psychology, 98,* 788–806.

Trautwein, U., Lüdtke, O., Schnyder, I., & Niggli, A. (2006). Predicting homework effort: Support for a domain-specific, multilevel homework model. *Journal of Educational Psychology, 98,* 438–456.

Tsai, Y.-M., Kunter, M., Lüdtke, O., & Trautwein, U. (2008). Day-to-day variation in competence beliefs: How autonomy support predicts young adolescents' felt competence. In R. G. Craven & H. W. Marsh (Eds.), *International advances in self research: Vol. 3. Self-processes, learning, and enabling human potential: Dynamic new approaches* (pp. 119–144). Greenwich, CT: Information Age.

Wagerman, S. A., & Funder, D. C. (2007). Acquaintance reports of personality and academic achievement: A case for conscientiousness. *Journal of Research in Personality, 41,* 221–229.

Wigfield, A., Eccles, J. S., & Pintrich, P. R. (1996). Development between the ages of 11 and 25. In D. C. Berliner & R. C. Calfee (Eds.), *Handbook of educational psychology* (pp. 148–185). New York, NY: MacMillan.

Wigfield, A., & Wagner, A. L. (2005). Competence, motivation, and identity development during adolescence. In A. J. Elliot & C. S. Dweck (Eds.), *Handbook of competence and motivation* (pp. 222–239). New York, NY: Guilford Press.

Winter, D. G., John, O. P., Stewart, A. J., Klohnen, E. C., & Duncan, L. E. (1998). Traits and motives: Toward an integration of two traditions in personality research. *Psychological Review, 105,* 230–250.

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