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Different Forces, Same Consequence:

Conscientiousness and Competence Beliefs are Independent Predictors of Academic Effort

and Achievement

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Abstract

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, but competence beliefs meaningfully predicted both conscientiousness and academic effort, irrespective of how academic effort was measured (student report 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. Cognitive ability, although associated with academic achievement, only loosely predicted academic effort.

Keywords: Conscientiousness; Competence Beliefs; Academic Effort; Academic Achievement

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"Genius is one per cent inspiration and ninety-nine per cent 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). Unlike the trait of conscientiousness, domain-specific competence beliefs are conceptualized to be rather malleable. These two very different conceptualizations both claim to predict effortful behavior

in academic domains. Interestingly, 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

Personality researchers have increasingly converged on the Big-Five model of personality (Digman, 1990; Funder, 2000; Goldberg, 1993; John, 1990). A broad variety of factor analyses have consistently identified five factors: neuroticism, extraversion, conscientiousness, agreeableness, and openness to experience (the latter sometimes labeled imagination, intellect, or culture). As shown by Watson, Suls, and Haig (2002), this Big-Five structure is remarkably robust, with the same factors emerging in both peer and self-ratings, in responses by children and adults, and across different languages, nationalities, and cultural groups (e.g., Digman, 1990; McCrae & Costa, 1987, 1997). Funder (2000) argued that the five broad traits serve as a common currency for personality psychology and define the "latitude and longitude" along which any new personality construct should routinely be mapped (Ozer & Reise, 1994, p. 361). Consequently, the Big-Five factors have been at the center of a tremendous number of studies, and the empirical data yield strong support for their stability and predictive validity (see McCrae & Costa, 1999).

Of the Big-Five factors, conscientiousness might seem most relevant for success in different life domains. Conscientious persons are characterized as being industrious, systematic, dutiful, high on achievement striving, and hard-working. Not surprisingly, conscientiousness has repeatedly been found to be the Big-Five factor most closely associated with 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. Moreover, in a study by Judge, Higgins, Thoresen, and Barrick (1999), conscientiousness was found to be associated with higher job satisfaction

and career success (income and status). Similarly, based on a systematic review of more than 50 empirical studies, Roberts, Kuncel, Shiner, Caspi, and Goldberg (2007) concluded that conscientiousness was substantively associated with low mortality, low divorce, and high occupational attainment.

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 GPA or course grade in college students. In 15 of these 20 studies, conscientiousness was significantly positively related to the academic outcome variable; 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. Studies with high school students provide further evidence for the impact of conscientiousness. Although relatively small in number, these studies have generally found positive associations between conscientiousness and achievement (e.g., Lounsbury, Sundstrom, Loveland, & Gibson, 2003; Lüdtke, Trautwein, Nagy, & Köller, 2004; Preckel, Holling, & Vock, 2006).

Why is conscientiousness positively associated with academic outcomes? It is generally assumed that the positive effects of conscientiousness on academic outcomes are mediated by academic effort (see De Raad & Schouwenburg, 1996). Recent studies lend empirical support to this assumption. For instance, 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. It is important to note that conscientiousness has been found to predict GPA even when cognitive abilities such as psychometric intelligence are controlled. In fact, although cognitive abilities

are associated with achievement, the association between conscientiousness and academic effort may be closer than that between cognitive abilities and academic effort (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; see also Marsh, Trautwein, Lüdtke, Köller, & Baumert, 2006). In this article, we investigate a surface characteristic that has received much attention from motivational and educational researchers and that 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; Wigfield, Eccles, & Pintrich, 1996; Trautwein, Lüdtke, Marsh, Köller, & Baumert, 2006). 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). There are various conceptions of competence beliefs, including 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 people with lower beliefs in their competence. In the school context, competence beliefs reflect students' belief in being able to execute goal-oriented behavior successfully. Not surprisingly, researchers have demonstrated that specific components of self-concept have important effects on 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. Confirmatory factor analyses conducted on competence beliefs obtained using the Academic Self-Description Questionnaire II (Marsh, 1990) for grades 7 to 10 showed that it was possible to reliably differentiate between competence beliefs regarding 15 school subjects. Correlations among competence beliefs are typically much lower than correlations among the corresponding grades or test scores (Marsh & Shavelson, 1985; Marsh et al., 2006). In particular, there is a strong distinction between more "verbal" and more "mathematical" subjects, with students tending to see themselves as either verbally or mathematically able, but not as both (Brunner, Lüdtke, & Trautwein, 2008).

Association between Conscientiousness, Competence Beliefs, and Academic Effort

Although conscientiousness and academic competence beliefs are both thought to be key variables in explaining academic effort and achievement, only a handful of empirical studies have considered them together. Fewer studies still have attempted to predict academic achievement by a combination of conscientiousness, competence beliefs, and academic effort. For this reason, the conceptual as well as empirical overlap among these three constructs remains largely unknown, as does their unique predictive power with regards to academic outcomes. This surprising lack of research is most likely attributable to the distinct research traditions and specializations that have grown up in the fields of personality research, on the one hand, and motivational and educational research, on the other (see Marsh et al., 2006).

Conceptually, the primary question is whether to consider competence beliefs and academic effort as manifestations of conscientiousness or as related but independent constructs. Two personality models arrive at related but different perspectives on this question. Classic trait models (e.g., McCrae & Costa, 1999) hold that traits are basic tendencies that are endogenous to all other variables. Therefore, contextualized motivations, such as competence beliefs, should be caused by conscientiousness, although external influences may also have some influence (McCrae & Costa, 2008). Similarly, contextualized

behaviors, such as academic effort and performance, should be influenced by traits, but competence beliefs should mediate the relation between conscientiousness and achievement outcomes. We will call this model the "mediated effects model."

On the other hand, several personality theories have highlighted the relative independence of motivational constructs from traits (e.g., Roberts & Wood, 2006; Winter, John, Stewart, Kohnen, & Duncan, 1998). For instance, several personality theories propose that motivational tendencies as encapsulated in motives and traits are each hierarchically arranged, yet separate, domains of personality. 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 learning environment and the accompanying frame of references 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 independent of conscientiousness. We will use the term "independent effects model" for this theoretical stance. For clarity's sake, it must be emphasized, however, that the independent effects model does not postulate a zero correlation between conscientiousness and competence beliefs. Instead, it postulates that conscientiousness is but one predictor of academic effort and achievement and that competence beliefs considerably contribute to their prediction above and beyond the effect of conscientiousness.

The few available studies indicate that conscientiousness and academic competence beliefs are moderately correlated and thus it is unclear which conceptual model will explain the combination of conscientiousness, academic competence, academic effort, and achievement. For example, in the study by Noftle and Robins (2007) described above, 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 mediated the predictive effects of conscientiousness on later academic achievement. In a large, representative sample of students

in their last year of high school, Marsh et al. (2006) found conscientiousness to correlate statistically significantly with competence beliefs in mathematics ($r = .26$) and verbal domains ($r = .10$).

Integrating elements from expectancy–value theory (Eccles & Wigfield, 2002) and research on personality traits (Costa & McCrae, 1992), Trautwein and colleagues (Trautwein & Lüdtke, 2007; Trautwein, Lüdtke, Kastens, & Köller, 2006; Trautwein, Lüdtke, Schnyder, & Niggli, 2006) recently proposed and tested a model that aims at explaining academic effort in homework and academic achievement. Although the authors acknowledged that conscientiousness might predict competence beliefs, their results seem to provide support 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 gender, cognitive ability, and parental homework support were controlled, conscientiousness predicted academic effort in all school subjects analyzed (mathematics, English as a foreign language, French as a foreign language), with some of the effect on academic effort being mediated by competence beliefs. However, competence beliefs not only mediated some of the predictive power of conscientiousness, but also added independently to explaining academic effort.

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 classical trait arrangement of these variables (mediated effects model) or the independent domains arrangement (independent effects model) fit the data better. All three studies also included a measure 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; these questions are detailed in the introduction to each study.

Study 1

A large sample of high school students participated in Study 1, in which we tested for the predictive effects of conscientiousness and competence beliefs regarding academic effort. In addition to conscientiousness and a measure 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).

There are three major contributions of this study. First, the student sample allowed us to test whether conscientiousness is already 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 et al., 2004; see also Marsh et al., 2006). We expected to find a positive association between conscientiousness and academic effort in both school subjects considered.

Second, we systematically tested whether the mediated effects model or the independent effects model provided a better explanation of 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 cognitive ability and conscientiousness to predict academic effort in mathematics and English. In the second step, we further included domain-specific competence beliefs in mathematics and English. According to the mediated effects model, inclusion of competence beliefs can be expected to mediate some of the predictive power of conscientiousness on academic effort, but competence beliefs should not explain an substantial amount of additional variance. Conversely, according to the independent effects model, both conscientiousness and competence beliefs can be expected to emerge as statistically significant predictor variables with unique predictive power regarding academic effort.

The third major contribution of the study is the inclusion of measures of two domain-specific competence beliefs instead of just one. This allowed us to conduct a further in-detail analysis of the predictive pattern found for competence beliefs. One of the striking results of

prior 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 is in line with the idea that internal comparison processes contribute to intrapersonal profiles of competence beliefs, alongside external comparison processes (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 with the perceived achievement of other students. Thus, classmates provide a frame of reference for a social comparison process that results in higher competence beliefs for higher-achieving students. At the same time, however, students compare their perceived achievement in one domain (e.g., verbal achievement) with their perceived 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).

Despite strong empirical support for the domain-specificity of competence beliefs, 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 really 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 clearly correspond to the independent effects model.

Methods

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 in intact classes 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 euros (approx. US$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).

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.

Conscientiousness. Conscientiousness was again measured with the German version of

the NEO Five Factor Inventory (NEO-FFI; Borkenau & Ostendorf, 1993; original version by

Costa & McCrae, 1992). One of the 12 items 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 parcel 2; items 7 and 11 parcel 3; and items 4, 8, and 12 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 (α = .83).

Cognitive ability. The Figure Analogies subscale from the Cognitive Ability Test 4-12+R (Heller & Perleth, 2000) was used to tap cognitive ability. The internal consistency (Kuder-Richardson formula 20) of the cognitive ability 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 of items 2, 7, 12, 17, and 22, etc.

Statistical Analyses

We used latent variable modeling throughout this study. As described above, 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 (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 "type = complex" option in Mplus 4.0 (Muthén & Muthén, 1998-2006). When the complex option is used, estimates of standard errors are automatically corrected for clustering effects (see 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, conscientiousness was substantively 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 substantively 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. Interestingly, cognitive ability 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, χ^2 ($df = 49$, $N = 571$) $= 56.89$, TLI $= .995$, RMSEA $= .017$, we used cognitive ability, prior mathematics achievement, and conscientiousness to predict mathematics effort. In Model 2, χ^2 ($df = 68$, $N = 571$) $= 76.26$, TLI $= .996$, RMSEA $= .015$, we additionally included mathematics competence beliefs. Paralleling this approach with English, we used cognitive ability, prior English achievement, and conscientiousness to predict English effort in Model 3, χ^2 ($df = 49$, $N = 571$) $= 58.03$, TLI $= .995$, RMSEA $= .018$, and additionally included English competence beliefs in Model 4, χ^2 ($df = 68$, $N = 571$) $= 85.08$, 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, χ^2 ($df = 126$, $N = 571$) $= 170.56$, TLI $= .985$, RMSEA $= .025$.

In Model 1 (see Table 2), prior mathematics achievement, cognitive ability, 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, cognitive ability, and conscientiousness indicated that mathematics competence beliefs functioned as a mediator variable to some extent. Importantly, the regression coefficient of conscientiousness was .59 in Model 1 and .48 in Model 2. However, 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 clearly in line with the predictions of the independent effects model.

In the next two models (Model 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 independent effects model. Specifically, the inclusion of English competence beliefs added substantively to the explained variance (from .31 to .46). Furthermore, both English competence beliefs and conscientiousness independently predicted English effort. Hence, there was again strong support for the independent effects model.

In the final Model 5, we used the complete set of predictor variables to simultaneously predicted 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 (β = -.35) and vice versa (β = -.23), and the overall percentage of explained variance in mathematics and English effort was higher than in Model 2 and Model 4. Hence, high domain-specific competence beliefs in mathematics and English not only contribute to high 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, the pattern of results is at odds with a mediation model and supports the independent effects model.

Summary

There are three major conclusions from Study 1. First, conscientiousness is indeed already associated with academic effort at high school. Second, although competence beliefs mediated some of the predictive effects of conscientiousness on academic effort, there was strong support for the independent effects model, with additional variance in domain-specific academic effort being explained by the inclusion of domain-specific competence beliefs and regression coefficients of substantial size for both conscientiousness and competence beliefs.

Third, as further support for the independent effects model, we found mathematics competence beliefs to negatively predict academic effort in English (and vice versa). These findings indicate that academic effort is not simply determined by a trait (conscientiousness), but is also a reflection of the individual student's motivational profile.

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, conscientiousness as well as competence beliefs were expected to be statistically significantly associated with academic effort. We expected to find 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.

Methods

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. The study took about 45 minutes to complete and was administered to intact classes selected by the respective head teachers based on availability of testing time. Trained research assistants administered the materials during regular lesson time.

Instruments

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.

Academic effort. Two scales were used to tap students' self-reported academic effort. *Homework compliance* was measured by 6 items (sample item: "I always try to complete my mathematics homework"). Students high on homework compliance do their homework assignments carefully and do not copy from others. Internal consistency (Cronbach's alpha) was adequate ($\alpha = .85$). *Persistence* was measured by means of three items (sample item: "Even if my mathematics homework is difficult, I don't give up quickly"). Internal consistency (Cronbach's alpha) was adequate ($\alpha = .79$).

Cognitive ability. 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).

Conscientiousness. Conscientiousness was again measured using the 12 conscientiousness items from the German version of the NEO personality inventory (Borkenau & Ostendorf, 1993; original version by Costa & McCrae, 1992). One item 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 ($\alpha = .84$).

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 ($\alpha = .87$).

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 in the structural equation models. To correct for the clustering effect, the "type = complex" option in Mplus

4.0 (Muthén & Muthén, 1998-2006) was again used in all analyses. Finally, we again dealt with missing values (average percent of missing data = 6%) by using the missing values estimator implemented in Mplus 4.0.

Results

Table 3 reports the intercorrelations for all constructs in Study 2. As before, all correlations between multi-indicator constructs are correlations between latent variables. 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. Cognitive ability 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, cognitive ability, 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 χ^2 ($df = 57$, $N = 415$) = 76.34, TLI = .988, RMSEA = .028 for the first model, and χ^2 ($df = 139$, $N = 415$) = 218.96, TLI = .977, RMSEA = .0.37 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 mathematics 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 to $\beta = .34$ when competence beliefs were included (see Figure 1b). Competence beliefs significantly predicted academic effort, and the percentage of explained variance in academic effort increased substantively (from $R^2 = .40$ to $R^2 = .67$) when competence beliefs were included. This finding is 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 substantively associated with academic effort. Although conscientiousness predicted academic behavior across different school subjects, interindividual differences in domain-specific competence beliefs added substantively to the prediction of academic effort. Overall, Studies 1 and 2 thus provided strong support for the independent effects model.

Study 3 adds another strong piece of evidence to research on students' academic behaviors. We examined the degree to which academic behavior is not only associated with conscientiousness and domain-specific competence beliefs as operationalized in Studies 1 and 2, but also 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/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, in press). 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 three 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. were able to show that situational competence beliefs were meaningfully affected by the quality of the lesson that preceded 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 substantive 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 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.

Method

Sample

The sample for Study 3 came from a large study (see Trautwein, Lüdtke, Schnyder, et al., 2006) on French as a second language conducted in collaboration between researchers at the University 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 in intact classes. 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 one-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 or 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

Cognitive ability. The verbal subscales of the Cognitive Ability Test 4-13 (Heller, Gaedicke, & 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 personality inventory (Borkenau & Ostendorf, 1993; original version by Costa & McCrae, 1992). Internal consistency (Cronbach's alpha) was satisfactory ($\alpha = .78$).

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).

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 score was high, at .88 (academic effort) and .88 (competence beliefs).

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 1,536 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 uncentered. At the second (between-person) level, regression equations were modeled for conscientiousness, cognitive ability, 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. Thus, 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 π_{1jk} is predicted by the coefficient β_{10k}.

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 maximum likelihood (FIML).

We assessed model fit using the deviance values provided by HLM, 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 χ^2 distribution with degrees of freedom equal to the difference in the number of parameters estimated. Because we used the full maximum likelihood method, the χ^2 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 χ^2 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 5.88 homework assignments, these correlations were based on a total of 9,030 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 academic effort. Further in line with our expectations, conscientiousness was significantly related with academic effort. Cognitive ability was only modestly related with most of the other variables in the study. Finally, the closest 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 cognitive ability, prior achievement, and conscientiousness as between-person predictor variables. As reported in Table 5 (Model 1), conscientiousness and cognitive ability statistically significantly predicted academic effort. The between-person variables explained 17% of the between-person variance

and about 52% of the between-class variance.

In Model 2 (see Table 5), we additionally included situational competence beliefs from the diary as a within-person predictor variable and competence beliefs as assessed in the questionnaire 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 as measured in the questionnaire were also statistically significantly associated with academic effort. The inclusion of these two parameters statistically significantly and considerably improved the fit of Model 2 relative to Model 1 ($\Delta\chi^2 = 737.9$, $df = 2$, $p < .001$). The variance explained at the between-person level increased by 10%. The predictive power of conscientiousness was only slightly decreased by the inclusion of competence beliefs. These findings are again in line with the independent effects model.

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 two 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 best reflected by the increase in explained variance 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.

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 tested the power of two different theoretical models to account for 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 (student report vs. diary data). 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, although associated with academic achievement, only loosely predicted academic effort.

Basic Tendencies Versus Competence Beliefs

As a personality trait (McCrae & Costa, 1999), conscientiousness is believed to constitute a basic tendency that is endogenous to "characteristic adaptations" and "self-concept" (see McCrae & Costa, 2008) or "surface characteristics" (Asendorpf & van Aken, 2003) such as competence beliefs. According to the mediated effects model, the trait of conscientiousness is of paramount interest when predicting academic effort. From this perspective, 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 explains why empirical studies have paid comparably sparse attention to characteristic adaptations such as competence beliefs.

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 rather stable, 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 motivators that predict the same outcomes. A perspective that focuses solely on traits and neglects the role of competence perceptions in explaining academic behavior collides with our results in four 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. Fourth, not only is it helpful to take relatively stable motivational dispositions such as competence beliefs into account, but attending to situational elements as expressed in situational competence beliefs can provide additional insight into student effort.

Taken together, both domain-general (conscientiousness) and domain-specific (competence beliefs) predictors must be taken into account when examining academic effort.

If academic behavior was governed primarily by conscientiousness, we would have found a stronger correlation between conscientiousness and academic effort, as well as a stronger correlation between academic effort in the two areas examined in Study 1. Conversely, if academic effort was driven primarily by domain-specific competence beliefs, conscientiousness would have had a smaller predictive effect once competence beliefs were included; furthermore, the students' academic effort profiles would arguably have been even more pronounced. Hence, 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.

We can thus conclude that both conscientiousness and competence beliefs should be included in all models that attempt to explain academic effort and achievement. So why have so few studies simultaneously examined both conscientiousness and competence beliefs? Our best guess is that this neglect is attributable to the distinct theoretical foundations of the different research traditions.

Stability and Malleability

A major conceptual difference between conscientiousness and competence beliefs is their assumed stability versus malleability. Interestingly, recent developments seem to indicate that the distinction between stable versus malleable person characteristics may not be as clear-cut as it once seemed.

Conscientiousness has typically been conceptualized as a rather enduring personality trait: "It appears from several longitudinal studies that most personality traits show little or no change in mean levels after age 30" (Costa & McCrae, 1992, p. 89) and only modest change throughout adulthood (McCrae & Costa, 1999). However, other authors have recently identified replicable associations between life experiences and changes in personality traits. For instance, features of the work environment seem to be associated with changes in conscientiousness, success in paid work is associated with increases in measures of dominance (Roberts, 2007; Roberts, Caspi, & Moffitt, 2003), and social relationship patterns

predict change in personality (Neyer & Asendorpf, 2001).

In contrast to conscientiousness, domain-specific competence and value beliefs have always been conceptualized as being considerably impacted by features of the learning environment (Eccles & Wigfield, 2002). In fact, the quality of a classroom environment is significantly associated with how students judge their competence, how strongly they value the subject, and how much effort they put into it (e.g., Lüdtke, Köller, Marsh, & Trauwein, 2005; Trautwein, Lüdtke, Schnyder et al., 2006). However, there is reason to believe that competence beliefs are also relatively stable (e.g., Marsh, Trautwein, Lüdtke, Köller, & Baumert, 2005) unless there is a quite substantial change in the learning environment (e.g., Marsh, Köller, & Baumert, 2001).

Provided that both conscientiousness and competence beliefs are neither perfectly stable nor completely malleable, environmental conditions that are conducive to their enhancement are of high theoretical and practical interest. In this context, the mutual relationship of conscientiousness and competence beliefs may be of specific importance. Do educational settings that boost competence beliefs also increase conscientiousness? As pointed out by Roberts, Walton, and Viechtbauer (2006, p. 31) with reference to personality traits, "addressing such questions will inevitably move the field to a new set of theories and potentially a new vision of personality psychology that is more dynamic, inclusive of both person and environmental variables, and hopefully more accurate."

One specific aspect of our research that may open up such new avenues for research integrating personality traits and motivational constructs was the combination of trait and process perspectives in Study 3. Schools may provide an ideal environment for such research because stable person characteristics and situational stimuli can be expected to shape students' feelings, thoughts, and behaviors simultaneously. In fact, the school environment allows two systematic approaches to the study of environmental variations. Researchers can study the same students in different subjects (e.g., Trautwein & Lüdtke, 2007) or the same students over several lessons in the same subject (e.g., Tsai et al., in press).

Issues of stability and malleability are also relevant to the practical implications of our studies. Our results indicate that both conscientiousness and competence beliefs are associated with academic effort and academic achievement. What does this finding mean for educational environments? What should be the primary target of attempts to foster students' academic effort? Conscientiousness? Competence beliefs? Or both?

Unfortunately, there is no straightforward answer. On the one hand, reliable evidence from educational psychology indicates that competence beliefs can be systematically increased in favorable learning environments (Bandura, 1997; Zimmerman, Bonner, & Kovach, 1996); no such evidence is available for conscientiousness. On the other hand, competence beliefs are domain specific and may in fact interfere with academic effort in other domains, whereas conscientiousness is related to academic effort across a broad spectrum of academic domains. Further research is needed to study to what degree effective learning environments positively impact both conscientiousness and competence beliefs.

Limitations and Further Research

Some critical issues should be kept in mind when interpreting the results of this study. Importantly, conscientiousness and competence beliefs were measured by means of student questionnaires only. Although we believe student reports to be the most valid source of information for these constructs, including reports from other sources has the potential to make the data even stronger. With regards to academic effort, we used two different operationalizations (student report, diary data). Future studies might include additional sources, such teacher report, video data, or log files for computer-administered tasks.

The issue of causality also needs to be mentioned. 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.

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 regards to conscientiousness, competence

beliefs, and academic effort, cross-cultural studies might detect such differences.

Taken together, although this article integrating results from four 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.

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Table 1

Intercorrelations of Study 1 Constructs

Variables	1	2	3	4	5	6	7
1 Cognitive ability							
2 Conscientiousness	-0.12 *						
3 Mathematics prior achievement	0.28 ***	0.15 **					
4 Mathematics competence beliefs	0.17 **	0.34 ***	0.29 ***				
5 English prior achievement	0.06	0.16 **	0.32 ***	-0.08			
6 English competence beliefs	-0.03	0.19 ***	0.05	0.16 **	0.46 ***		
7 Mathematics effort	0.13 **	0.62 ***	0.41 ***	0.58 ***	0.11	-0.02	
8 English effort	-0.08	0.47 ***	-0.01	-0.10	0.37 ***	0.56 ***	0.23 ***

Note. $N = 571$. Correlations involving multi-indicator constructs are correlations between latent variables.

*** $p < .001$. ** $p < .01$. * $p < .05$.

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	
					Mathematics	
Predictors	Model 1	Model 2	Model 3	Model 4	effort	English effort
Mathematics prior achievement	0.29 ***	0.22 ***			0.18 ***	-0.04
Mathematics competence beliefs		0.34 ***			0.39 ***	-0.35 ***
Cognitive ability	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.

*** $p < .001$. ** $p < .01$. * $p < .05$.

Table 3

Intercorrelations of Study 2 Constructs

Variables	1	2	3	4	5
1 Time 1 mathematics achievement					
2 Cognitive ability	0.32				
3 Conscientiousness	0.25	0.10			
4 Mathematics competence beliefs	0.51	0.13	0.23		
5 Mathematics effort	0.48	0.16	0.51	0.73	
6 Time 2 mathematics achievement	0.67	0.28	0.23	0.49	0.51

Note. $N = 415$. All correlations between multi-indicator constructs are correlations between latent variables. All correlations are statistically significant at $p < .05$.

Table 4

Intercorrelations (Between-Person Level) of Study 3 Variables

Variables	1	2	3	4	5
1 Prior achievement					
2 Cognitive ability	0.22				
3 Conscientiousness	0.20	*0.02*			
4 Competence beliefs (questionnaire)	0.40	0.15	0.27		
5 Situational competence beliefs (diary)	0.33	0.15	0.28	0.44	
6 Effort (diary)	0.08	0.06	0.39	0.24	0.41

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

Table 5

Predicting Academic Effort: Results from Multilevel Modeling (Study 3)

Predictors	Model 1		Model 2	
	B	*SE*	*B*	*SE*
Between-person variables				
Cognitive ability	0.03 *	0.01	0.02	0.01
Prior achievement	0.00	0.02	-0.05 **	0.02
Conscientiousness	0.21 ***	0.02	0.19 ***	0.02
Competence beliefs (questionnaire)			0.10 ***	0.04
Within-person variable				
Situational competence beliefs (diary)			0.20 ***	0.02
Explained variance				
Level-3	0.52		0.56	
Level-2	0.17		0.27	
Level-1	0.00		0.04	
Deviance	17680.8		16942.8	
Estimated parameters	7		9	

Note. *** $p < .001$; ** $p < .01$; * $p < .05$

Figure Captions

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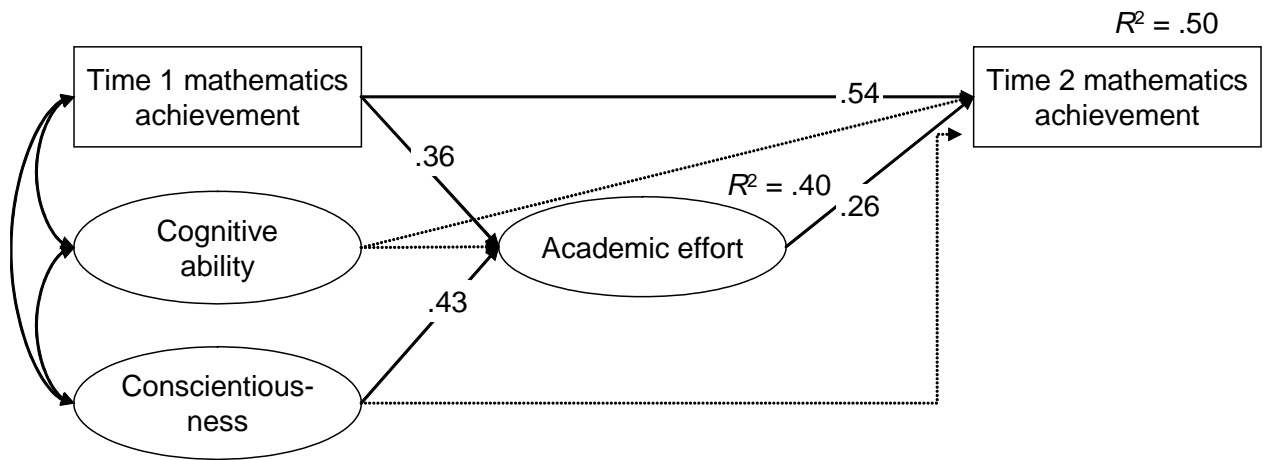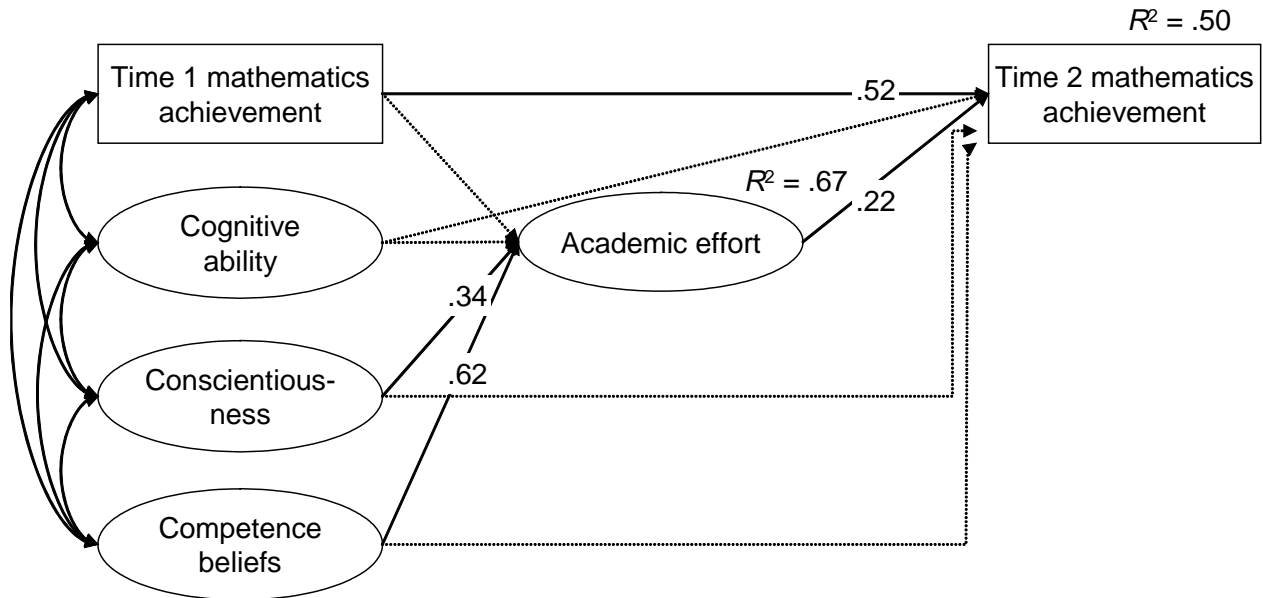
Figure 1a

Figure 1b