

A person-centered approach to homework behavior: Students' characteristics predict their homework learning type[☆]



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ABSTRACT

Homework time (i.e., the total amount of time spent on homework) and homework effort (i.e., the extent to which students work seriously on their homework) are defined as two central aspects that characterize students' homework behavior. Recent research has identified homework learning types by considering differences in students in both homework effort and homework time with a person-centered approach (Flunger et al., 2015). The present study investigated how students' characteristics (i.e., motivation, conscientiousness, gender, and verbal abilities) are associated with these homework behavior profiles. To this end, data on homework behavior in the subject of French as a second language of 1649 Swiss eighth-grade students were reanalyzed by applying latent profile analyses (LPAs) with covariates in a modified three-step method (Vermunt, 2010). The findings suggest that large amounts of homework time can be a characteristic of favorable homework behavior: When students simultaneously invested a great deal of effort in their homework, spending a lot of time on homework was associated with high motivation and high conscientiousness. By contrast, when students exerted low effort, large amounts of homework time were found to be associated with low motivation and low conscientiousness.

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1. Introduction

As students spend billions of hours on homework every year around the globe, a better understanding of how students can optimally do their homework remains a pressing issue in educational psychology. Homework can be understood as “tasks assigned to students by schoolteachers that are meant to be carried out during non-school hours” (Cooper, 1989, p. 7). One of the currently most vexing questions in educational research concerns the role of *homework time* (i.e., the amount of time spent on homework; Cooper, 2001), which is the most frequently used indicator of

homework behavior (see Cooper, Robinson, & Patall, 2006). High amounts of homework time are often viewed as an indicator of better study habits (e.g., Cooper et al., 2006), but the association between students' motivation (in particular, competence and value beliefs) and homework time is still unclear. In the rare cases when a significant association was found between homework time and competence beliefs, it was negative (e.g., Trautwein, Lüdtke, Schnyder, & Niggli, 2006). This finding suggests that highly motivated students tend to spend less time on homework than less motivated students. Yet, does this also mean that students who spend large amounts of time on homework automatically have low competence and value beliefs?

The findings for homework time can certainly be contrasted with research on *homework effort* (e.g., Trautwein, 2007), the second central indicator of homework behavior. Homework effort is defined as the degree to which students work seriously on their homework (e.g., Trautwein & Köller, 2003). Students with high value and competence beliefs have often been found to demonstrate high homework effort (e.g., Trautwein, Lüdtke, Schnyder, et al., 2006).

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However, such prior findings resulted from variable-centered analyses in which the association between one outcome (either homework time or effort) and competence or value beliefs was investigated. Recently, a study showed that students could be classified as distinct homework learning types by applying person-centered methods (i.e., latent profile analysis; LPA), which allowed for the identification of qualitatively different profiles of students by simultaneously considering homework time and homework effort (Flunger et al., 2015). With its exclusive focus on the link between students' homework behavior and academic achievement, this earlier investigation was completely in line with the dominant educational effectiveness approach to homework (e.g., Cooper et al., 2006): In this prominent and productive research tradition, the focus is almost exclusively on whether or not homework is effective for predicting achievement, whereas psychological predictors (most important: motivational predictors) are of negligible concern (see Trautwein, Lüdtke, Nagengast, & Flunger, 2015).

In the present article, we expanded on this earlier work by applying a systematic investigation of motivational/psychological predictors of homework learning types. This was done by estimating LPAs with covariates, a procedure that enabled us to simultaneously consider both homework effort and homework time as outcomes and competence and/or value beliefs as covariates. Thereby, we were able to obtain a more fine-grained picture of students' differences, regarding both their personal characteristics and homework behavior. We also considered additional student characteristics (i.e., conscientiousness, gender, and cognitive abilities) as covariates of the homework learning types. Data on homework behavior in the subject of French as a second language of 1649 Swiss eighth-grade students were reanalyzed via LPAs with covariates in a modified three-step approach (e.g., Vermunt, 2010).

1.1. A person-centered approach to students' homework behavior

Researchers have often highlighted the idea that “the relationship between homework and academic performance is not linear” (Fernández-Alonso, Suárez-Álvarez, & Muñoz, 2015, p. 7; see also Cooper & Valentine, 2001; Daw, 2012). That is, previous research has pointed to an inconsistent association between students' homework time and academic achievement (see, e.g., the wide range of correlations reported in the meta-analyses by Cooper et al., 2006; Hendriks, Luyten, Scheerens, & Sleegers, 2014). When a significant association between homework time and achievement was found, it was mainly small and negative (e.g., Chang, Wall, Tare, Golonka, & Vatz, 2014; De Jong, Westerhof, & Creemers, 2000; Paschal, Weinstein, & Walberg, 1984).

However, students' homework behavior cannot be fully captured by focusing solely on homework time. Both time-on-task (Fredricks, Blumenfeld, & Paris, 2004) and effort (Skinner, Kindermann, & Furrer, 2008) are understood as facets of behavioral engagement (Fredricks, Blumenfeld, Friedel, & Paris, 2005). Accordingly, homework effort is acknowledged as the second central indicator of homework behavior (e.g., Schmitz & Skinner, 1993; Trautwein, 2007). Several subfacets of homework effort (e.g., homework compliance, homework persistence, and seasonal effort) have been identified. Homework compliance refers to the care students put into homework tasks (e.g., working on them as well as they can; Trautwein, Lüdtke, Kastens, & Köller, 2006). Moreover, it is common in homework research to assess homework persistence as a subfacet of homework effort (see, e.g., the formulation of items such as “I finish my homework even if they are difficult (...)”, Fernández-Alonso et al., 2015, p. 3). Homework persistence is understood as students' willingness to continue investing time in homework when the tasks are difficult (e.g., Hong, Peng, & Rowell, 2009). Another subfacet of homework effort,

seasonal homework effort, refers to potential variability in students' homework behavior. Some students fail to work on homework on a regular basis (e.g., Katz, Eilott, & Nevo, 2014) and show periodic shifts in their homework effort. Thus, homework-specific seasonal effort refers to the inconsistency in the degree of concentrated and engaged learning over time (e.g., depending on the proximity of exams). Many studies have confirmed a positive association between homework effort or homework persistence and achievement (e.g., Fernández-Alonso et al., 2015; Natriello & McDill, 1986; Schmitz & Skinner, 1993; Trautwein, 2007).

However, prior research has not sufficiently differentiated between the amount of engaged and off-task behavior when measuring the time spent on homework (Trautwein & Köller, 2003). Recently, it was proposed that more could be learned about the meaning of students' homework behavior if homework time and effort were studied in conjunction (Flunger et al., 2015). The person-centered approach was the technique that was best suited to meet this objective because it enabled to study person-specific configurations of homework effort and homework time (Flunger et al., 2015). Person-centered methods represent a cluster-analytical approach (Lazarsfeld, Henry, & Anderson, 1968). Thereby, students with a similar profile on a set of variables can be classified as one type (e.g., Vermunt & Magidson, 2002). Amongst person-centered methods, LPA has the advantage that it represents a model-based approach which allows to evaluate the model fit and the comparison of different models with distinct numbers of profiles (Vermunt & Magidson, 2002).

Using LPA, it was investigated whether students with similar patterns in both homework effort and time could be identified that differed in this respect from students classified as other learning types. Four indicators of students' homework behavior were used (homework compliance, persistence, seasonal efforts, and homework time) that were measured twice in a large longitudinal data-set of 1915 8th grade students.

At both time points, five distinct learning types with similar patterns on both homework effort and time in French as a second language were found (Flunger et al., 2015). They were labeled *fast learners*, *high-effort learners*, *average students*, *struggling learners*, and *minimalists* (see Fig. 1 for more information regarding the mean scores in the profiles of students' homework behavior and the frequencies of students classified as specific homework learning types). *Fast learners* were characterized by high homework effort (i.e., high homework compliance and persistence and low seasonal effort) as well as low amounts of time spent on homework. *High-effort learners* were characterized by high levels of both effort and time. *Average students* were characterized by medium levels of homework effort and low levels of homework time. *Struggling learners* were shown to have low levels of homework effort (i.e., low homework compliance, low homework persistence, and high seasonal effort) and high levels of homework time. *Minimalists* were characterized by low levels of both homework effort and time.

To test the meaningfulness of the learning types (e.g., Morin, Morizot, Boudrias, & Madore, 2010), longitudinal analyses (latent transition analyses) were applied, and associations with external variables (i.e., additional aspects of homework engagement and academic achievement) were examined. Latent transition analyses revealed that the majority of students were consistently classified as the same learning type over time. The *fast* and *high-effort learners* showed higher levels in agentic engagement and lower levels in emotional engagement (assessed as homework anxiety) than the *struggling learners* and the *minimalists*. When controlling for students' prior achievement, track level, and gender, *fast learners* were shown to have higher French grades and French test scores than students classified as *average students*, *struggling learners*, and *min-*

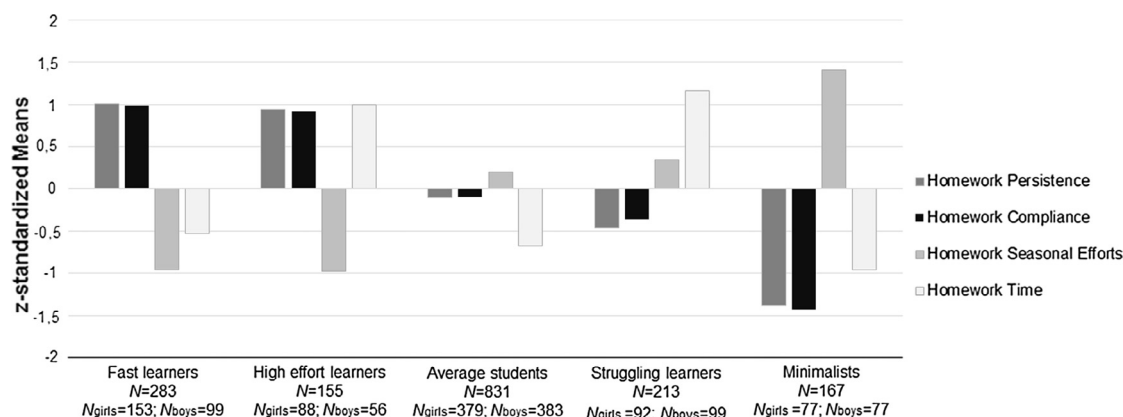


Fig. 1. Mean scores of students' homework behavior (z-standardized for presentation) characterizing five distinct profiles of learning types with regard to homework (Flunger et al., 2015).

imalists, but there were no statistically significant differences between *fast learners* and *high-effort learners* (Flunger et al., 2015).

Thus, the approach of studying the two core indicators of homework behavior together has already proven successful at yielding a better understanding of the association of students' homework behaviors and their achievement. However, the study by Flunger et al. (2015) did not examine why a student was classified as one specific learning type and thus did not address the role that students' motivation played in determining their distinct homework learning types. That is, research has yet to identify which student characteristics underlie the distinct homework learning types. This can be investigated with LPAs with covariates, a procedure that can be used to explore the associations between students' characteristics and their homework learning types.

1.2. Students' characteristics and their homework behavior

Which characteristics of students are relevant for their homework behavior? A multitude of empirical studies have shown that students' motivation, gender, or (perceived) cognitive abilities predict their academic behavior (e.g., Hagger, Chatzisarantis, Culverhouse, & Biddle, 2003; Kurdek & Sinclair, 1988; Miller, Greene, Montalvo, Ravindran, & Nichols, 1996; Ryan & Connell, 1989; Von Stumm & Furnham, 2012). The predictive validity of students' characteristics has also been found specifically for homework behavior (e.g., Katz, Kaplan, & Buzukashvili, 2011; Katz et al., 2014; Trautwein, Lüdtke, Kastens, et al., 2006). Moreover, the impact of students' characteristics on their academic and homework behavior has been posited from the perspective of theoretical frameworks. For example, the trans-contextual model of motivation (Hagger, Chatzisarantis, Barkoukis, Wang, & Baranowski, 2005; Hagger et al., 2003) posits that student motivation influences homework behavior.

A conceptual model that integrates a number of factors associated with students' homework behavior was developed by Trautwein, Lüdtke, Schnyder, et al. (2006); see also Trautwein, Lüdtke, Kastens, et al. (2006) and was subsequently tested in a sequence of studies (e.g., Dettmers, Trautwein, Lüdtke, Kunter, & Baumert, 2010; Trautwein & Lüdtke, 2007). An illustration of this multilevel, multidimensional homework model is shown in Fig. 2. The model incorporates the three protagonists in the homework process (students, teachers, and parents) and embraces six major groups of variables (achievement, homework behavior, student characteristics, parental behavior, and the learning environment). The model also highlights the idea that students' motivation is a key determinant in the homework process (e.g.,

Trautwein et al., 2015). We next characterize the parts of the model that are central for the current article in more detail and describe the available empirical support for the model. The results for homework effort and time will be reported separately because none of the existing studies (e.g., Fernández-Alonso et al., 2015; Trautwein, 2007; Trautwein, Lüdtke, Schnyder, et al., 2006) considered homework effort and time simultaneously as outcomes.

1.2.1. The role of competence and value beliefs

Students' competence and value beliefs (Eccles et al., 1983) have been considered to have a great deal of influence on their homework behavior in the model (see Fig. 2). Competence-related beliefs can be developed with respect to specific domains and specific tasks (Wigfield, Eccles, Schiefele, Roeser, & Davis-Kean, 2006). The homework model highlights both domain- and homework-specific competence and value beliefs as predictors of students' homework behavior (Trautwein, Lüdtke, Schnyder, et al., 2006). Regarding specific domains, competence beliefs refer to students' assessments of their own abilities in different subjects (e.g., academic self-concept; Eccles & Wigfield, 2002). With regard to tasks (e.g., homework tasks), competence beliefs are defined as subjective beliefs in one's ability to accomplish academic tasks (i.e., self-efficacy; Bandura, 1994). Value beliefs refer to a person's reasons for engaging in a learning behavior, indicating its meaningfulness for an individual (Eccles et al., 1983).

A positive association between competence and/or value beliefs and students' homework behavior was found only for homework effort (Trautwein, Lüdtke, Kastens, et al., 2006) but not for homework time: Students with high competence or value beliefs in a specific subject were found to exert greater homework effort in that subject compared with their effort in subjects for which they held low competence or value beliefs (Nagengast, Trautwein, Kelava, & Lüdtke, 2013) or compared with other students with low competence or value beliefs (e.g., Trautwein, Lüdtke, Schnyder, et al., 2006).

By comparison, in the majority of studies, the associations of competence and value beliefs with homework time have been shown to be nonsignificant (Nagengast et al., 2013; Trautwein & Lüdtke, 2007, 2009). In some studies (e.g., Trautwein, Lüdtke, Schnyder, et al., 2006), homework-specific competence beliefs were even negatively associated with homework time.

1.2.2. The role of conscientiousness

Furthermore, the model emphasizes that students' conscientiousness is particularly meaningful for their homework behavior (Trautwein, Lüdtke, Roberts, Schnyder, & Niggli, 2009). Students'

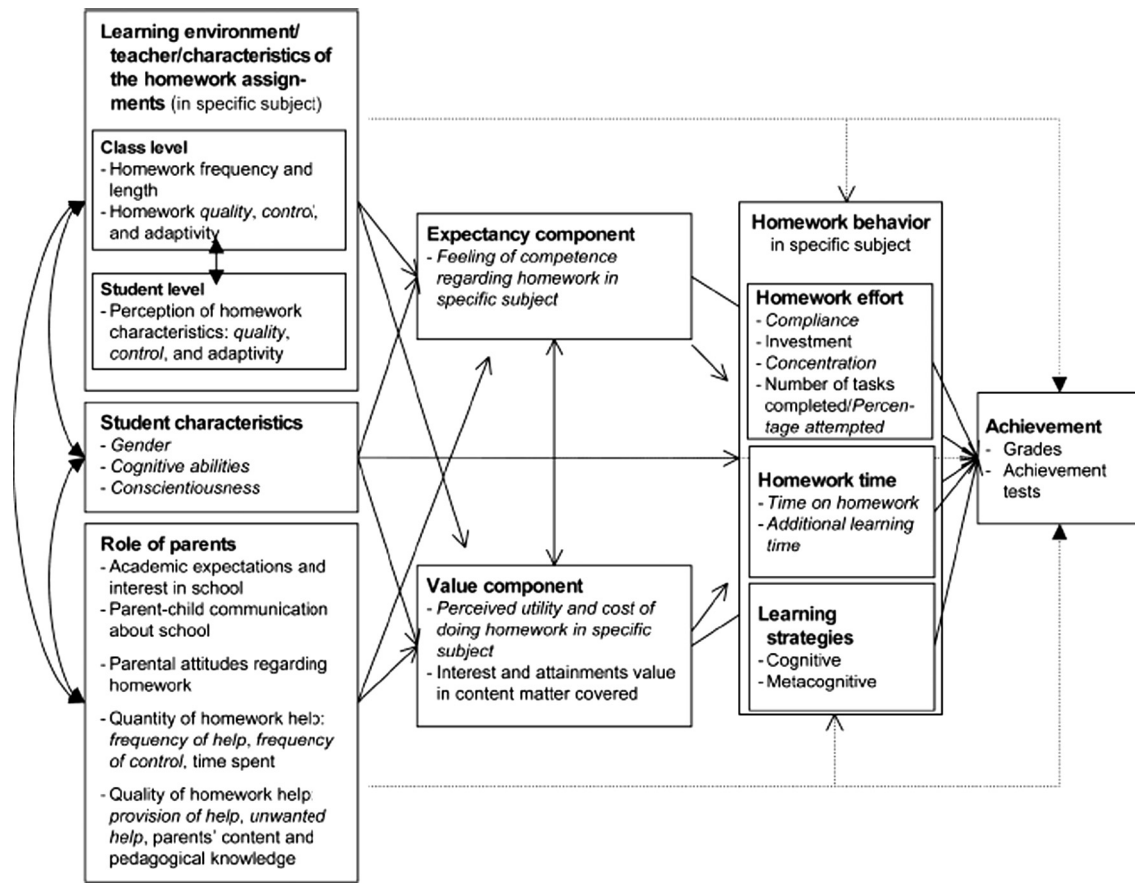


Fig. 2. A multilevel, domain-specific homework model (adapted from Trautwein, Lüdtke, Schnyder, et al., 2006).

conscientiousness is a trait that is defined by self-discipline, diligence, dutifulness, and achievement striving (Chamorro-Premuzic & Furnham, 2003). In line with the assumptions of the homework model, previous studies have shown that homework effort is positively associated with conscientiousness (e.g., Trautwein, Lüdtke, Schnyder, et al., 2006). When considered jointly as predictors of homework effort, competence and value beliefs as well as conscientiousness were found to independently predict homework effort (Trautwein et al., 2009). Aside from these additive effects, recent research has shown that the effects of conscientiousness and motivation-related constructs on students' effort—when considered as predictors in combination—can be more complex. A recent study by Trautwein et al. (2015) provided evidence that conscientiousness and interest (a construct with similarities with value beliefs; see, e.g., Krapp, 2002) interacted in predicting students' academic effort.

The model does not make any suggestions about the association between conscientiousness and homework time. Previous findings have been ambiguous. Some studies have shown that conscientious students spend more time on homework (e.g., Lubbers, Van Der Werf, Kuyper, & Hendriks, 2010). However, Trautwein and Lüdtke (2007) did not find a significant association between conscientiousness and homework time.

1.2.3. The role of gender

Gender differences have been found in students' study skills (e.g., Robbins et al., 2004), in particular, the tendency for girls to exert more effort on academic tasks than boys (Fischer, Schult, & Hell, 2013; Schuler & Prochaska, 2000). Less is known about gender differences in the time invested in learning activities. When comparing boys and girls in 5th and 6th grade on the time spent

studying and playing across an interval of 27 days, only one significant finding emerged (i.e., boys initially reported a higher amount of playtime than girls; Zhang, Karabenick, Maruno, & Lauermaun, 2011).

The homework model proposes that students' gender plays a role in the homework process. In line with the previous argument, gender differences in students' homework behavior are expected only for homework effort (Trautwein, Lüdtke, Schnyder, et al., 2006). Previous studies have shown that girls show greater homework effort than boys (Honigsfeld & Dunn, 2003; Trautwein, Lüdtke, Schnyder, et al., 2006). There are also studies that have pointed to a difference between boys and girls in seasonal effort: Peng, Hong, Li, Wan, and Long (2010) found that boys exhibited more inconsistency in working on homework than girls. Regarding homework time, in some studies, gender differences (favoring females) were found, in particular regarding the ability to manage homework time (Xu, 2006; Xu, Yuan, Xu, & Xu, 2014). By contrast, in other studies that considered additional factors, for example, teacher feedback, parental education, or students' attitudes about the purpose of homework (e.g., peer-, adult-, and learning-oriented reasons for doing homework), no gender differences were found (Xu, 2010).

1.2.4. The role of cognitive abilities

Finally, the model considers the role of students' cognitive abilities in their homework behavior. Although cognitive abilities are assumed to be positively associated with students' commitment and performance in various learning situations in and outside of school (e.g., Lau & Roeser, 2002), the homework model does not make assumptions about the effect of students' cognitive abilities on their homework behavior. However, it has been argued that

students with low cognitive abilities might spend more time on homework because they might need more time to complete their homework (Trautwein et al., 2009).

Previous findings on the association between students' cognitive abilities and their homework behavior have been inconsistent. In three studies in which the effect of gender was controlled for, one significant negative association was reported for students' cognitive abilities with time spent on homework (Trautwein, 2007), whereas no significant association was found between students' cognitive abilities and homework effort when the roles of other covariates were considered (Trautwein, 2007; Trautwein, Lüdtke, Schnyder, et al., 2006).

1.2.5. Future directions: Homework learning types and students' characteristics

With respect to homework effort, the inferences from the homework model regarding associations with both academic achievement as an outcome and students' characteristics as predictors are straightforward. By contrast, associations between homework time and other variables in the homework model remain unspecified. The lack of consistency in homework time could be attributed to the approach that is usually embraced in homework research. This involves the investigation of homework time as a stand-alone indicator without considering homework effort, even though homework time and effort are both proposed to be essential aspects of students' homework behavior (Trautwein et al., 2015).

1.3. The present study

In the present study, we investigated whether student characteristics play a role in the development of students' distinct homework learning types. For this purpose, we estimated LPAs with covariates. These analyses allowed us to use several indicators simultaneously and to explore the complexity of differential associations with students' characteristics in depth.

For students' characteristics, we considered competence and value beliefs, conscientiousness, gender, and cognitive abilities (see Fig. 2). We assessed both domain- and task-specific competence and value beliefs in French. Regarding domain-specific competence and value beliefs, students' general French-specific self-concept and their French-specific value beliefs were explored; regarding homework-specific beliefs, students' homework-specific self-efficacy and homework-specific value beliefs were investigated.

In a large sample of 1649 eighth-grade students who were surveyed on their homework behavior in the domain of French as a second language, we addressed the following three research questions:

- (1) How are students' characteristics associated with their homework learning types?

On the basis of prior research (Fischer et al., 2013; Honigsfeld & Dunn, 2003; Lubbers et al., 2010; Nagengast et al., 2013; Peng et al., 2010; Schuler & Prochaska, 2000; Trautwein & Lüdtke, 2007, 2009; Trautwein, Lüdtke, Kastens, et al., 2006; Trautwein, Lüdtke, Schnyder, et al., 2006; Trautwein et al., 2009; Xu, 2006, 2010; Xu et al., 2014; Zhang et al., 2011), three specific associations were expected. As consistent associations of competence/value beliefs, conscientiousness, and gender were found only with homework effort in these prior studies (e.g., Trautwein, Lüdtke, Kastens, et al., 2006; Trautwein, Lüdtke, Schnyder, et al., 2006), we relied on only these findings in deducing the hypotheses. Regarding cognitive abilities, we relied on only the consistent findings found for

the association with homework time (Trautwein et al., 2009) in deducing the hypotheses.

First, students characterized as investing a great deal of effort and large amounts of time on homework (*high-effort learners*) were expected to be highly motivated and highly conscientious, whereas students with high levels of homework time but low levels of effort (*struggling learners*) were expected to show low motivation and low conscientiousness. Second, on the basis of the finding that gender was positively associated with homework effort, we expected that girls would have a higher probability of being classified as a learning type characterized by high levels of homework effort, irrespective of their level of homework time (i.e., as *fast* or *high-effort learners*). Third, on the basis of Trautwein et al.'s (2009) assumptions, we expected that students with higher cognitive abilities would have a higher probability of being classified as a homework learning type characterized by low levels of homework time (i.e., as *fast learners* or *minimalists*). By contrast, we expected that students with lower cognitive abilities would have a higher probability of being classified as a learning type characterized by high levels of homework time (i.e., as *high-effort learners* or *struggling learners*).

- (2) Do students' value beliefs interact with conscientiousness in predicting students' homework learning types?

Because a recent study showed that students' conscientiousness and interest interact in predicting students' academic effort (Trautwein et al., 2015), we expected that students with high conscientiousness and high value beliefs would have an even higher probability of being classified as a learning type characterized by high homework effort. Moreover, we expected that students with low conscientiousness and low value beliefs would have an especially high probability of being classified as learning types characterized by low homework effort. We were also interested in exploring whether high conscientiousness would buffer the effect of low value beliefs in predicting whether a student would be classified as a learning type characterized by low homework effort.

- (3) Finally, we were interested in the unique effects of student characteristics when considering all student characteristics as covariates in a joint analysis, but given the many variables, we did not formulate specific expectations for each of the constructs.

2. Method

2.1. Sample and design

The present study involved a secondary data analysis that employed a longitudinal data set that stemmed from a research project on students' homework behavior. More specifically, the study reanalyzed data from a large survey in three Swiss cantons (Fribourg, Valais, and Lucerne) in which students' homework behavior in French as a second language was evaluated (e.g., Trautwein, Schnyder, Niggli, Neumann, & Lüdtke, 2009). In this research project, the measures that were implemented were chosen on the basis of the conceptual model that also served as a theoretical basis for the current project. Therefore, six major groups of variables (achievement, homework behavior, student characteristics, parental behavior, teacher behavior, and characteristics of the learning environment) were measured. The homework tasks in French as a second language were assigned to offer more practice of the material learned in class (e.g., to practice French grammar or word use). The sample was comprised of a total of 1915 eighth-grade students (47.96% female; $M_{age} = 13.63$, $SD = 1.16$) from 112 classes in 27 schools. The average class size was 18.38 ($SD = 4.81$). The survey had already served as a data-basis for

several distinct studies that investigated different research questions with variable-centered methods, such as the role of parents (e.g., Dumont, Trautwein, Nagy, & Nagengast, 2014) or the role of students' characteristics (Trautwein et al., 2009) in their homework behavior.

As we considered students' homework behavior as an outcome at Time 2, the sample size in all analyses referred to the Time-2 sample of 1649 students (52% female; $M_{\text{age}} = 13.63$, $SD = 1.16$) from 96 classes in 27 schools.

2.2. Measures

All items¹ except homework time were measured on a 4-point Likert scale (1 = *completely disagree*, 2 = *somewhat disagree*, 3 = *somewhat agree*, and 4 = *completely agree*).

2.2.1. Homework time

Homework time was assessed with a single item in an open format: "If you are assigned French homework, how many minutes do you need on average to finish this French homework (without learning vocabulary)?" The student reports in minutes were recoded into a 7-point Likert scale where each point represented a 5-min block so that 1 stood for 0–5 min.

2.2.2. Homework effort

Homework effort was assessed with the measures homework compliance, persistence, and seasonal effort (see Flunger et al., 2015) as adapted from Trautwein and Köller (2003). Compliance was assessed with four items (e.g., "I do my best at French homework," $\alpha = 0.72$). Persistence was measured with three items (e.g., "If I don't find a solution to a certain task quickly, I skip it," $\alpha = 0.71$). The negatively worded items were recoded. Seasonal effort was also assessed with four items (e.g., "In French, I am a very irregular learner," $\alpha = 0.72$).

2.2.3. French-specific competence beliefs

French-specific competence beliefs were measured in terms of students' academic self-concept with three items (e.g., "Nobody is good at everything—I simply have no talent for French," $\alpha = 0.72$) that were adapted from the Self-Description Questionnaire (SDQ; Marsh, 1990). The negatively worded items were recoded.

2.2.4. French-specific value beliefs

French-specific value beliefs were measured with five items (e.g., "I think the subject French is very important," $\alpha = 0.75$), which were adapted from Fredricks and Eccles (2002) and Marsh, Trautwein, Lüdtke, Köller, and Baumert (2005).

2.2.5. Homework-specific competence beliefs

Homework-specific competence beliefs were measured in terms of students' self-efficacy with five items (e.g., "If I want, I always find a way to complete my French homework correctly," $\alpha = 0.72$) that were developed by Trautwein and Köller (2003).

2.2.6. Homework-specific value beliefs

Homework-specific value beliefs were measured with four items (e.g., "French homework is no use to me," $\alpha = 0.75$) that were developed by Trautwein and Köller (2003) for the homework context. The negatively worded items were recoded.

2.2.7. Conscientiousness

Conscientiousness was measured with the complete set of 12 items that are part of the NEO Five Factor Inventory (NEO-FFI; Borkenau & Ostendorf, 1993; Costa & McCrae, 1992). The item "I am not a person who proceeds very systematically" was discarded because of its low item total correlation of 0.07. The reliability of the remaining scale was good ($\alpha = 0.84$).

2.2.8. Verbal abilities

In order to assess cognitive abilities, the verbal subscales of the Cognitive Ability Test 4–13 (Heller, Gaedicke, & Weinläder, 1976) were used. A total of 95 verbal items in a multiple-choice format (finding analogies, similarities, opposites, and missing words in a sentence) were administered.

2.3. Statistical analyses

The associations of students' characteristics with the five homework learning types that were identified in prior work (Flunger et al., 2015) were tested via LPA with covariates in a modified three-step approach (e.g., Vermunt, 2010). The nesting of students in classes was considered via a design-based correction of standard errors (analysis option type is complex in Mplus). All continuous covariates were z-standardized prior to the analyses.

2.3.1. The modified three-step approach for LPA with covariates

Via LPA, students' probabilities of being classified as each specific learning type as well as their most likely latent profile membership (modal profile) were estimated. Relying on the most likely latent profile membership introduces classification error due to misclassification (e.g., Bolck, Croon, & Hagenaars, 2004).

In order to explore the association of covariates with the classification to certain learning types with regard to homework, two approaches can be chosen (i.e., the simultaneous or the three-step approach; e.g., Vermunt, 2010). The simultaneous approach estimates the latent profile model concurrently with a logistic regression model in which the latent profiles are regressed on one or more covariates. However, the simultaneous approach has some limitations (e.g., the number and meaning of the profiles yielded by the model with and without covariates can diverge). In the second approach, the so-called three-step approach, first, the latent profiles are estimated by taking into account solely the indicator variables; second, individuals are classified as specific profiles (i.e., learning types), and third, external variables are considered as predictors of the latent profile variable in a logistic regression model. Although the three-step approach has several advantages when compared with the one-step approach (e.g., see Bakk, Tekle, & Vermunt, 2013), it was also shown to underestimate the association of profile membership and covariates, especially when the classification error regarding profile classification was large (Bolck et al., 2004). Consequently, several correction methods have been developed (e.g., Bolck et al., 2004).

To test our research questions, we used the modified three-step approach for continuous covariates by Vermunt (2010). Here, in the first step, the latent profile model was estimated without the covariates. In the second step, students were classified as those learning types for which the probability of profile membership obtained in the first step was the highest (i.e., modal assignment). In the third step, the modal profile (i.e., a nominal variable indicating the most likely profile) was used as an indicator of the latent profile variable (instead of the manifest homework behavior measures) and regressed on the covariates in a multinomial logistic regression model (e.g., Nguyen et al., 2015; Vermunt, 2010). Thereby, the classification error was considered because the nominal variable was linked to the latent profile while taking into account the classification error probabilities as weights (e.g.,

¹ All measures can be obtained from the first author.

Bakk et al., 2013). An implementation of this modified three-step approach for LPA with covariates in the statistical program Mplus (7.3, Muthén & Muthén, 1998–2016) was recently developed: the R3STEP-command for auxiliary variables (Asparouhov & Muthén, 2014), which automatically creates the most likely class variable as the outcome variable.

2.3.2. Multinomial logit latent-profile regression models

LPA with covariates refers to multinomial logistic regressions for modeling the association between external variables and the categorical latent factor (e.g., Masyn, 2013). More specifically, LPA with covariates estimates the probability of being assigned to one specific profile (compared with a reference profile) given one or more covariates (e.g., Lanza, Collins, Lemmon, & Schafer, 2007). The number of estimated multinomial logistic regression models represents the total number of categories of the categorical latent factor (e.g., Lanza et al., 2007). Thus, each latent profile is considered as the reference group once in order to determine the different probabilities for all potential assignments. The selection of the number of categories of the latent profiles should be conducted with unconditional models (i.e., LPA without covariates; e.g., Masyn, 2013) because incorporating covariates in the selection process of LPA models has been shown to lead to biased results (e.g., Nylund & Masyn, 2008). Therefore, based on prior work that compared LPAs with different numbers of learning types, a stability check, and a construct validity check (see Flunger et al., 2015, for information on fit indices and further results), the categorical latent factor was modeled with five categories (representing five distinct learning types). For each covariate, five different multinomial logistic regression analyses were estimated in total, and each of the five homework learning types served as the reference group once. In these five analyses, a regression model for each of four assignment probabilities as the dependent variable was tested with the fifth profile serving as the reference group.

Following the procedure in the research literature of using LPA with covariates in a modified three-step approach (e.g., Bakk et al., 2013; Härtwig, Crayen, Heuser, & Eid, 2014; Lanza et al., 2007; Masyn, 2013; Nguyen et al., 2015), the regression coefficients for the set of predictors in separate and multinomial logistic regression models are reported in the present study. The logistic regression coefficients have to be interpreted in relation to the reference group (i.e., the logistic coefficients indicate how each covariate is associated with the probability of being classified as belonging to a specific outcome group compared with the reference group; e.g., Lanza et al., 2007). Hence, positive coefficients indicate that the higher the value of a covariate, the more likely is the membership in a specific class compared to a reference profile; negative coefficients indicate that the higher the value of a covariate, the lower is the probability of being characterized as a specific type compared with a reference profile. When exponentiated, logistic regression coefficients yield odds ratios.

2.3.3. Analytic strategy

In the LPAs with covariates, students' homework behavior was targeted as the outcome; therefore, we took into account homework compliance, persistence, seasonal effort, and homework time at Time 2 as indicators of students' homework profiles. Students' competence and value beliefs, conscientiousness, gender, and verbal abilities were considered as covariates of the latent profiles. Conscientiousness was measured only at Time 2, whereas all other personal characteristics were reported at Time 1.

Seven separate models were estimated with single covariates in which the association of each covariate with the learning types was estimated in a distinct analysis (Models 1–7). Subsequently, two models were tested to explore the interactive effects of French- (Model 8) and homework-specific value beliefs (Model 9)

with conscientiousness on students' homework learning types. The interactive effects were predefined as multiplicative terms and specified as further predictors in the LPAs with covariates via the R3Step-command. Finally, the covariates were considered jointly in one model in order to explore which student characteristic was most strongly associated with the homework learning profiles while controlling for the associations with the other covariates (Model 10).

For reasons of clarity and parsimony, we focus on the findings for five pairwise comparisons of homework learning types that had similar levels on one indicator but differed on the second indicator of homework behavior. More specifically, in the Results section, we report the comparisons of students' classifications as *fast learners* rather than as *high-effort learners*, as *fast learners* rather than as *minimalists*, as *high-effort learners* rather than as *struggling learners*, as *average students* rather than as *minimalists*, and as *struggling learners* rather than as *minimalists*.

In each model, the sample sizes differed slightly, as it is not currently possible to use full information maximum likelihood estimation when applying the modified three-step method of LPA with covariates in Mplus. The missing values in the 10 models ranged from 2.85% (Model 3) to 18.80% (Model 10). As suggested by Hedeker and Gibbons (1997), we compared students with missing and nonmissing data on the outcome measures and the covariates. These comparisons indicated that the scores of students with missing data displayed patterns that were similar to the scores of students without missing data.

3. Results

3.1. Descriptive statistics

The descriptive statistics (means and standard deviations) and the calculated reliabilities of the homework behavior measures and all continuous covariates are displayed in Table 1. The inter-correlations of all homework behavior indicators and all covariates are shown in Table 2. The mean scores on the five homework behavior profiles (z-standardized for presentation), distinguishable according to their high, medium, or low levels of homework time and effort at the second measurement point yielded by the LPA models, are presented in Fig. 1 (see Flunger et al., 2015, for more information about the criteria for selecting the five-profile solution). Moreover, the frequencies of students classified as specific learning types as well as the gender differences in these frequencies are shown in Fig. 1. The mean scores for students' verbal abilities, conscientiousness, French- and homework-specific competence, and value beliefs separated according to the five distinct homework learning type profiles are shown in Fig. 3 (z-standardized for presentation). These mean scores showed a clear pattern of differential associations of students' characteristics with the distinct homework learning profiles.

Table 1

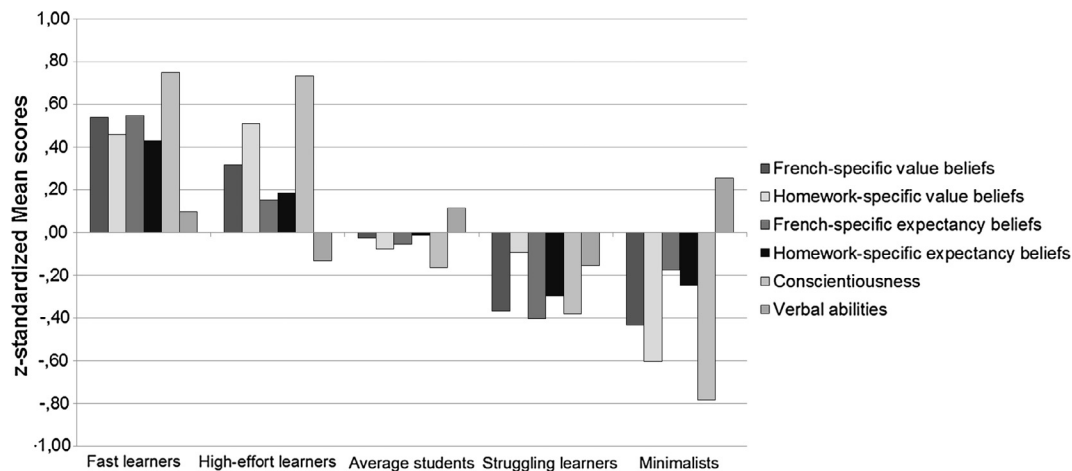
Descriptive statistics and reliabilities of homework behavior measures and continuous covariates.

Measure	M	SD	α
Homework compliance	2.75	0.62	0.72
Homework persistence	2.63	0.68	0.71
Homework seasonal effort	2.45	0.68	0.72
Homework time	3.45	1.72	
French-specific value beliefs	2.73	0.71	0.84
French-specific competence beliefs	2.73	0.74	0.72
Homework-specific value beliefs	3.10	0.59	0.75
Homework-specific competence beliefs	3.18	0.51	0.68
Conscientiousness	2.73	4.51	0.83
Verbal abilities	49.50	12.94	0.89

Table 2

Intercorrelations of the homework behavior measures and students' personal characteristics.

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) Homework compliance	–									
(2) Homework persistence	0.52**	–								
(3) Homework seasonal effort	–0.57**	–0.54**	–							
(4) Homework time	0.15**	0.09**	–0.18**	–						
(5) French-specific value beliefs	0.31**	0.34**	–0.30**	–0.03	–					
(6) French-specific competence beliefs	0.20**	0.34**	–0.23**	–0.12**	0.55**	–				
(7) Homework-specific value beliefs	0.30**	0.28**	–0.33**	0.14**	0.40**	0.24**	–			
(8) Homework-specific competence beliefs	0.20**	0.29**	–0.18**	–0.07**	0.40**	0.40**	0.32**	–		
(9) Conscientiousness	0.52**	0.44**	–0.46**	0.09**	0.30**	0.25**	0.26**	0.24**	–	
(10) Gender (0 = female, 1 = male)	–0.09*	–0.06*	0.06*	0.01	–0.22**	–0.14**	–0.09**	–0.08**	–0.12**	–
(11) Verbal abilities	–0.05**	0.02	0.12**	–0.11**	0.03	0.06*	0.01	0.12**	0.02	0.01

* $p < 0.05$.** $p < 0.01$.**Fig. 3.** Z-standardized mean scores of students' personal characteristics, distinguished between the five homework learning types.

3.2. Results for the LPA with single covariates (Research Question 1)

The first research question explored whether differential levels in students' motivation were associated with distinct homework learning types. To test our first research question, seven distinct multinomial logit latent-profile regression models were computed to estimate how each covariate was associated with students' characterization as certain homework learning types via the modified three-step approach (Vermunt, 2010). In these analyses, the outcome was a categorical latent variable, and the classification errors in the outcome variable were considered in the estimation (see Bakker et al., 2013). The results of the seven LPAs with each covariate (Models 1–7; i.e., logistic regression coefficients and corresponding odds ratios) are presented in Table 3.

3.2.1. Comparing the classification as fast learners versus high-effort learners

When considering only one covariate in Models 1–7, students with higher French- or homework-specific competence beliefs had a higher probability of being classified as *fast learners* rather than as *high-effort learners*. Moreover, students with higher verbal abilities were more likely to be classified as *fast learners* than as *high-effort learners*.

3.2.2. Comparing the classification as fast learners versus minimalists

In Models 1–7, students with higher French- or homework-specific value beliefs, higher French- or homework-specific competence beliefs, or higher conscientiousness were shown to be more likely to be classified as *fast learners* rather than as *minimalists*.

3.2.3. Comparing the classification as high-effort learners versus struggling learners

When comparing students' classification as *high-effort learners* with their classification as *struggling learners* in analyses that considered each single covariate, students with higher French- or homework-specific value beliefs, higher French- or homework-specific competence beliefs, or higher conscientiousness were shown to be more likely to be classified as *high effort learners* rather than as *struggling learners*.

3.2.4. Comparing the classification as average students versus minimalists

Regarding the results of Models 1–7, when comparing *average students* with *minimalists*, students with higher French- or homework-specific value beliefs or higher conscientiousness were more likely to be classified as *average students*. Students with higher verbal abilities were more likely to be classified as *minimalists* than as *average students*.

3.2.5. Comparing the classification as struggling learners versus minimalists

When comparing *struggling learners* with *minimalists*, students with higher homework-specific value beliefs were more likely to be classified as *struggling learners*, whereas students with higher French competence beliefs were more likely to be classified as *minimalists*. Students with higher conscientiousness or lower verbal abilities were more likely to be classified as *struggling learners* than as *minimalists*.

Table 3
Results of LPAs with separate covariates (Models 1–7).

Model	Fast learners vs. high-effort learners			Fast learners vs. minimalists			High-effort learners vs. struggling learners			Average students vs. minimalists			Struggling learners vs. minimalists		
	Est.	OR	SE	Est.	OR	SE	Est.	OR	SE	Est.	OR	SE	Est.	OR	SE
Model 1: Covariate French value beliefs	0.41	1.51	0.24	0.09	1.55	0.18	0.00	2.97	0.26	0.50	1.65	0.14	0.05	1.05	0.14
Model 2: Covariate homework value beliefs	–0.17	0.84	0.21	0.56	1.46	0.16	0.00	2.86	0.19	0.72	2.05	0.12	0.58	1.79	0.13
Model 3: Covariate French competence beliefs	0.52	1.68	0.18	0.00	1.00	0.17	0.00	2.29	0.20	0.10	1.09	0.15	–0.35	0.70	0.16
Model 4: Covariate homework competence beliefs	0.51	1.67	0.22	0.02	1.01	0.18	0.00	1.84	0.16	0.20	1.22	0.14	–0.11	0.90	0.14
Model 5: Covariate conscientiousness	0.01	1.01	0.19	0.65	3.03	0.27	0.00	8.08	0.45	1.84	6.30	0.24	1.25	3.49	0.24
Model 6: Covariate gender (0 = female, 1 = male)	–0.04	0.96	0.31	0.91	–0.56	0.57	0.08	0.52	0.35	0.05	1.05	0.27	0.86	1.13	0.32
Model 7: Covariate verbal abilities	0.32	1.38	0.13	0.02	–0.22	0.80	0.14	0.98	0.15	–0.28	0.76	0.13	–0.53	0.59	0.15

Note. The table presents five specific comparisons of students' classifications as *fast learners* rather than as *high-effort learners*, as *fast learners* rather than as *minimalists*, as *high-effort learners* rather than as *struggling learners*, as *average students* rather than as *minimalists*, and as *struggling learners* rather than as *minimalists*. Est. = Logistic regression coefficient indicating the effect of being classified as a specific homework learning type versus the respective reference group, given specific categories/levels of the covariate. OR = Odds ratio = $e^{(Est.)}$, SE = Standard error.

3.3. Results for the exploration of interactive effects of conscientiousness and value beliefs

The second research question assessed the potential interactive effects of French- and homework-specific value beliefs and conscientiousness in predicting students' classifications as specific learning types. To test the second research question, two separate multinomial logit latent-profile regression models were estimated by considering the two interacting predictors and a multiplicative term comprised of both predictors as covariates of the homework learning types. The results of the investigation of the interactive effects of value beliefs and conscientiousness are summarized in Table 4. In Models 8 and 9, ten interaction effects were tested in total. In both Models 8 and 9, five interaction effects were found to be significant (see Table 4).

First, in this section, we refer to the significant interaction effects regarding the pairwise comparisons of students' classifications as learning types that explicitly differed from each other in terms of the levels of homework effort (*fast learners* vs. *minimalists*, *high-effort learners* vs. *struggling learners*, *average students* vs. *minimalists*) or homework time (*fast* vs. *high-effort learners*, *struggling learners* vs. *minimalists*).

In Model 8, the probability of being classified as a *fast learner* rather than as a *minimalist* was found to be especially high when French-specific value beliefs and conscientiousness were high. Moreover, the probability of being classified as a *high-effort learner* rather than as a *struggling learner* was especially high when both French-specific value beliefs and conscientiousness were high. The probability of being classified as an *average student* rather than as a *minimalist* was found to be especially high when French-specific value beliefs and conscientiousness were high.

In Model 9, the probability of being classified as an *average student* rather than as a *minimalist* was found to be especially high when homework-specific value beliefs and conscientiousness were high. Moreover, the probability of being classified as a *struggling learner* rather than as a *minimalist* was found to be especially high when homework-specific value beliefs and conscientiousness were high.

Further significant interactions indicated that the probability of being classified as a *high effort learner* rather than as an *average student* or as a *minimalist* was especially high when French-specific value beliefs and conscientiousness were high. The probability of being classified as a *high effort learner* rather than as a *minimalist* was also found to be especially high when homework-specific value beliefs and conscientiousness were high. Moreover, two additional statistically significant interaction terms indicated that homework-specific value beliefs and conscientiousness might compensate for each other in predicting students' classification as *fast learners* rather than as *average students* or *struggling learners*.

The comparisons of homework learning types that had similar levels on one indicator but differed on the second indicator of homework behavior indicated that students with high values on both conscientiousness and French value beliefs had an even higher probability of being classified as the learning type characterized by higher effort.

3.4. Results for the LPA that considered all covariates jointly (Research Question 3)

The third research question referred to the unique effects of the student characteristics when considering all student characteristics as covariates in a joint analysis. Therefore, a multinomial logit latent-profile regression model was estimated that considered all covariates simultaneously (Model 10). The results of the LPA that considered all covariates jointly are presented in Table 5 (i.e., the adjusted logistic regression coefficients and adjusted odds ratios).

Table 4

Results of LPAs with covariates considering the interactive effects of value beliefs and conscientiousness (Models 8 and 9).

Model	Non-reference profiles															
	Fast learners				High-effort learners				Average students				Struggling learners			
	Est.	AOR	SE	p	Est.	AOR	SE	p	Est.	AOR	SE	p	Est.	AOR	SE	p
Model 8																
<i>Reference group high effort learners</i>																
French-specific value beliefs	0.06	1.07	0.22	0.77												
Conscientiousness	0.67	1.95	0.28	0.02												
French-Specific Value Beliefs x Conscientiousness	−0.30	0.74	0.21	0.15												
<i>Reference group average students</i>																
French-specific value beliefs	1.26	3.51	0.15	0.00	1.19	3.29	0.21	0.00								
Conscientiousness	0.76	2.13	0.16	0.00	0.09	1.09	0.25	0.73								
French-Specific Value Beliefs x Conscientiousness	0.18	1.20	0.18	0.29	0.49	1.63	0.21	0.02								
<i>Reference group struggling learners</i>																
French-specific value beliefs	1.84	6.32	0.18	0.00	1.78	5.94	0.26	0.00	0.59	1.80	0.13	0.00				
Conscientiousness	1.26	3.53	0.20	0.00	0.59	1.81	0.28	0.03	0.50	1.66	0.13	0.00				
French-Specific Value Beliefs x Conscientiousness	0.38	1.46	0.22	0.09	0.68	1.98	0.23	0.00	0.20	1.22	0.12	0.10				
<i>Reference group minimalists</i>																
French-specific value beliefs	3.08	21.76	0.34	0.00	3.02	20.43	0.37	0.00	1.83	6.20	0.30	0.00	1.24	3.45	0.30	0.00
Conscientiousness	1.77	5.88	0.29	0.00	1.10	3.01	0.35	0.00	1.01	2.76	0.26	0.00	0.51	1.67	0.23	0.03
French-Specific Value Beliefs x Conscientiousness	0.77	2.16	0.27	0.01	1.07	2.92	0.28	0.00	0.58	1.79	0.21	0.01	0.39	1.47	0.22	0.08
Model 9																
<i>Reference group high effort learners</i>																
Homework-specific value beliefs	0.23	1.26	0.24	0.35												
Conscientiousness	0.18	1.20	0.29	0.53												
Homework-Specific Value Beliefs x Conscientiousness	−0.43	0.65	0.22	0.06												
<i>Reference group average students</i>																
Homework-specific value beliefs	1.52	4.59	0.14	0.00	1.30	3.65	0.26	0.00								
Conscientiousness	0.87	2.38	0.16	0.00	0.69	1.99	0.28	0.01								
Homework-Specific Value Beliefs x Conscientiousness	−0.35	0.71	0.14	0.01	0.08	1.08	0.23	0.73								
<i>Reference group struggling learners</i>																
Homework-specific value beliefs	2.08	8.00	0.18	0.00	1.85	6.37	0.30	0.00	0.56	1.75	0.13	0.00				
Conscientiousness	0.96	2.62	0.19	0.00	0.78	2.18	0.32	0.02	0.10	1.10	0.11	0.37				
Homework-Specific Value Beliefs x Conscientiousness	−0.32	0.73	0.16	0.04	0.11	1.12	0.22	0.63	0.03	1.03	0.11	0.79				
<i>Reference group minimalists</i>																
Homework-specific value beliefs	3.29	26.82	0.32	0.00	3.06	21.35	0.40	0.00	1.77	5.84	0.28	0.00	1.21	3.35	0.28	0.00
Conscientiousness	1.95	7.06	0.22	0.00	1.77	5.88	0.33	0.00	1.09	2.96	0.18	0.00	0.99	2.69	0.20	0.00
Homework-Specific Value Beliefs x Conscientiousness	0.12	1.13	0.20	0.54	0.55	1.73	0.28	0.05	0.47	1.60	0.14	0.00	0.44	1.55	0.17	0.01

Note. Est. = Logistic regression coefficient indicating the effect of being classified as a specific homework learning type versus the respective reference group, given specific categories/levels of the covariate. These coefficients are in logit form and have to be interpreted as partial regression coefficients, adjusted for all other effects in the model. AOR = Adjusted odds ratios = $e^{(Est.)}$, SE = Standard error. All continuous covariates were z-standardized beforehand.

3.4.1. Comparing the classification as fast learners versus high-effort learners

Adjusting for the other covariates, students with higher verbal abilities had a higher probability of being classified as *fast learners* rather than as *high-effort learners*. Moreover, compared with the learning type of *fast learners*, students with higher homework value beliefs were more likely to be classified as *high-effort learners*.

3.4.2. Comparing the classification as fast learners versus minimalists

Students with higher French- and homework-specific value beliefs and higher conscientiousness were more likely to be classified as *fast learners* rather than as *minimalists* when all covariates were considered simultaneously.

3.4.3. Comparing the classification as high-effort learners versus struggling learners

When comparing students' classification as *high-effort learners* with their classification as *struggling learners* in an analysis controlling for the other covariates, students with higher

conscientiousness and higher homework-specific value beliefs were more likely to be classified as *high-effort learners*.

3.4.4. Comparing the classification as average students versus minimalists

When comparing students' classification as *average students* with their classification as *minimalists* in Model 10, students with higher French specific value beliefs, higher homework-specific value beliefs, or higher conscientiousness were more likely to be classified as *average students*.

3.4.5. Comparing the classification as struggling learners versus minimalists

Regarding the comparison of students' classified as either *struggling learners* or *minimalists* in an analysis that controlled for all other covariates, students with higher conscientiousness, higher homework-specific value beliefs, and lower verbal abilities had a higher probability of being classified as *struggling learners* rather than as *minimalists*.

Table 5
Results of LPAs considering all covariates jointly (Model 10): adjusted logistic regression coefficients and adjusted odds ratios.

Model 10	Fast learners vs. high-effort learners			Fast learners vs. minimalists			High-effort learners vs. struggling learners			Average students vs. Minimalists			Struggling learners vs. minimalists		
	Est.	OR	SE	Est.	OR	SE	Est.	OR	SE	Est.	OR	SE	Est.	OR	SE
French-specific value beliefs	0.34	1.40	0.29	0.25	2.27	0.28	0.00	0.42	1.53	0.32	0.19	0.03	0.06	1.07	0.21
Homework-specific value beliefs	−0.49	0.61	0.20	0.01	1.06	0.20	0.00	0.80	2.23	0.19	0.00	0.00	0.76	2.13	0.16
French-specific competence beliefs	0.26	1.29	0.19	0.18	1.53	0.24	0.08	0.35	1.42	0.25	0.16	0.00	−0.19	0.83	0.20
Homework-specific competence beliefs	0.19	1.20	0.20	0.34	1.20	0.27	0.49	0.18	1.20	0.21	0.38	0.00	−0.18	0.83	0.20
Conscientiousness	−0.24	0.79	0.22	0.27	2.65	0.33	0.00	1.83	6.22	0.28	0.00	0.00	1.06	2.89	0.27
Gender (0 = female, 1 = male)	0.16	1.17	0.31	0.61	1.17	0.40	0.69	−0.25	0.78	0.38	0.51	0.38	0.25	1.28	0.34
Verbal abilities	0.33	1.39	0.16	0.04	−0.31	0.73	0.18	−0.19	0.83	0.18	0.29	0.10	−0.46	0.63	0.17

Note. The table displays five specific comparisons of students' classifications as *fast learners* rather than as *high-effort learners*, as *fast learners* rather than as *minimalists*, as *high-effort learners* rather than as *struggling learners*, as *average students* rather than as *minimalists*, and as *struggling learners* rather than as *minimalists*. Est. = Logistic regression coefficient indicating the effect of being classified as a specific homework learning type versus the respective reference group, given specific categories/levels of the covariate. These coefficients are in logit form and have to be interpreted as partial regression coefficients, adjusted for all other effects in the model. AOR = Adjusted odds ratios = $e^{(Est.)}$. SE = Standard error. All continuous covariates were z-standardized beforehand.

4. Discussion

The present study explored whether the simultaneous consideration of homework effort and time as indicators of students' homework learning types could shed light on the previously unclear associations between homework time and students' characteristics. In detail, we analyzed whether students' probabilities of being classified as each of five homework learning types (i.e., *fast learners*, *high-effort learners*, *average students*, *struggling learners*, or *minimalists*; Flunger et al., 2015), which could be distinguished by their different levels of homework time and effort, would be associated with their personal characteristics.

Thereby, we showed that large amounts of homework time could correspond with high homework value beliefs and high conscientiousness (in the case of *high-effort learners*). When students reported exerting low effort and spending a great deal of time on homework, their learning behavior seemed to be associated with low motivation and low conscientiousness (*struggling learners*). By exploring the interactive effects of conscientiousness and value beliefs, we showed that students with high conscientiousness and French-specific value beliefs were even more likely to be classified as the learning types characterized by high levels of homework effort.

In sum, we showed that considering homework time and effort together is highly relevant for exploring associations between students' characteristics and their homework behavior and yields a more conclusive picture of differences in homework behavior.

4.1. Studying the role of students' characteristics in their homework behavior with a person-centered approach

Previously, in a first endeavor to yield a better understanding of homework time by investigating it in conjunction with homework effort, students' differences in homework effort and time in the domain of French as a second language could be abstracted to five distinct homework learning types (Flunger et al., 2015). Because the reasons behind why the students showed these different homework learning types had yet to be determined, the present research was aimed at identifying the factors that could potentially account for the different homework learning types.

Most important, the current results extend the previously mentioned perspective that the association between homework behavior and academic achievement is not linear (Cooper & Valentine, 2001; Daw, 2012; Fernández-Alonso et al., 2015; Flunger et al., 2015) by pointing to further nonlinear associations of the processes at play with respect to homework. Our principal expectation—that large amounts of homework time can imply either a highly engaged and motivated learning type or a maladaptive homework type that goes hand in hand with low effort and low motivation—was confirmed. Moreover, the study allowed us to compare the relative importance of various characteristics of students. Thus, our results are in line with studies that have suggested the necessity of relying on a comprehensive conceptual model (e.g., Cooper, 1989; Xu, 2008).

First, the study showed that different levels of task-specific value beliefs and conscientiousness were most strongly associated with distinct homework learning types. Thus, the study confirmed that students' motivation, as suggested by the homework model, is a key construct in the homework process, but it also highlighted the role of students' conscientiousness. A number of studies have confirmed the predictive validity of both student motivation and conscientiousness, in particular for shedding more light on the association between homework behavior and academic achievement (Lubbers et al., 2010; Trautwein &

Lüdtke, 2009; Xu, 2008; Zimmerman & Kitsantas, 2005). The present study adds to this research but also presents the new finding that student motivation and conscientiousness can expand the understanding of the nonlinear association of homework effort and time.

Second, the study showed that students with lower verbal abilities tended to spend more time on homework and were more likely to be classified as either *high-effort learners* or *struggling learners*. Previously, *struggling learners* were found to show significantly lower achievement than *fast learners* when students' prior achievement, track level, and gender were controlled for (Flunger et al., 2015). That is, whereas *struggling learners* showed good will in terms of the amount of time spent on homework, they could not turn their good intentions into favorable learning behavior.

Students with higher verbal abilities were more likely to be classified as *minimalists* than as *struggling students*. This finding is in line with previous studies that showed that students with higher cognitive abilities tend to spend less time on their homework (Trautwein, 2007). Regarding students' homework effort, previous studies did not find a significant association with their cognitive abilities (Trautwein, 2007; Trautwein, Lüdtke, Schnyder, et al., 2006). So far, only a few studies have explored the association between students' cognitive abilities and their academic engagement. For example, Von Stumm and Furnham (2012) examined the association of students' cognitive abilities with their cognitive engagement in a sample of university students, taking into account deep, achievement-oriented (operationalized as striving for maximizing the grade), and surface learning strategies as indicators of cognitive engagement. The study revealed only one significant association of cognitive abilities with the deep learning strategy, which was small and negative (when controlling for the other characteristics). Using a similar approach in a sample of Chinese university students, Xie and Zhang (2015) found that "cognitive abilities" were the weakest predictor of students' cognitive engagement, compared with personality factors. Regarding further aspects of students' engagement, Lau and Roeser (2002) proposed that cognitive abilities influence students' engagement in testing situations, in the classroom, and outside of school. In an empirical study in the domain science, applying measures of the distinct aspects of student engagement that considered facets such as students' effort, applied cognitive strategies, attention paid in class, and participation in science experiments, the authors were not able to identify significant associations of students' cognitive abilities with students' test, classroom, and extracurricular engagement (see Lau & Roeser, 2002). However, they found significant associations between students' cognitive abilities and their competence beliefs, which in turn were associated with students' test and classroom engagement.

Accordingly, the competence and value beliefs of the *minimalists* deserve attention. Value beliefs were found to be central for students' course selection and future academic careers (Wigfield, Tonks, & Klauda, 2009). If students with higher cognitive abilities have lower value beliefs regarding a domain, they might drop the domain at the earliest date possible, even though they would not have to invest a lot of effort to perform well. This could result in a domain losing its most talented students.

Third, the study enabled exploratory analyses of the combined effects of conscientiousness and value beliefs in predicting students' homework learning types. Our results showed that students with high values on both conscientiousness and French-specific value beliefs had an even higher probability of being classified as a learning type characterized by higher effort. Thus, by conducting LPA with covariates, it was possible to yield more information about the complex associations of conscientiousness and value beliefs with two distinct aspects of students' homework behavior.

Fourth, the pattern of associations between student characteristics and homework behavior in the case of the *struggling learners* is

in line with previous research that confirmed potential problems with homework for some students (e.g., Katz, Buzukashvili, & Feingold, 2012) and studies that showed that relying on one factor (e.g., competence beliefs) was not sufficient for preventing this homework learning style from occurring (Katz et al., 2014).

4.2. Implications

Some students—those who showed low homework effort and could be characterized as *struggling learners*—might tend to achieve lower gains in academic achievement through their homework behavior than other students (Flunger et al., 2015). That is, it is important to think about methods for supporting students in developing a homework learning type with higher achievement gains, such as the one of "fast learners". In the current study, we took into account several characteristics of students that could help explain why students have developed a specific homework learning type. One of our main findings was that students reporting high levels of conscientiousness and homework-value beliefs had a higher tendency to be classified as learning types that were characterized by high homework effort.

Although students have been shown to become more conscientious as their school graduation approaches (Bleidorn, 2012), it might be hard to train students to become more conscientious. Thus, currently, it might be more fruitful to target value beliefs because recent research has shown that students' value beliefs can effectively be promoted, for example, via relevance interventions (e.g., Gaspard et al., 2015; Hulleman, Godes, Hendricks, & Harackiewicz, 2010). Interventions that address the relevance of students' homework could foster students' homework-value beliefs and might boost homework effort directly.

Moreover, paradigms on self-regulated learning (Pintrich, 2000) might serve as a resource for developing interventions that are designed to enhance students' homework effort. Frameworks on self-regulated learning posit that cognition, metacognition, motivation, affect, and volition (e.g., Boekaerts, 1996) influence a person's decision to exert effort (Efklides, 2011). Consequently, one can assume that the regulation of cognition might affect not only cognitive strategies but also effort (Ariel, Dunlosky, & Bailey, 2009; Efklides, 2011). Ben-Eliyahu and Linnenbrink-Garcia (2015) developed a framework that integrated the regulation of emotions, behaviors, and cognitions and elaborated on their links to behavioral engagement in classwork (amongst other aspects of engagement). When they tested this model in a sample of high school students, they found a positive association of the behavioral strategy of time planning with engagement. Previous studies had focused primarily on the association of time management strategies with homework time (Stoeger & Ziegler, 2011; Xu, 2006), but it might be useful to also study the links of time management strategies with homework effort. Ben-Eliyahu and Linnenbrink-Garcia (2015) suggested that if students' use of self-regulated learning strategies such as "organization" (i.e., writing summaries of content and outlining the material) is inefficient, this might result in larger periods of time spent on learning without achievement gains. Thus, future research should try to combine intervention strategies that help students to implement time planning and to effectively make use of the time scheduled for homework. Thereby, future studies should also try to combine intervention strategies that target students' regulation of metacognition, cognition, and behaviors.

Another implication of our study is that the person-centered approach can effectively complement (prior) variable-centered studies. Variable-centered methods enable researchers to determine the unique contribution and predictive power of specific factors. Person-centered methods can be used to assess the complexity of associations among several factors and provide a

more extensive account of the potential interplay between a range of variables (e.g., Lanza & Cooper, 2016). Variable-centered methods can be complemented with person-centered methods, for example, when studies focusing on the predictive validity of one factor for an outcome (e.g., homework time as a predictor of achievement) yield inconsistent findings. Person-centered methods can help researchers examine whether the effect of a variable is determined through its interplay with other factors (e.g., homework effort).

The complementary use of both methods can advance research in two aspects. First, when designing interventions, variable-centered studies can provide information about the factors to focus on. Results from person-centered studies can determine dynamics that might undermine the success of an intervention and can help in the development of potential vaccination strategies. Second, considering results from both variable- and person-centered studies enables definitions to be improved (e.g., behavioral engagement) because both approaches contribute to highlighting which aspects are meaningful (e.g., homework time and effort). Person-centered methods can be applied for judging whether it is sufficient to rely on one or a few factors to yield adequate insight into academic behaviors or whether definitions need to be expanded.

4.3. Limitations and future research

To our knowledge, this is the first study to investigate homework time and homework effort simultaneously and to study their associations with the key constructs of students' characteristics. However, this study has some limitations that need to be kept in mind. For example, in order to obtain more information on how students' characteristics influence the development of specific learning types, longitudinal studies are needed to investigate the homework behavior of students and its antecedents over a longer period of time.

First, when additional covariates were considered, gender was not significantly associated with students' homework learning types. However, this finding does not necessarily imply that gender has less impact on students' homework behavior than originally assumed. Previous studies have suggested that gender differences in academic behaviors can be explained through gender differences in self-beliefs (e.g., value and competence beliefs; e.g., Eccles, Wigfield, Harold, & Blumenfeld, 1993; Jacobs & Eccles, 1992). Moreover, several studies have pointed toward gender differences in conscientiousness. More specifically, girls have been found to be more self-disciplined than boys (Duckworth & Seligman, 2006; Humphrey, 1982). These gender differences might mediate the effect of gender on students' homework behavior. Our study involved a reanalysis of a two-wave study, and we might have received biased results when investigating this issue (see Maxwell, Cole, & Mitchell, 2011) because our data did not allow us to adequately statistically control for initial levels in the mediator (i.e., gender differences in self-beliefs and conscientiousness) and initial homework behavior. Thus, longitudinal studies in which gender differences in students' competence and value beliefs as well as their conscientiousness and homework behavior are examined at several time points and in several domains would be worthwhile (for an example of a longitudinal study on gender differences in competence and value beliefs, see Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2002).

Second, conscientiousness was assessed only at the second measurement. The findings regarding the association of conscientiousness with students' homework learning types could be corroborated by their simultaneous assessment. Nevertheless, previous longitudinal studies have pointed to the predictive validity of students' conscientiousness on their homework behavior compared with other factors (e.g., Trautwein, Lüdtke, Kastens, et al., 2006).

Third, this study involved only one domain. Homework behavior in other domains should be studied as well.

Fourth, whereas the present research yielded meaningful insights into the associations of students' characteristics with students' homework learning types, future research could consider the roles of teachers, parents, or specific contexts. It might be valuable to explore whether teachers' differences in assigning homework are associated with distinct homework learning types in students. Moreover, it might be useful to investigate the role of the setting of exams (Haag & Mischo, 2002; Mischo, 2006) in determining the learning behavior of specific homework learning types. Zhang et al. (2011) showed that the effect of students' self-reported intentions to delay gratification depended on the proximity of an exam. Delay of gratification refers to the ability to delay an immediately rewarding activity in favor of an activity that might lead to a gratifying outcome after a longer time period (Mischel & Metzner, 1962). Therefore, delay of gratification is important when students are faced with the choice between an attractive leisure activity and a demanding task that requires the investment of a lot of both time and effort but will result in accomplishing a desired outcome (such as performing well; e.g., Zhang et al., 2011). In detail, Zhang et al. (2011) found that students with high self-reported intentions to delay gratification spent less time on leisure activities and more time on schoolwork than students who reported low levels of delay of gratification only when an exam was distal. When an important test was on the horizon, the impact of delay of gratification could no longer be found. The authors suggested that the same pattern of results might be found for procrastination (Zhang et al., 2011). Homework procrastination refers to postponing homework until a student is worried about not having completed it earlier (Katz et al., 2014; adapted from Solomon & Rothblum, 1988). It might be the case that students with high levels of intentions to delay gratification have a higher probability of being classified as *high-effort learners* than students who are characterized by low levels of delay of gratification and high levels of homework procrastination. Given the findings by Zhang et al. (2011), future research should investigate whether the classification of students to specific learning types depends on the proximity of exams in a longitudinal study design. In addition, it might be worthwhile to explore the associations between students' ability to delay gratification, homework procrastination, and homework learning types.

Finally, the study drew on self-report data; consequently, students were asked to estimate the time they typically spend on homework. Although we yielded new insights with this measurement method, it does not capture potentially diverging starting and ending times or different habits of finishing a homework assignment completely in one session or doing part of it and completing it on a later day. Thus, this type of measurement might yield inaccurate data because students could over- or underestimate their actual homework time. It might be fruitful to explore other methods, such as assessing students' behaviors directly while they are working on homework (e.g., with video studies). Future studies could compare the results of behavioral measures with the estimated time assessed via questionnaires in order to evaluate the accuracy of the homework time measure.

4.4. Conclusion

In conclusion, our study is one of the first to apply person-centered methods to evaluate homework behavior. Notably, this study is the first to show that large amounts of homework time are not necessarily a sign of low (or high) motivation in students. Moreover, this study confirmed that students' conscientiousness is a second central predictor of their homework behavior along with homework value beliefs.

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