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Being over- or underchallenged in class: Effects on students' career aspirations via academic self-concept and boredom☆

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ABSTRACT

The current study investigated links between students' level of perceived challenge (being over- or underchallenged) and students' career aspirations. We hypothesized indirect effects of over- and underchallenge on career aspirations via academic self-concept and academic trait boredom and tested our hypotheses in a sample of $N = 662$ Swiss eleventh grade students in the domains of German, French, and mathematics. Our results were consistent across all three domains and showed that being overchallenged had a negative impact on academic self-concept. Lower academic self-concept, in turn, was associated with decreased career aspirations. Being underchallenged enhanced academic self-concept, which was positively related to students' career aspirations. Further, both being over- and underchallenged enhanced students' domain-specific boredom experiences resulting in a decrease in their career aspirations. As such, the effect of being underchallenged was of particular importance as its influence on career aspirations via academic trait boredom was negative, whereas via academic self-concept there was a positive indirect effect.

1. Introduction

One of the major challenges of modern classrooms is to provide learning opportunities for every single student in such a way that the demands of a classroom setting adequately match the needs of individual students (e.g., Abels, 2015; Levy, 2008). This goal is certainly laudable but not easily achievable. In the vast majority of school situations teachers have to deal with heterogeneous classrooms in terms of students' cognitive capabilities and prior knowledge. In lessons, in which the use of purely individualized instruction and student-specific lesson plans is restricted, some students will inevitably feel overchallenged whereas others will feel underchallenged. Consequences of less than optimal challenge may influence a range of important educational outcomes. In this study, we investigated the frequency of students reported over- or underchallenge in three different domains, namely, German, French, and mathematics. Furthermore, we investigated the effect of students' level of challenge on their career aspirations, which are known to drive students' later career choice and, hence, represent an important variable for students' academic and life success (Fend, 2003). We examined two domain-specific motivational and emotional mechanisms that underlie this contingency. Being over- or underchallenged is related to students' academic ability self-concepts (Marsh & Craven, 2002; Wigfield & Eccles, 2000) as well as to their experience of academic boredom (Acee et al., 2010; Daschmann, Goetz, & Stupnisky, 2011; Fahlman, Mercer-Lynn, Flora, & Eastwood, 2013), which, in turn, may have an impact on career aspirations (Durik, Vida, & Eccles, 2006; Eccles, 2009; Schwarz, 2000). More precisely, we examined whether being overchallenged related to a lower domain-specific academic self-concept leading to a decrease in career aspirations, and whether being underchallenged may be linked to a higher domain-specific academic self-concept, which may enhance students' career aspirations. Furthermore, we investigated whether being both over- and underchallenged enhanced domain-specific academic trait boredom, which may lower students' career aspirations. Therefore, we hypothesized that academic self-concept and academic boredom should mediate the proposed link between students' level of challenge and their career

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aspirations. In the case of being underchallenged we expected the indirect effect via boredom to be the opposite of the indirect effect via academic self-concept.

2. Being over- or underchallenged – definition and empirical findings

In a typical school situation students are confronted with more or less challenge depending on their cognitive capabilities as well as the difficulty of the task at hand. In the literature, the term “challenge” is not clearly defined (e.g., Kanevsky & Keighley, 2003). Generally speaking, the concept of challenge incorporates on the one hand, individual ability as a person factor (Malmberg & Little, 2007; Nicholls, 1984) and on the other hand, task difficulty as a situational factor (Heckhausen & Heckhausen, 2006; Malmberg & Little, 2007; Nicholls, 1984). Due to the fact that students differ in their cognitive abilities, the exact same school situation could result in students' being either over- or underchallenged. That is, when task demands are above their perceived abilities, students may feel overchallenged, whereas when task demands are below their abilities, students may feel underchallenged (Pekrun, Goetz, Daniels, Stupnisky, & Perry, 2010). In both cases, there is a non-optimal alignment (or lack thereof) between environmental stimulation and students' individual needs.

Surprisingly, hardly any empirical studies have investigated either the frequency of situations, in which students feel over- or underchallenged, or the potential consequences of less than optimal challenge. One reason behind it could be that an objective measure of challenge would call for a standardized competence test, for example based on item response theory which allows for an estimation of the ability of an individual person (person parameter) together with an estimation of the difficulty of an individual item (item parameter; e.g., Embretson & Reise, 2000). This way, students' ability along with the difficulty of a specific task could be assessed (e.g., Tymms, 2010), thus making it possible to gauge individuals' actual challenge, indexed through the estimated fit between the difficulty of the task and the individual ability of the student. However, such an assessment may prove difficult in an in situ school environment.

The problem of challenge assessment can be addressed through the lens of Bandura's (1986) social cognitive theory that suggests that students take actions depending on their self-referent thinking processes and their beliefs. Such subjective measure of challenge should be influenced by internal processes of students evaluating their individual ability and their perception of the task difficulty (Malmberg & Little, 2007; Nicholls, 1984; Preckel, Goetz, & Frenzel, 2010). Hence, perceived challenge resulting from these evaluations of ability and difficulty would therefore be of special importance when it comes to the students' subsequent behaviors (e.g., Abelson, 1979; Pajares, 1996). This makes self-report measures of challenge a good or – depending on the question researchers are trying to answer – even a better alternative to the measurement of the actual challenge. As a result, we use the term “challenge” to describe individuals' perception of their level of being over- or underchallenged depending on their self-evaluation of abilities and task difficulty.

Concerning students' perceived level of challenge, studies examining this construct are scarce. In a study by Malmberg and Little (2007) students from the fifth and sixth grade reported their school-related beliefs about perceived task difficulty, ability, and effort. The constructs were assessed with Likert scale items that gauged perceived difficulty, ability, and effort. Sample items included: “Do you think that learning something new at school is hard to do” (for perceived difficulty), “When it comes to learning something new at school, are you smart enough to do it?” (for ability) and “When it comes to figuring out a new lesson, can you put enough effort into it?” (for effort). The researchers found different profile groups with one group of students characterized by high ability, high effort, and low difficulty profile (*Agentic group*; being probably underchallenged) and another group characterized by low ability, low effort, and high difficulty profile (*Challenged group*; being probably overchallenged), with more students falling into the *Agentic* group ($n = 67$) than into the *Challenged* group ($n = 29$).

To our knowledge, only few studies have explicitly assessed students' level of perceived challenge at school. For example, Moneta and Csikszentmihalyi (1996) investigated 14 to 17-year old students' level of challenge across different school situations. The researchers asked students about their current level of challenge referring to the momentary situation (“Rate the challenges of the activity” on a scale ranging from 0 = low challenge to 9 = high challenge, reporting a mean level of $M = 3.50$ with a standard deviation of $SD = 3.00$). The study has a few notable limitations as the data were collected only at two schools and during the academic year of 1984/1985. Furthermore, no distribution of students' level of challenge was reported, but the mean level of challenge below 4.5, which is the theoretical mid-point of the scale representing an optimal challenge, shows a slight tendency for the students to feel underchallenged. Additionally, a very recent study by Strati, Schmidt, and Maier (2017) investigated nine to twelve graders and their academic engagement as predicted by – among others – their perceived challenge. The authors assessed perceived challenge via the experience-sampling method, with one item asking how challenged the participating students felt (responses ranged from “not at all” to “very much”). The researchers reported that students, recruited from a single American high school were, on average, only “a little” challenged in the investigated science domains. Further, initial evidence from a study exploring German students' and teachers' emotions in mathematics suggested that 52.3% of ninth and 10th-grade students reported feeling overchallenged, and 14.1% reported being underchallenged (Becker, Keller, Bieg, & Staub, 2017). In sum, it is still unclear how often and how intensely students feel over- or underchallenged in different school domains. Our study will close this gap by examining both groups of non-optimally challenged students in the domains of German, French, and mathematics. In addition, our study links students' perceived challenge to their career aspirations. According to our definition of challenge, this construct incorporates students' ability (as a personal characteristic) as well as perceived task difficulty (as a characteristic of the school environment). Further, an essential mechanism behind individuals' development of career aspirations includes an ongoing comparison of person-level variables, such as ability, with the demands of potential (occupational) environment, such as task difficulty (e.g., Hackett, Lent, & Greenhaus, 1991; Holland, 1997). A mismatch between these factors could be directly and negatively connected to students' career aspirations (Hackett et al., 1991). Furthermore, we investigated two potential mechanisms underlying this contingency, which we describe in more detail in the following section.

2.1. Being over- or underchallenged from a motivational perspective: relations with domain-specific academic self-concept

Looking at the level of challenge from a motivational perspective, being over- and underchallenged may be closely related to the individuals' expectancy of success (e.g., Wigfield & Eccles, 2000). Being over- or underchallenged results from individuals' perceived fit between their abilities and task difficulties. In the case of a perfect fit students' feel optimally challenged, whereas low ability combined with high task difficulty may lead to the feeling of overchallenge, and the opposite combination to the feeling of underchallenge. Expectancy of success is defined as task-specific beliefs about the probability of future success on the related task (Eccles, 1983) and should therefore be closely related to the students' perceived challenge. In the case of expectancy of success, the related beliefs build on the probability of success of solving tasks in the future, whereas perceived challenge is generated based on past experiences. Furthermore, empirical evidence shows that expectancy of success is not clearly distinguishable from and could be operationalized by self-concept of ability (i.e., the individuals' beliefs about their own abilities; Eccles, 2009; Guo, Parker, Marsh, & Morin, 2015; Marsh & Martin, 2011).

Drawing upon these definitions of challenge and expectancy of success, operationalized through academic ability self-concept (Eccles, 2009; Guo et al., 2015; Schunk & Pajares, 2005), our study links students' reported over- or underchallenge to their domain-specific academic self-concepts. More specifically, being overchallenged in a specific domain should have a negative relation with students' domain-specific academic self-concepts, and being underchallenged should be positively related to these academic self-concepts due to a higher expectation of success (e.g., Marsh & Craven, 2002).

2.2. Being over- or underchallenged from the perspective of emotions: relations with domain-specific academic boredom

At school, boredom is an important emotion, particularly due to its omnipresence in the educational context (e.g., Goetz & Hall, 2014). This emotion is defined as an unpleasant and aversive state (affective component; Harris, 2000; Mikulas & Vodanovich, 1993; Scherer, 2000), characterized by an altered perception of time (cognitive component), and the desire to avoid or modify the situation (motivational component; Goetz & Hall, 2014). When it comes to the latter component, the motivational consequences of boredom could result in both approach (e.g., asking the teacher for more engaging tasks or devising extensions to a task at hand; Gasper & Middlewood, 2014; Nett, Goetz, & Daniels, 2010) and avoidance (e.g., daydreaming or engaging in different, unrelated activities; Nett et al., 2010; Pekrun, Hall, Goetz, & Perry, 2014) strategies. Boredom is associated with specific facial, vocal, and postural reactions (expressive component; Goetz & Hall, 2014) and is distinct from other negative affective experiences that include sadness and frustration (Van Tilburg & Igou, 2012, 2017). When it comes to the physiological component of boredom, there is an ongoing debate of whether boredom is a low arousal-emotion (e.g., Mikulas & Vodanovich, 1993) or a relatively high arousal-emotion (e.g., London, Schubert, & Washburn, 1972; for a discussion see Pekrun et al., 2010). Furthermore, it is also important to note that boredom should not be conceptualized as the absence of positive emotions or lacking interest (Pekrun et al., 2010), as it comprises a unique combination of affective, cognitive, motivational, physiological, and expressive components and is provoked by specific stimulus conditions (Fisher, 1993).[1]

The most common antecedents of boredom include individuals' states of being over- and underchallenged (e.g., Acee et al., 2010; Daschmann et al., 2011; Fahlman et al., 2013; Lohrmann, 2008) resulting from a mismatch between the need for arousal and environmental stimulation (Eastwood, Frischen, Fenske, & Smilek, 2012; Fahlman et al., 2013). In a school setting, boredom often results from a discrepancy between individuals' ability and task demands (Daschmann et al., 2011), defined as the concept of challenge. More specifically, according to Pekrun's control-value theory, boredom at school occurs when students view tasks as unimportant and when these tasks are either insufficiently challenging due to task demands being below individuals' abilities (high control) or due to task demands being above one's abilities (low control; Pekrun et al., 2010). As such, the occurrence of boredom can be explained by a combination of various aspects of students' individual needs and environmental stimulation emphasizing that both being under- and overchallenged are important antecedents of achievement boredom (Acee et al., 2010; Daschmann et al., 2011; Lohrmann, 2008). Consequently, the intensity of boredom should be higher for students who are over- or underchallenged compared to students who experience an optimal level of challenge in classroom situations.

Several studies support the aforementioned contingency. In doing so, Ahmed, van der Werf, Minnaert, and Kuyper (2010) did not explicitly focus on challenge, but on the broader concept of competence appraisals and reported a negative link between seventh graders' competence appraisals on today's mathematics lessons topic and their momentary boredom experiences. A study by Titz (2001) found that university students who retrospectively reported experiences of boredom during general learning situations and specific university courses reported both low and high judgments of their corresponding competencies. These judgments were captured by open-ended questions explicitly asking students about their perception of challenge, expectancy of success, and performance during the learning situation or the university course and while being bored. Interestingly, in this study students only reported overchallenge while being bored (Titz, 2001). Goetz and Frenzel (2010) examined these links more closely and investigated students' tendency to feel bored in the domain of mathematics caused by over- and underchallenging subject matter (e.g., "When I'm bored in mathematics class it is because the subject matter in math is too difficult for me."). The researchers showed that in a sample of German students with a mean age of $M = 13.55$ girls showed more mathematics-related boredom experiences due to being overchallenged as compared to boys who were more likely to generally feel bored in mathematics due to being underchallenged. Finally, Lohrmann (2008) demonstrated that a sample of primary school students tended to experience domain-specific boredom (in the domains of German and mathematics) especially when being in underchallenging, but also due to overchallenging classroom situations. Nevertheless, empirical investigations focusing on the influence of being over- and underchallenged on students' boredom experiences are relatively scarce. Therefore, we would like to gather additional empirical evidence of the proposed link between challenge and boredom.

3. The impact of academic self-concept and boredom on students' career aspirations

In an educational context, career aspirations develop through the continuous integration of the individual students' abilities, motivations, and emotional experiences (e.g., Gottfredson, 2003; Hackett et al., 1991; Holland, 1997). As academic self-concept and boredom are important variables in academic contexts and their effects on student academic achievement are well-investigated (e.g., Marsh et al., 2015; Tze, Daniels, & Klassen, 2016) linking them to more distal outcomes such as students' career aspirations seems to be meaningful.

A number of recent studies have revealed positive links between students' academic self-concepts and their subject-choice, coursework selection, career choice, and career aspirations (e.g., Durik et al., 2006; Guo et al., 2015; Watt et al., 2016; Wigfield & Eccles, 2000). One has to mention, that the majority of these investigations were limited to the domains of mathematics and science (e.g., Nagengast & Marsh, 2012; Simpkins, Davis-Kean, & Eccles, 2006; Wang, 2012; Watt et al., 2016).

Unlike the positive connection of academic self-concept and students' career aspirations, the aversive emotion of boredom (e.g., Goetz & Hall, 2014; Harris, 2000) should be negatively connected to students' career aspirations. That is, students who generally experience high levels of boredom in a certain discipline are expected to have a reduced aspiration to work in a related discipline. On a more general level, research has already shown the important influence of emotions on human decision making (e.g., Fredrickson & Kahneman, 1993; Gigerenzer & Selten, 2001; Peters, Västfjäll, Gärling, & Slovic, 2006; Schwarz, 2000). Researchers consistently reveal that people often anticipate feelings about future outcomes and use these emotions to guide their behavior (e.g., Baumeister, Vohs, DeWall, & Zhang, 2007; Mellers & McGraw, 2001).

Extending research findings that link emotions with career

[1] For example, it's possible to lack enjoyment without being bored (Pekrun et al., 2010). Similarly, a lack of situational interest (Hidi & Renninger, 2006) may potentially lead to boredom experiences but is not identical to boredom as the former is an affectively neutral state whereas the latter is affectively aversive (Goetz & Hall, 2014).

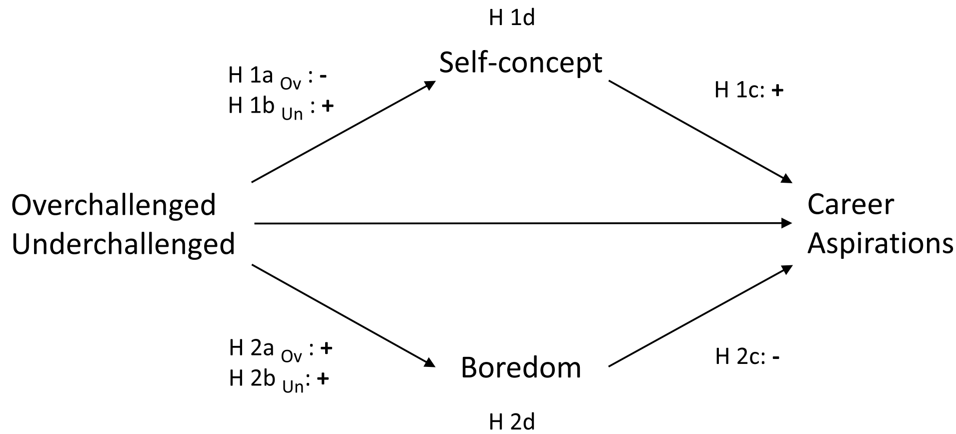

Fig. 1. Proposed relations of being over-and underchallenged, self-concept, boredom, and career aspirations.

aspirations (e.g., Wigfield, Battle, Keller, & Eccles, 2002; Wigfield & Eccles, 2000), we were interested in the degree of perceived boredom, defined as one's general tendency to feel bored in particular school domains – often referred to as academic "trait" boredom (Goetz, Bieg, Lüdtke, Pekrun, & Hall, 2013; Pekrun et al., 2014). Thereby, we define *trait* not as a general predisposition or an individual characteristic, but as a response tendency (Porter et al., 2000; Snow, Corno, & Jackson, 1996). Thus, it captures individuals' tendency to frequently and repeatedly experience situations in the respective school domains as boring (Bieg, Goetz, & Lipnevich, 2014; Schutz & Davis, 2000). Academic *trait* boredom might be strongly influenced by subjective beliefs and should therefore serve as effective predictor of career aspirations (e.g., Robinson & Clore, 2002; Schuster, Bieg, & Hubbard, 2016). We surmised that individuals' tendency to feel bored in an academic domain should reduce career aspirations regarding occupational fields that are related to the respective domain. This effect is particularly important because of the prevalence of this kind of boredom in the classroom (e.g., Larson & Richards, 1991). Surprisingly, the influence of emotions in general and of domain-specific academic trait boredom in particular on students' career aspirations is relatively understudied (e.g., Hartung, 2011). We are going to redress this deficiency and investigate links between the level of challenge and student career aspirations via academic self-concept and academic trait boredom.[2]

4. The present study and hypotheses

The current study investigated the frequency of students' reported over- or underchallenge and its influence on their career aspirations via domain-specific academic self-concept and academic trait boredom in the school domains of German, French, and mathematics. In bringing the two research approaches together, we attempted to untangle the complex relations among these constructs. Drawing upon the existing theory and empirical results, we hypothesized that (1a) being overchallenged lowered students' domain-specific academic self-concept whereas (1b) being underchallenged enhanced students' academic self-concept. (1c) Academic self-concept should have a positive effect on students' career aspirations. As such, (1d) academic self-concept should mediate the influence of being over- and underchallenged on career aspirations. Furthermore, we hypothesized that both being (2a) over- as well as (2b) underchallenged enhanced domain-specific trait boredom. We propose that (2c) boredom due to being over- and underchallenged negatively predicts career aspirations. Hence, (2d) boredom should also mediate the effects of being under- and overchallenged on students' career aspirations. Taken together, we propose negative indirect effects via academic self-concept and academic trait boredom on students' career aspirations for the overchallenged students. The indirect effects via academic self-concept and boredom should be two-fold for the underchallenged students: We predicted them to be positive in the case of domain-specific academic self-concept, but negative in the case of domain-specific trait boredom. The proposed relations are graphically displayed in Fig. 1.

5. Method

5.1. Sample and procedure

The sample consisted of $N = 662$ Swiss students from 35 different classes and seven schools in the German-speaking part of Switzerland. Students were in the eleventh grade and attended the highest track of the Swiss school system ($M_{age} = 17.69$ years, $SD = 0.75$; 54.1% female). 90.4% of the students reported to have been born in Switzerland, 3.7% in Germany, 0.9% in Liechtenstein, 0.5% in Austria, and 4.6% in other, non-German speaking countries. German was a native language of 88.6% of the students (11.4% of the students reported other languages as native tongues, with only 0.9% reporting French as their first language). As for parents' educational level, 23.9% of the students' mothers and 30.7% of the students' fathers had the Swiss qualification to university entrance (comparable to a high-school diploma; used as an indicator for high SES), whereas 9.6% of the students' mothers and 7.5% of the students' fathers had the lowest possible educational level.[3]

The procedure of the study complied with ethical principles for research involving human subjects of the WMA Declaration of Helsinki. All student participants and their parents were informed about the objectives and the procedure of the study and provided their written consent to participate. Furthermore, heads of schools as well as respective teachers approved the study protocol. Students' participation in the current study was voluntary and confidential, and no connection from the participants to the data was possible. The reported study was part of a larger research project that aimed at investigating students' cognitions, motivation, and emotions, conducted in the school years of 2014 and 2015. Domain-specific perceived challenge, academic self-concept, emotions, demographic data, and other variables were assessed in German, French, and mathematics classes using a standardized questionnaire at the beginning of the study. Another questionnaire was submitted after a two-week period to assess students'

[2] In the following, when we use the term "(academic) trait boredom" or "boredom" we are always referring to the domain-specific tendencies of the students' to feel bored in particular domains as outlined above.

[3] The frequency of missing data was quite high, with 35.0% of non-valid data points for mothers' education and with 35.5% for fathers' educational level.

domain-specific career aspirations. All constructs were gauged separately in the three school domains.

5.2. Study measures

5.2.1. Assessment of perceived challenge

Domain-specific challenge was assessed by asking how students perceived the difficulty level in the respective domain ("The difficulty level in [subject] classes usually is … for me" with the domains being German, French and mathematics) with responses ranging from 1 (*too easy*) to 5 (*too difficult*) on a bipolar rating scale. Previous research suggested that single items could be sufficient for measuring subjective experiences that are generally unambiguous (see Ainley & Patrick, 2006; Gogol et al., 2014; Nagy, 2002; Robins, Hendin, & Trzesniewski, 2001). Because we were interested in the differences between underchallenged and overchallenged students, the items were dummy-coded in such a way that students answering the question with 1 or 2 (*too easy*, *a little bit too easy*) were labeled as "being underchallenged", whereas students answering the question with 4 or 5 (*a little bit too difficult*, *too difficult*) were labeled as "being overchallenged". Both categories were compared to a dummy variable indexing optimal challenge (students answering the question with 3 "*just right*").

5.2.2. Assessment of domain-specific academic self-concept

German, French, and mathematics self-concept was assessed with three items per domain (e.g., "I am generally good at math"). They were modified from the German adaptation (Schwanzer, Trautwein, Lüdtke, & Sydow, 2005) of the Self-Description Questionnaire III (Marsh, 1992). The responses were bounded by 1 (*completely disagree*) to 5 (*completely agree*).

5.2.3. Assessment of domain-specific academic trait boredom

We assessed domain-specific academic trait boredom with two items (e.g., "I'm generally bored during math classes.") that were taken from the Achievement Emotions Questionnaire (AEQ; see Pekrun, Goetz, Frenzel, Barchfeld, & Perry, 2011). Items were rated on a five-point Likert scale, ranging from 1 (*strongly disagree*) to 5 (*strongly agree*).

5.2.4. Assessment of domain-specific career aspirations

To measure students' domain-specific career aspirations we revised TIMSS 2011 (Mullis, Martin, Foy, & Arora, 2012) and PISA 2006 (OECD, 2009) items. Similar items were also used in a study by Schuster and Martiny (2016). The items had been previously pilot tested and showed appropriate psychometric qualities. The final set of domain-specific items consisted of six items in the domains of German and mathematics and seven items in domain of French, and included several reversed items (e.g., "I would like to have a job in which I get to use my French language skills", item in the domain of French; "I would rather not have a job that would require strong math skills", reversed item in the domain of mathematics) rated on a five-point Likert scale from 1 (*completely disagree*) to 5 (*completely agree*). For the final analyses the inverted items were recoded and the unidimensionality of the scales for each domain as well as their reliabilities were tested on an item-level basis.

5.3. Data analyses

Our analyses focused simultaneously on domain-specific challenge, academic self-concept, and boredom and their relations with career aspirations. Hence, multivariate methods were employed. We investigated our hypotheses in separate models for German, French, and mathematics. Structural equation modeling (SEM) was conducted in Mplus 7.11 (Muthén & Muthén, 1998–2012) with confirmatory factor analyses (CFA) estimating the latent constructs of academic self-concept, boredom, and career aspirations. In regards to the scale scores assessing students' career aspirations, we used a balancing approach averaging the original items to build item parcels (also called factorial approach; see Little, Rhemtulla, Gibson, & Schoemann, 2013; Rogers & Schmitt, 2004). This procedure was used to reduce item non-normalities and the number of estimated parameters to stabilize the measurement models (Little et al., 2013). Three parcels per domain were built each out of two items[4] based on the factorial structure of the original items (for a description of the procedure see Landis, Beal, & Tesluk, 2000; Little et al., 2013). The resulting three parcels per domain where then included in the structural part of the final models to estimate students' career aspirations in German, French, and mathematics on a latent level. The dummy variables assessing over- and underchallenge were directly included into the models in a manifest way, as previous studies did not allow for an adequate a priori estimation of the proportion of variance that was due to measurement error (Kline, 2011).

We first had a separate look at all main effects and at mediation models only including one of the mediators (academic self-concept or boredom). All of these models and the respective coefficients can be found in the Table A1 of the Appendix.

All measurement models were identified by an effect-coding procedure to avoid a stronger influence of one specific item (Little, Slegers, & Card, 2006) and were estimated by using the MLR-estimator to account for possible non-normality problems (Muthén & Muthén, 1998–2012). In the final models, which were used to answer our hypotheses, we tested the following propositions in the structural part of the models: 1) the main effect of challenge on career aspirations, 2) the effect of the dummy variables assessing perceived over- and underchallenge (with optimal challenge as the reference variable) on academic self-concept and academic trait boredom, 3) the effect of academic self-concept on career aspirations, 4) the effect of boredom on career aspirations as well as 5) the effects of challenge on career aspirations mediated by academic self-concept and boredom.

5.3.1. Hierarchical data structure and missing data

The data set has a nested structure with students nested within classes. We accounted for this clustered data structure by using the "type is complex" procedure in Mplus together with the "cluster" and "stratification options" to adjust the standard errors. For all indirect effects, we used the "model indirect" and "cinterval" option of Mplus to calculate unstandardized and standardized effects obtaining confidence intervals and Bayes credibility intervals (Muthén & Muthén, 1998–2012). Missing data were handled with full information maximum likelihood procedures (Arbuckle, 1996; Rubin, 1976).

5.3.2. Model fit indices

Determining the fit of the domain-specific SEM models we used the comparative fit index (CFI; Bentler, 1990), the Tucker-Lewis Index (TLI) and the root mean square error of approximation (RMSEA). According to Hu and Bentler (1999) values > 0.95 or 0.90 were considered as excellent or acceptable fit of the data when it comes to CFI and TLI; RMSEA values < 0.06 or 0.08 were considered as good or acceptable fit.

6. Results

6.1. Preliminary analyses

Tables 1 and 2 show the reliability, missing rates and intercorrelations for all key variables. The reliabilities of all scales were acceptable ranging from Cronbach's $\alpha = 0.74$ for boredom in mathematics classes to $\alpha = 0.95$ for the assessment of career aspirations again in

[4] For the domain of French in which career aspirations were assessed via seven items, the balancing approach resulted in one parcel built out of three items.

Table 1
Measures of internal consistencies (Cronbach's alpha) of item scales and frequencies of missing data (in percent) of key study variables separated by subjects.

Measure	German		French		Mathematics	
	Cronbach's α	Missing data	Cronbach's α	Missing data	Cronbach's α	Missing data
Challenge	–	6.3%	–	7.1%	–	5.9%
Self-concept	0.87	6.0%	0.90	6.6%	0.90	5.6%
Boredom	0.87	2.1%	0.90	2.9%	0.74	1.8%
Career aspirations	0.85	12.8%	0.92	13.1%	0.95	12.4%

Table 2
Intercorrelations of academic self-concept, trait boredom and career aspirations separated by subjects.

Variable	1	2	3	4	5	6	7	8	9
German									
1. Self-concept	–								
2. Boredom	−0.11**	–							
3. Career Aspirations	0.61**	−0.19**	–						
French									
4. Self-concept	0.23**	−0.04	0.16**	–					
5. Boredom	0.06	0.35**	−0.11*	−0.18**	–				
6. Career Aspirations	0.16**	−0.11**	0.22**	0.62**	−0.36**	–			
Mathematics									
7. Self-concept	−0.23**	−0.01	−0.30**	−0.03	−0.06	−0.12**	–		
8. Boredom	0.08	0.39**	0.06	−0.06	0.30**	−0.05	−0.27**	–	
9. Career Aspirations	−0.30**	0.07	−0.25**	−0.28**	−0.03	−0.20**	0.63**	−0.31**	–

Note. Reported coefficients are product-moment correlations based on manifest scale scores.
* $p < .05$.
** $p < .01$.

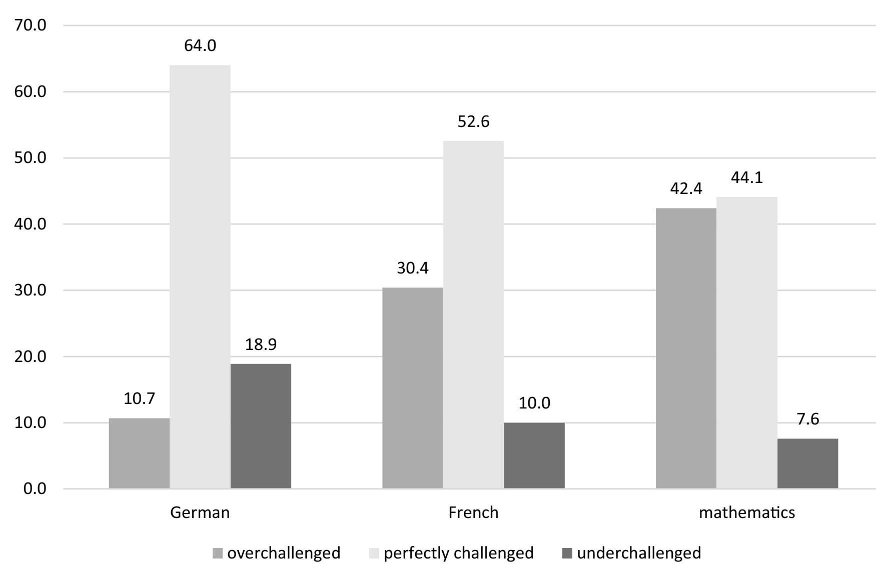

Fig. 2. Graphical depiction of students' frequencies (in percent) of being overchallenged, perfectly challenged, or underchallenged in the domains of German, French, and mathematics.

mathematics. Item-specific missing rates were low for the assessment of domain-specific boredom, relatively low for the assessment of domain-specific challenge and academic self-concept and rising to a higher level for the assessment of students' career aspirations.

Studies showing the frequencies of students' reported over- or underchallenge are scarce. Hence, the analyses of frequencies of perceived challenge seem to be of special importance: These analyses (see Fig. 2) revealed that 10.7% of students felt overchallenged in German, 30.4% in French, and 42.4% in mathematics classes. Conversely, 18.9% of students felt underchallenged in German classes, 10.0% in French, and 7.6% in mathematics classes. As such, a relatively high proportion of students, especially in the domain of mathematics, reported being overchallenged. For German, the proportion of optimally challenged students was the highest (64.0%) compared to 52.6% of optimally challenged students in French and 44.1% in mathematics. Consequently, over 40% of students were not optimally challenged in French and mathematics classes.

Mean scores for academic self-concepts were 3.25 (*SD* = 0.97) for German, 2.90 (*SD* = 1.12) for French and 3.00 (*SD* = 1.14) for mathematics, respectively, and for academic boredom 2.76 (*SD* = 1.17)

Table 3
Descriptive statistics of key study variables separated by subjects and being overchallenged, underchallenged, or perfectly challenged.

Measure	German						French						Mathematics					
	Ov		Un		Perf		Ov		Un		Perf		Ov		Un		Perf	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
SC	2.31	0.77	3.77	0.88	3.26	0.91	1.97	0.70	3.93	0.94	3.24	0.97	2.30	0.87	4.29	0.77	3.48	0.95
BO	3.35	1.15	3.38	1.18	2.55	1.07	3.26	1.11	3.38	1.03	2.60	1.01	2.85	1.09	2.82	1.11	2.26	0.87
CA	2.67	0.84	3.72	0.80	3.46	0.77	2.14	0.85	3.58	0.78	3.07	0.87	2.52	1.04	3.97	0.80	3.30	1.06

Note. SC = academic self-concept; BO = academic trait boredom; CA = career aspirations; Ov = overchallenged; Un = underchallenged; Perf = perfectly challenged; means and standard deviations were based on manifest variables.

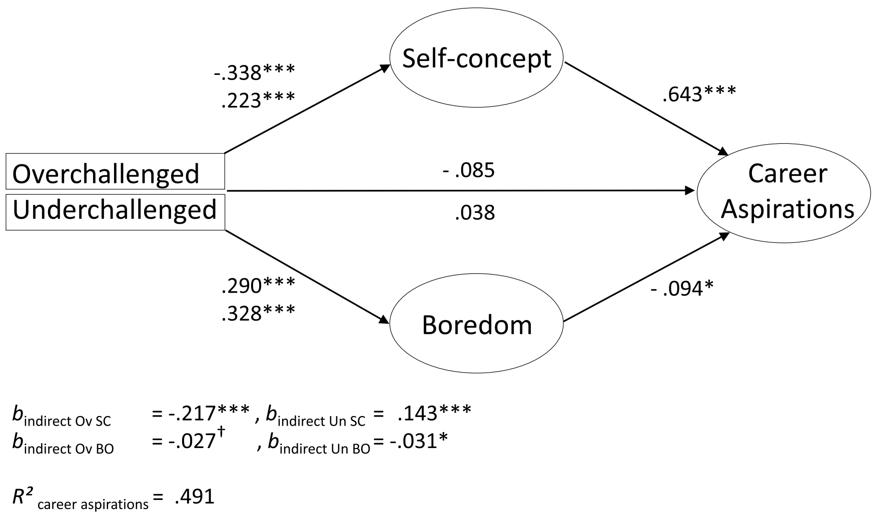

Fig. 3. Standardized regression coefficients and R^2 of the structural equation model in German.

in German, 2.86 (*SD* = 1.10) in French classes, and 2.53 (*SD* = 1. 50) in mathematics. To get a more precise picture of the data concerning our hypotheses, we also examined means for academic self-concept and boredom as crossed with students' perceived challenge (see Table 3). The mean scores for academic self-concept in German for students who felt overchallenged were 2.31 (*SD* = 0.77) and 3.77 (*SD* = 0.88) for the ones who felt underchallenged. In French classes overchallenged students reported a mean of 1.97 (*SD* = 0.70) and underchallenged students a mean of 3.93 (*SD* = 0.94) in French classes. In mathematics classes the mean academic self-concept was 2.30 (*SD* = 0.87) for the overchallenged students and 4.29 (*SD* = 0.77) for the underchallenged ones. Across academic domains, means for students who reported being overchallenged were significantly different from the means for those who felt underchallenged (German: $t(194) = 11.71$, $p < .001$; French: $t(263) = 15.41$, $p < .001$; mathematics: $t(325) = 15.19$, $p < .001$). The mean scores of the reported boredom in German for students who reported being overchallenged were 3.35 (*SD* = 1.15) and 3.38 (*SD* = 1.18) for the underchallenged ones; overchallenged students in French reported a mean trait boredom of 3.26 (*SD* = 1.11) and underchallenged a mean of 3.38 (*SD* = 1.03); for mathematics the means were 2.85 (*SD* = 1.09) for the overchallenged and 2.82 (*SD* = 1.11) for the underchallenged students. There were no statistically significant differences in boredom experiences for over- and underchallenged students in any of the three academic domains (German: $t(174) = -0.23$, $p <$ n.s.; French: $t(237) = 0.71$, $p <$ n.s.; mathematics: $t(288) = 0.13$, $p <$ n.s.). Descriptive statistics for the career aspirations revealed the mean scores of 3.43 (*SD* = 0.82) for the German-specific items, 2.83 (*SD* = 0.99) for the French-specific items, and 2.99 (*SD* = 1.14) for the mathematics-related items.

6.2. SEM: interrelations of domain-specific challenge, academic self-concept, trait boredom, and career aspirations

To test the proposed hypotheses, we looked at three different structural equation models for the domains of German, French, and mathematics (see Figs. 3 to 5). The proposed models fitted the data well and the explained variance for the outcome variable of career aspirations was relatively high in all academic domains ($CFI_{German} = 0.985$, $TLI_{German} = 0.978$, $RMSEA_{German} = 0.041$, $R^2_{German} = 0.49$; $CFI_{French} = 0.981$, $TLI_{French} = 0.971$, $RMSEA_{French} = 0.058$, $R^2_{French} = 0.54$; $CFI_{Math} = 0.975$, $TLI_{Math} = 0.962$, $RMSEA_{Math} = 0.067$, $R^2_{Math} = 0.46$; see also Table 4). All reported regression effects were standardized unless indicated otherwise and all effects have to be interpreted as dependent on all other variables included in the models. For an overview of all relations of the final models, as well as direct, indirect, and total effects and the respective regression coefficients see Table 5.[5]

Hypothesis 1. (a–d) – Effects of being over- and underchallenged on academic self-concept, of academic self-concept on career aspirations, and indirect effect via academic self-concept.

Our results revealed that being overchallenged significantly reduced students' academic self-concept, as compared to the reference category

[5] We additionally estimated all models without building parcels, as there is an ongoing debate about the advantages and disadvantages of item parcels (e.g., Little et al., 2013; Marsh, Lüdtke, Nagengast, Morin, & Von Davier, 2013). Comparing the models and effects of both procedures, the pattern of results as well as the respective coefficients remained stable in all models.

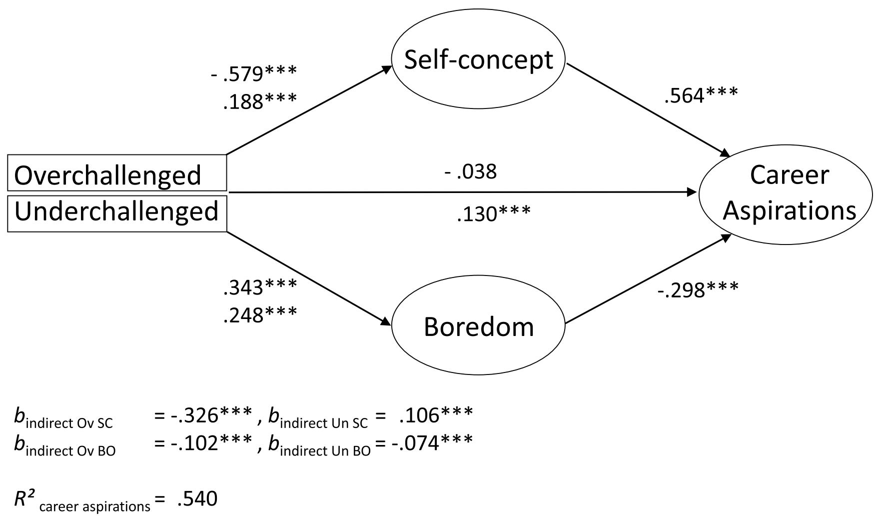

Fig. 4. Standardized regression coefficients and R^2 of the structural equation model in French.

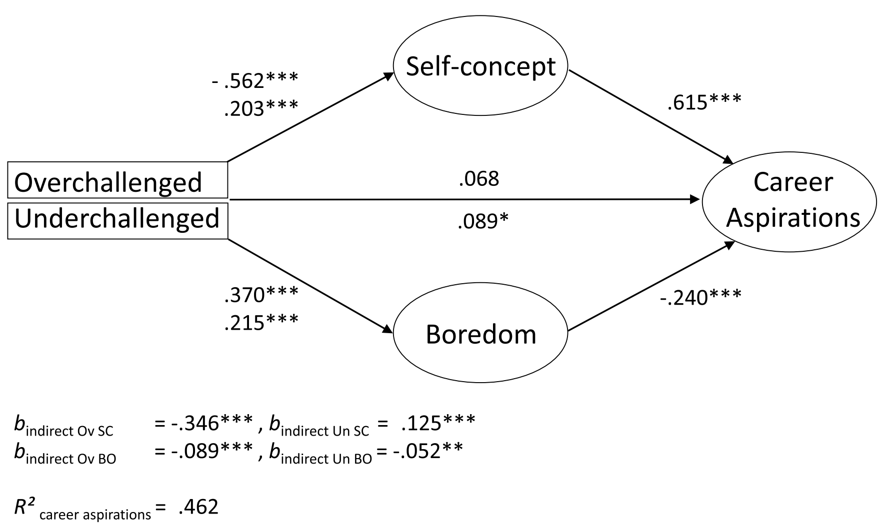

Fig. 5. Standardized regression coefficients and R^2 of the structural equation model in mathematics.

Table 4
Fit indices and explained variance of proposed models separated by subjects.

	Fit indices				R^2		
	Chi² (*df*)	CFI	TLI	RMSEA	CA	SC	BO
German	59.8 (29)	0.985	0.978	0.041	0.491	0.191	0.157
French	88.6 (29)	0.981	0.971	0.058	0.540	0.423	0.138
Mathematics	109.5 (29)	0.975	0.962	0.067	0.462	0.418	0.141

Note. $n_{German} = 619$; $n_{French} = 615$; $n_{Math} = 623$; SC = academic self-concept; BO = academic trait boredom; CA = career aspirations.

of being optimally challenged, in all three investigated academic domains ($\beta_{German} = -0.34$, $p < .001$; $\beta_{French} = -0.58$, $p < .001$; $\beta_{Math} = -0.56$, $p < .001$).[6] This result supports Hypothesis 1a. When it comes to Hypothesis 1b, analyses showed the opposite effect, with students' who felt underchallenged reporting higher academic self-concepts ($\beta_{German} = 0.22$, $p < .001$; $\beta_{French} = 0.19$, $p < .001$; $\beta_{Math} = 0.20$, $p < .001$) compared to their optimally challenged counterparts. Furthermore, as proposed in Hypothesis 1c, the effects of academic self-concept on career aspirations were positive for all academic domains ($\beta_{German} = 0.64$, $p < .001$; $\beta_{French} = 0.56$, $p < .001$; $\beta_{Math} = 0.62$, $p < .001$). Analyses also showed a negative indirect effect of being overchallenged on career aspirations via academic self-concept for German ($\beta_{indirect} = -0.22$, $p < .001$), whereas the indirect effect of being underchallenged on career aspirations mediated by academic self-concept was positive ($\beta_{indirect} = 0.14$, $p < .001$). The same result pattern was revealed for French (being overchallenged: $\beta_{indirect} = -0.33$, $p < .001$; being underchallenged: $\beta_{indirect} = 0.11$, $p < .001$) and mathematics (being overchallenged: $\beta_{indirect} = -0.35$, $p < .001$; being underchallenged: $\beta_{indirect} = 0.13$, $p < .001$). Additionally, the direct effects of being overchallenged were non-significant in all three domains, whereas for being underchallenged there were significant direct effects in French ($\beta_{direct} = 0.13$, $p < .001$) and mathematics ($\beta_{direct} = 0.09$, $p < .05$), but not in German ($\beta_{indirect} = 0.04$, $p = .447$).

[6] Due to the specific way, in which we operationalized challenge, all effects of students' being over- or underchallenged in this and the following section have to be interpreted in comparison to the optimally challenged reference group.

Table 5
Total, direct, and indirect effects of proposed models separated by subjects.

	Subject		
	German	French	Mathematics
Overchallenged			
Total CA on Ov	−0.33*** (0.04)	−0.47*** (0.03)	−0.37*** (0.04)
Total Indirect CA on Ov	−0.25*** (0.04)	−0.43*** (0.03)	−0.44*** (0.04)
Indirect CA on Ov via SC	−0.22*** (0.03)	−0.33*** (0.02)	−0.35*** (0.04)
Indirect CA on Ov via BO	−0.03 (0.01)	−0.10*** (0.02)	−0.09*** (0.02)
Direct SC on Ov	−0.34*** (0.04)	−0.58*** (0.03)	−0.56*** (0.04)
Direct BO on Ov	0.29*** (0.05)	0.34*** (0.05)	0.37*** (0.05)
Direct CA on Ov	−0.09 (0.05)	−0.04 (0.04)	0.07 (0.04)
Underchallenged			
Total CA on Un	0.15** (0.05)	0.16*** (0.04)	0.16*** (0.04)
Total Indirect CA on Un	0.11*** (0.03)	0.03 (0.03)	0.07** (0.03)
Indirect CA on Un via SC	0.14*** (0.03)	0.11*** (0.03)	0.13*** (0.02)
Indirect CA on Un via BO	−0.03* (0.02)	−0.07*** (0.02)	−0.05** (0.02)
Direct SC on Un	0.22*** (0.04)	0.19*** (0.04)	0.20*** (0.03)
Direct BO on Un	0.33*** (0.06)	0.25*** (0.05)	0.22*** (0.05)
Direct CA on Un	0.04 (0.05)	0.13*** (0.04)	0.09* (0.04)
Self-concept			
Direct CA on SC	0.64*** (0.04)	0.56*** (0.04)	0.62*** (0.04)
Boredom			
Direct CA on BO	−0.09* (0.05)	−0.30*** (0.05)	−0.24*** (0.05)

Note. $n_{German} = 619$; $n_{French} = 615$; $n_{Mathematics} = 623$; all regression coefficients are standardized; Ov = overchallenged; Un = underchallenged; SC = academic self-concept; BO = academic trait boredom; CA = career aspirations; standard errors are displayed in brackets.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Hypothesis 2. (a–d) – Effects of being over- and underchallenged on academic trait boredom, of boredom on career aspirations, and indirect effect via boredom.

The mediation models revealed significant positive effects of being overchallenged on academic trait boredom ($\beta_{German} = 0.29$, $p < .001$; $\beta_{French} = 0.34$, $p < .001$; $\beta_{Math} = 0.37$, $p < .001$) as well as significant positive effects of being underchallenged on boredom ($\beta_{German} = 0.33$, $p < .001$; $\beta_{French} = 0.25$, $p < .001$; $\beta_{Math} = 0.22$, $p < .001$) in all three academic domains, thus supporting Hypothesis 2a and b. Examining the effects of boredom on domain-specific career aspirations we could show negative effects in German ($\beta_{German} = -0.09$, $p < .05$), in French ($\beta_{French} = -0.30$, $p < .001$) and mathematics classes ($\beta_{Math} = -0.24$, $p < .001$), supporting Hypothesis 2c. To test Hypothesis 2c and the mediating effect of boredom on career aspirations we considered the indirect effects of being over- and underchallenged on career aspirations via domain-specific boredom. For all three academic domains, the resulting pattern showed negative indirect effects for the students being overchallenged with the effect in German being non-significant (German: $\beta_{indirect} = -0.03$, $p = .051$; French: $\beta_{indirect} = -0.10$, $p < .001$; mathematics: $\beta_{indirect} = -0.09$, $p < .001$). For the students who reported feeling underchallenged this indirect effects were also negative in all three academic domains (German: $\beta_{indirect} = -0.03$, $p < .05$; French: $\beta_{indirect} = -0.07$, $p < .001$; mathematics: $\beta_{indirect} = -0.05$, $p < .01$). Results additionally revealed negative total effects of overchallenge on students' career aspirations in all three domains (German: $\beta_{total} = -0.33$, $p < .001$; French: $\beta_{total} = -0.47$, $p < .001$; mathematics: $\beta_{total} = -0.37$, $p < .001$), whereas the total effects of underchallenge on students' career aspirations were positive, again, in all three domains (German: $\beta_{total} = 0.15$, $p < .01$; French: $\beta_{total} = 0.16$, $p < .001$; mathematics: $\beta_{total} = 0.16$, $p < .001$).

7. Discussion

Focusing on students' different achievement levels and dealing with heterogeneous classrooms represents a central issue that teachers and school systems are confronted with (Gröhlich, Scharenberg, & Bos, 2009). Our study focused on students' being over- or underchallenged as an aspect of heterogeneity, specifically considering influences on students' career aspirations. Thereby, we examined two key motivational and emotional variables – academic self-concept and boredom – mediating this important effect. As such, we investigated the complex interrelations of domain-specific challenge, academic self-concept, and boredom, and considered mechanisms through which these variables, alone and in constellation, may predict students' career aspirations. The proposed relations were studied in three different school domains, namely, German, French, and mathematics to enhance the generalizability and validity of the results. Furthermore, students' career aspirations were assessed two weeks after the assessment of domain-specific challenge, academic self-concept, and academic trait boredom to reduce possible response biases on these aspirations due to the data collection beforehand.

Across the three school domains, the results of our study were consistent, with a relatively high proportion of students reporting feelings of non-adequate challenge. This high proportion of non-adequately challenged students seems to be of special relevance not only for our study but also to student engagement and achievement at school in general (Alexander, Entwisle, & Horsey, 1997; Fredricks, Blumenfeld, & Paris, 2004; Strati et al., 2017). We could show that the highest reported frequency of overchallenge arose in the domain of mathematics (42.4%), and we found the highest reported level of underchallenge in the domain of German (18.9%). Consequently, in our study more students reported feelings of overchallenge compared to underchallenge, especially in the domain of mathematics, which is generally experienced as a relatively difficult domain (Haag & Goetz, 2012). This very high frequency of overchallenged students, especially in mathematics, is somehow alarming as we could additionally show the negative consequences on students' academic self-concept and their boredom experiences. In line with these frequencies, we found that academic boredom was prevalent among the underchallenged students in German ($M = 3.38$, $SD = 1.18$) and French ($M = 3.38$, $SD = 1.03$) classes, whereas the level of boredom experiences for the overchallenged students in mathematics was relatively low ($M = 2.82$, $SD = 1.09$).

The results of our study showed a stable influence of being over- as well as underchallenged at school on students' career aspirations via the two mediators of academic self-concept and academic trait boredom. When it comes to the reported overchallenge, the effects of this experience were consistently negative. That is, in all three school domains being overchallenged reduced students' intentions to go into related fields via academic self-concept and boredom. More specifically, overchallenged students had a lower domain-specific academic self-concept, which was connected with a decreased intention to start a career in a corresponding domain. From a motivational perspective, experiences of (over-)challenge are discussed to differ in their behavioral consequences depending on their interpretation as being either motivating or threatening (e.g., Csikszentmihalyi, 1990; Strati et al., 2017); our results support the second interpretation. Even more importantly (and to our knowledge the current study was the first one to show that) we could demonstrate that the same was true for academic trait boredom: overchallenged students reported significantly higher levels of boredom experiences compared to optimally challenged students and boredom, in turn, reduced students' intention to start a career in related fields. Studies that investigated boredom resulting from being overchallenged are scarce (for exceptions see Acee et al., 2010; Preckel et al., 2010; Sparfeldt, Buch, Kolender, & Rost, 2011). Our study extended results of these investigations and examined links between students' academic trait boredom and their reported overchallenge. This is a critical finding considering the relatively high frequency of overchallenged students in our study. We also showed that the negative indirect effect of overchallenge on career aspirations via the boredom accumulated with the negative indirect effect of overchallenge on students' career aspirations via academic self-concept. One can see that the negative indirect effect of overchallenge via academic self-concept was lower than the total negative indirect effect of overchallenge on career aspirations (see Table 5). This was true for all three domains. Importantly, this finding means that boredom should be taken into account when considering effects of overchallenge on career aspirations.

The effects of being underchallenged were shown to be more complex: Whereas the indirect effect of perceived underchallenge on career aspirations via academic self-concept (accounting for academic trait boredom) was a positive one, the indirect effect on career aspirations via boredom (accounting for academic self-concept) was negative. That is, underchallenged students had a higher academic self-concept, which may have resulted in an increased intention to start a career in a related field. On the other hand, these underchallenged students reported more academic boredom, which reduced their intention to make occupational choices in corresponding domains. Thus, the influence of boredom significantly reduced career aspirations for the underchallenged students, although the total effect of students' perceived underchallenge was still slightly positive due to the strong influence of students' academic self-concepts. It appears that academic trait boredom has a crucial additional effect on students' career aspirations, which, in the case of the underchallenged students, runs contrary to the effect of academic self-concept. As such, this influence may be of special importance for gifted students as they probably feel underchallenged more frequently (e.g., Rogers, 2007) and their resulting boredom experiences due to being underchallenged are higher in frequency and intensity than those due to being overchallenged (Preckel et al., 2010). These students are not able to optimally utilize their cognitive resources, and as a result experience negative emotional experiences that often go unnoticed (Preckel et al., 2010). Despite the fact that underchallenge may result in a higher academic self-concept, gifted students may not go into specific occupational fields driven by avoidance motivation and in an attempt to avoid feeling perpetually bored (e.g., Atkinson, 1957; Covington & Beery, 1976; Elliot, 1999; Goetz & Hall, 2014; Pekrun et al., 2010).

In addition to revealing evidence that supported our main hypotheses, our findings demonstrated a substantial direct link between being underchallenged and students' respective career aspirations in the domains of French and mathematics, even after taking academic self-concept and boredom into account. These results suggest that there could be additional moderating or mediating variables explaining the positive relation between students' reported underchallenge and their career aspirations. For example, motive strength (Gollwitzer, 1990) could moderate the link between being underchallenged and career aspirations independently from one's academic self-concept and the feeling of being bored in the respective field (Braver et al., 2014). Additionally, achievement goals may explain the link between the level of challenge and career aspirations. Students who report feeling underchallenged and who have performance-approach goal orientation may have a strong aspiration to go into related fields, whereas underchallenged students who have a strong mastery-approach orientation may prefer more challenging career paths (Elliot, 2005; Pekrun, Elliot, & Maier, 2009). Furthermore, these different goal structures could influence the perception of challenge itself (Darnon, Butera, Mugny, Quiamzade, & Hulleman, 2009; Tanaka & Murayama, 2014). As a result, it seems worthwhile to examine these additional moderators in future studies. At the same time, due to the fact that French and mathematics are generally experienced as very difficult school domains (Graham, 2002; Haag & Goetz, 2012), it also seems plausible that there remains, in fact, a direct effect of being underchallenged on career aspirations related to French and mathematics. A career in a relatively difficult, but highly prestigious field – especially in a math-related domain – could be considered as desirable for cognitively underchallenged students independently from their level of domain-specific academic self-concept and their general tendencies to feel bored in the respective domain.

Our study demonstrated the critical effect of students' being over- and underchallenged on their respective career aspirations, and examined motivational and affective variables that may mediate these contingencies. Feeling overchallenged in a specific domain produced a negative effect on students' career aspirations via academic self-concept, and the tendency to feel bored due to overchallenge strengthened this negative indirect link. The effect of being underchallenged is important also as it lowers students' career aspirations due to the detrimental effect of perpetual boredom – despite its positive effects on students' academic self-concept. In sum, the experience of perpetual boredom in school settings plays an important role for students' career aspirations in both groups of students' – the under- and the overchallenged ones. This is an important result as, quite sadly, boredom is one of the most frequently experienced emotions in academic settings (Goetz & Hall, 2014).

8. Limitations of the study, implications, and future directions

In our study, domain-specific challenge was measured by a single item indexing students' perceived difficulty in German, French, and mathematics classes and being over- and underchallenged, in turn, was operationalized with two dummy-coded items. Although this approach has been proven effective in past research (e.g., Cohen, 1968; Hardy & Reynolds, 2009), such operationalization is limited. Specifically, this manifest approach includes score unreliability, and the respective measurement errors are not explicitly represented (Kline, 2011). Hence, future studies should assess domain specific challenge in a more elaborate way. First of all, a full scale with several indicators should be included to enable separation of the true score and the error variance and thus, probably improving the reliability of the measure. Second, assessments should include measures of students' actual and perceived cognitive capabilities as well as their perceived and actual task difficulty. This way, a comparison of subjective as well as objective measures and the investigation of their respective benefit as predictors for motivational and other constructs would be possible. Due to the fact that the latter approach may prove difficult to utilize in a classroom, including more items to gauge students' perceptions of challenge would be a more straightforward solution.

We assessed all of the study variables via a questionnaire-based trait assessment asking students about their general evaluation of domain-specific challenge, academic self-concept, and academic boredom experiences. Future studies could include state assessments – as momentary in-situation measurements – to get information of the actual situational condition of the subjects, for example, via experience sampling methods (e.g., Bieg et al., 2014; Larson & Csikszentmihalyi, 1983; Trull & Ebner-Priemer, 2009). In particular, research focusing simultaneously on students' cognitive capabilities, their momentary state of challenge as well as their perceived task difficulty would be a boon to all researchers and educators alike. Furthermore, due to the fact that emotions could also differ on a more situational level (e.g., Buehler & McFarland, 2001) and boredom as a construct is often viewed as a transient state (e.g., Eastwood et al., 2012), future studies would benefit from situational state assessments of boredom. These assessments should more closely reflect the actual momentary emotional experiences (e.g., Eid, Schneider, & Schwenkmezger, 1999) in comparison to the investigation of general, habitual trait-assessments of emotions, influenced by subjective beliefs (e.g., Robinson & Clore, 2002).

The proposed relations of challenge, academic self-concept, academic trait boredom, and career aspirations were tested with one sample of Swiss high school students from the eleventh grade. As such, the results are not generalizable to younger students and across different countries. The effects have to be tested in additional studies with samples differing in age and with samples from other countries. Nevertheless, we could show stable correlations across three different school domains indicating a relatively stable pattern of results. One notable exception was the missing indirect effect via boredom in German classes, which could be explained by the relatively weak effect of boredom on students' career aspirations in this domain. Studies with different age groups but in German-speaking countries are needed to further investigate this effect in German classes.

Additionally, our hypotheses were tested with a cross-sectional data set that does not allow for causal interpretations of the proposed relationships. Hence, a sufficient testing of the proposed mediation was not possible. However, we assessed students' career aspirations two weeks after the assessment of domain-specific challenge, academic trait boredom, and academic self-concept, and thus can very cautiously speculate about the level of challenge, academic self-concept, and boredom influencing student career aspirations (Acee et al., 2010; Durik et al., 2006; Schunk & Pajares, 2005; Wigfield et al., 2002). Future research may investigate complex interrelations of domain-specific challenge, academic self-concept, boredom, and career aspirations with longitudinal data, which will allow for directional conclusions. This way, investigating long-term influences of students' perceived challenge on their future career choice could also be possible.

Students' perceived degree of challenge, academic self-concept, and emotional experiences are – at least to a certain degree – malleable. Intervention studies aiming at enhancing students' self-concepts already exist (for an overview see O'Mara, Marsh, Craven, & Debus, 2006), but programs reducing students' boredom experiences in classroom settings are still lacking and are urgently needed. Our study revealed a negative influence of domain-specific boredom experiences in school on students' career aspirations. Hence, it is safe to speculate that there could also be a negative influence of academic boredom on students' future career choice (Bandura, Barbaranelli, Caprara, & Pastorelli, 2001). Teaching students how to cope effectively with their boredom experiences (Nett et al., 2010) to circumvent the negative consequences of this emotion would be of great practical significance. Additionally, intervention studies informing students about differences regarding task demands in school domains or academic domains in general versus task demands in later occupations could be of use. This kind of intervention could be of special importance for gifted students experiencing a high level of boredom at school in specific domains. These students should be advised that experiences of boredom, for example, in French classes do not mean that all occupations that require French language competencies would be equally boring.

Finally, in a classically structured teacher-oriented instructional setting, the perfect fit between the difficulty level of a learning task and every student's ability level would be virtually impossible to attain (Goetz & Hall, 2014). This is probably one of the reasons why boredom in the classroom is one of the most frequently experienced emotions in an academic setting, occurring across different ages, subjects, and countries (e.g., Csikszentmihalyi & Larson, 1984; Larson & Richards, 1991; for an overview see Goetz & Hall, 2014). To overcome this problem, more adaptive classroom environments that allow students to modify tasks depending on their actual and perceived ability levels along with more self-regulated learning approaches should be devised. Fostering open classroom environments through the application of didactic concepts shaped by a more constructivist view on learning along with a more consistent integration of flexible e-learning elements could prevent negative influences of non-adequate challenges for students who feel frequently under- or overchallenged. This, in turn, will help with adequate development of students' career aspirations (e.g., Green & Gredler, 2002; Huang, 2002). After all, career aspirations and subsequent career choice play a crucial role not only from purely educational, but also from an economical perspective. Our study suggests that heterogeneity aspects in the classroom could have an important influence on such aspirations via students' academic self-concepts and their experience of academic boredom.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.lindif.2018.10.004.

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