British Journal of Educational Psychology (2013), 83, 252–266

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The developmental trajectory of perceived self-regulation, personal interest, and general achievement throughout high school: A longitudinal study

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Background. Our interest in perceived self-regulation of learning arose in the context of educational reform. After decades of stability, the Finnish high school system underwent reform in the 1990s, with a significant emphasis being placed on promoting student self-regulation of learning.

Aims. The purposes of the study were (1) to evaluate changes in the mean level of perceived self-regulation throughout high school and (2) to evaluate the nature of the developmental relations between achievement, perceived self-regulation, and personal interest.

Sample. The participants consisted of 245 systematically sampled high school students from a mid-sized Finnish city.

Methods. *T* tests for paired samples were employed to assess changes in the level of personal interest and perceived self-regulation. Analysis of the developmental relations was carried out within a structural equations modelling framework.

Results. The main result was that perceived self-regulation at the beginning of high school predicted not only scholastic achievement at the end of high school over and above prior achievement, but also subsequent personal interest. Additionally, following an international trend, the level of perceived self-regulation decreased from the first to third year of study.

Conclusions. The study has important theoretical and practical implications. First, the results suggest that perceived self-regulation and personal interest are only partially explained by achievement. Second, it appears that perceived self-regulation drives personal interest, not the other way around. Finally, ways for teachers and schools to sustain perceived self-regulation throughout the high school years are discussed.

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DOI:10.1111/bjep.12014

Our interest in perceived self-regulation of learning arose in the context of educational reform of the Finnish general upper secondary school ('high school'). After decades of stability, the system underwent reform in the 1990s, with a significant emphasis being placed on promoting student self-regulation of learning. First and foremost, high school became non-graded, which meant that the curriculum, which was formerly studied in 3 years, could now, at least in principle, be completed in 2–4 years. The second innovation was adopting intensive 8-week teaching blocks. Third, much emphasis was placed on promoting personalized learning paths. It was presumed that, in such a context, self-regulation of learning, coupled with personal interest, would assume a central role in predicting student achievement. Further, it was expected that such a context would be conducive to promoting self-regulation of learning and personal interest in the same way as many higher education environments. Understanding how perceived self-regulation and personal interest develop has been limited, because investigators of these patterns have only recently begun working with longitudinal designs (Vanthournout, Donche, Gijbels, & van Petegem, 2011). Thus, the purposes of the present study were to compare the level of perceived self-regulation across time in a novel context following reform and to unravel the developmental relations between achievement, perceived self-regulation, and personal interest in order to test various theoretical viewpoints.

Overview of research

Self-regulated and self-directed learning

Self-regulation and self-directed learning have their unique roots in educational psychology and adult education, which must be traced to frame the subsequent empirical analysis. In the domain of adult education, Tough (1967) provided the first comprehensive descriptions of self-directed learning based on a study of the self-planned learning projects of Canadian adults. Subsequently, Knowles (1975) defined self-directedness in relation to external direction (i.e., teacher or parent direction). Moving to the field of educational psychology, most models of self-regulated learning, a term adopted in the 1980s to refer to self-regulation in academic settings, incorporated aspects of metacognition and self-regulation (Dinsmore, Alexander, & Loughlin, 2008). Metacognition ('thinking about thinking') emerged as a concept in the 1970s and was introduced in the writings of Flavell (1971), who emphasized introspection. The understanding of self-regulation, in turn, was heavily influenced by the work of Bandura (1977) and originally focused on behavioural and emotional regulation. It was emphasized that the act of self-regulation does not occur without the interaction of the person with the environment. Despite differences in emphasis, there appears to be agreement that self-directed or self-regulated students plan, set goals, organize, self-monitor, and self-evaluate during the process of studying. To the observer, self-regulating students are 'self-starters who display extraordinary effort and persistence during learning' (Zimmerman, 1989, p. 5).

In this study, self-regulation is defined in relation to external regulation and lack of regulation (cf. Vermunt & Vermetten, 2004). A distinction is made between regulation of content and regulation of process and results. Self-regulation of process and results refers to regulating one's own learning processes through regulation activities such as planning learning activities, monitoring progress, diagnosing problems, testing one's outcomes, adjusting, and reflecting, whereas self-regulation of content refers to consulting literature and sources outside the syllabus.

Based on the measures used, studies on self-regulated or self-directed learning fall into roughly two categories: dynamic and static. Dynamic studies rely on detailed, online measures of self-regulation such as trace and think-aloud measures (Ainley & Patrick, 2006; Azevedo & Cromley, 2004), whereas static studies rely on data, which are extracted from some form of retrospective accounts exemplified by research incorporating Bandura's Multidimensional Scale of Perceived Academic Efficacy (1990), the Self-regulated Learning Interview Schedule developed by Zimmerman and Martinez-Pons (1986), certain scales of the Motivated Strategies for Learning Questionnaire developed by Pintrich, Smith, Garcia, and McKeachie (1991), or the inventory of learning styles (ILS; Vermunt, 1994). Although critics have argued that self-regulation may be elusive prey to such static measures (see Veenman, Prins, & Verheij, 2003) or that evidence points to the fact that self-perceptions are reactive rather than causal (Zimmerman & Schunk, 2001, p. 294), proponents have argued that belief in one's ability to self-regulate may actually be the point, because it may provide 'the staying power in the face of difficulties' (Caprara *et al.*, 2008, p. 526). It is beyond the scope of the present study to determine the degree to which perceived self-regulation overlaps with actual self-regulation of learning. However, it will be tested whether perceived self-regulation influences scholastic achievement over and above previous achievement, which would support a view that perceived self-regulation is not merely a reaction to past achievement, but a reason behind future achievement.

Personal interest

In the past, motivation and self-regulation tended to be studied independently. There is, however, an increasing awareness that they need to be examined together (cf. Schunk & Zimmerman, 2008). Early work exploring the relation between academic achievement and interest was based on three traditions: (1) measuring interest in particular interest categories (e.g., science) and relating it to course work in the same domain; (2) attempting to assess whether interests of any kind (e.g., social) are predictive of academic performance; and (3) assessing whether certain abstract characteristics such as clarity of interests, their intensity, and so forth would have a bearing upon achievement. According to the review by Lavin (1965), all of these pursuits had proved to be fruitful.

In the present study, personal interest is defined in relation to vocational orientation, certificate orientation (i.e., extrinsic), self-test orientation, and ambivalent orientation. Personal interest refers to studying out of general interest in course subjects and developing oneself as a person. Other authors have referred to essentially the same thing using the constructs of intrinsic value or intrinsic motivation. Vocational orientation refers to studying to acquire professional skills. Certificate orientation refers to striving for grades and credit points, to pass examinations, and to get a degree. Self-test orientation refers to studying to test one's capabilities to cope with the demands of education. Ambivalent orientation reflects a doubtful, uncertain attitude towards school, one's capabilities, and the chosen school type (Vermunt & Vermetten, 2004). They are not viewed as discrete phenomena, but as continuous dimensions that do not exclude each other.

Certain prominent investigators stress that because 'students are not omnivorous', interest should be viewed as a domain-specific construct (Schiefele, Krapp, & Winteler, 1992, p. 207). However, as students are expected to be rather omnivorous in the context examined, it does make sense to examine personal interest towards studying in high

school in general. Lonka, Olkinuora, and Mäkinen (2004) stress the importance of making a distinction between different levels of (motivational) orientations: curriculum-wide (i.e., general), domain or course specific, and situation specific. In this study, we are referring to the general level.

The developmental course of perceived self-regulation, personal interest, and achievement

Several groups have investigated the *level* of self-reported self-regulation by comparing sets of means and the *stability* of the construct by examining autocorrelations: Caprara *et al.* (2008) reported a decline in the level of self-efficacy for self-regulation in a sample (N = 412) of Italian students aged 12–18. As for stability, the authors reported separate pairwise correlations for males (.58) and for females (.81) from 16 to 18 years of age. Heater (2005) studied the development of a range of affective, cognitive, and metacognitive factors including intrinsic value and perceived self-regulation and their relation to classroom goal structure among a cohort of Canadian students (N = 699). Results indicated a decrease in both the level of intrinsic value and the level of self-reported self-regulation from sixth to eighth grade.[1] These students were from 11 to 13 years of age. Interestingly, increases in perceived self-regulation measured by the ILS or meaning directedness[2] can, to our knowledge, only been found in the domain of higher education (For a review, see Vanthournout *et al.*, 2011).

Several authors have also addressed the level and stability of intrinsic motivation. Gottfried, Fleming, and Gottfried (2001), based on a longitudinal study of 130 North American students aged 9–17, obtained a significant decreasing trend for intrinsic motivation, but it was found to be modified by subject area. It was also shown that with advancement in age, academic intrinsic motivation became increasingly stable. Another longitudinal study examining the motivation of 646 Canadian students from grades 8, 9, and 10 revealed that both intrinsic and extrinsic motivation gradually decreased (Otis, Grouzet, & Pelletier, 2005). Intrinsic value also decreased in the longitudinal study by Heater (2005).

Other authors have examined the relationship between perceived self-regulation or interest and achievement. Several studies from different countries have reported a positive correlation between perceived self-regulation and (university) Grade point average in the order of .15 to .20 (Boyle, Duffy, & Dunleavy, 2003; Heikkilä & Lonka, 2006; Vermunt, 2005). Quite impressively, Minnaert and Janssen (1999) were even able to show that perception of self-regulation is not a mere reflection of intelligence, but an additive factor contributing to academic performance in the freshman year at university. As for interest, Schiefele *et al.* (1992) in their review reported interest–achievement correlations in the order of .30 for most school subjects examined, but observed 'an almost total lack of studies testing causal inferences' (Schiefele et al., 1992, p. 207).

Indeed, few attempts have been made to unravel the *developmental trajectory* of perceived self-regulation or interest and achievement, which requires collecting longitudinal data and modelling it with an approach permitting causal inference such as structural equations modelling. A notable exception is the study by Caprara *et al.* (2008), the results of which indicated that self-regulatory efficacy may contribute to high school grades and retention in school after controlling for prior achievement. Rather

[1] *Heater (2005) reported a stability coefficient (i.e., retest reliability) of .71 for self-regulation, but the measurements were taken only 3 months apart.*

[2] *Meaning-directedness is a broader concept than self-regulation: it is characterized by a high level of self-regulation, high personal interest, and a knowledge construction view of learning.*

surprisingly, another issue addressed infrequently is the interplay of the elements of learning patterns such as perceived self-regulation and personal interest (for a notable exception using cross-sectional data, see Law & Meyer, 2008). According to the theoretical framework proposed by Vermunt (1998), (self)-regulation is central in the learning process: it should drive processing and, ultimately, achievement, whereas orientations (along with conceptions of learning) are expected to fuel regulation and processing. A long line of research has established that personal interest is the orientation related to *self*-regulation (Boyle *et al.*, 2003; Vermunt, 2005; Vermunt & Vermetten, 2004). However, it remains unclear how perceived self-regulation and achievement, on the one hand, and interest and achievement, on the other, interact with each other across time. More specifically, is perceived self-regulation merely a 'reaction' to previous academic success ('I do well in school, so I must be a self-regulated student') or does it make a unique contribution to subsequent success? Additionally, does personal interest at the outset actually drive (perceived) self-regulation and subsequent achievement? These are among the questions, unanswered to date, which we attempt to answer by a 2-wave longitudinal study of the development of high school students' perceived self-regulation and personal interest, which are modelled both as a consequence and as an antecedent of achievement.

Aims, purposes, and hypotheses

Thus, the purposes of the study are (1) to evaluate changes in the mean level of perceived self-regulation in an interesting, novel context: Finnish upper secondary school following reform in which self-regulation and personal interest had a central place; and (2) to unravel the developmental relations between achievement, perceived self-regulation, and personal interest.

We propose the following set of hypotheses:

(1) The mean of perceived self-regulation is expected to decrease, as in other phases in the educational system, as reported in the Overview of Research.
(2) A positive structural relation is expected between self-regulation at Time 1 and Time 2; that is, students reporting low levels of self-regulation in comparison with other students in the beginning of high school are expected to report relatively low levels in the third year (cf. Caprara *et al.*, 2008).
(3) Perceived self-regulation is expected to be reactive to achievement (Zimmerman & Schunk, 2001). As noted earlier, based on earlier research, the causal relation between achievement and personal interest is unclear. We presumed that students with consistently lower grades in comprehensive school would be less interested in high school than high achievers.
(4) In line with Caprara *et al.* (2008) on self-regulatory efficacy and contrary to Zimmerman and Schunk (2001), it is expected that perceived self-regulation will make a unique contribution to final scholastic achievement over and above prior scholastic performance.
(5) Personal interest is expected to predict self-regulation (Vermunt, 1998). In addition, personal interest is expected to have a direct effect on achievement (cf. Vermunt, 1998, 2005). Concurrent measures of self-regulation and personal interest are expected to correlate (Boyle *et al.*, 2003). Finally, a positive structural relation is expected between personal interest at Time 1 and Time 2 (cf. Gottfried *et al.*, 2001).

The structural relations are summarized in Figure 1.

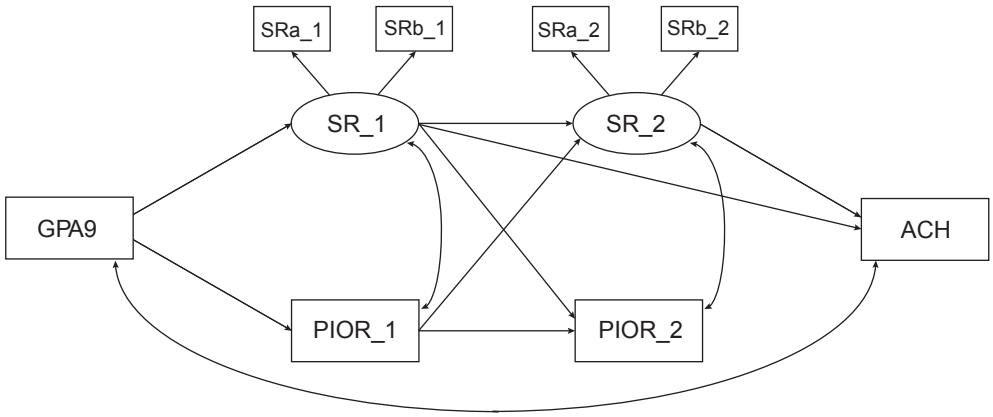

Figure 1. The expected model: Model 1 (ACH = total score on matriculation examination [or final GPA or score on examination of native language], SR = self-regulation, SRa = self-regulation of process and results, SRb = self-regulation of results, PIOR = personal interest orientation, GPA_9 = ninth-grade GPA, suffix_1 = at Time 1, suffix_2 = at Time 2). The regular arrows depict positive causal relations, and the arrows with two spears indicate a correlation.

Method

Population, the educational system, and the matriculation examination

The population of this study consisted of all first-year students from all municipal ($N_{students}$ = 985; $N_{schools}$ = 10) general upper secondary schools providing instruction to primarily adolescents (vs. adults) in Finnish in 2004 in a mid-sized Finnish city. Two characteristics of the Finnish secondary education system are worth noting (see Helle & Klemelä, 2010). In Finland, secondary education is part of post-compulsory education, which is divided into general upper secondary school and vocational education. Approximately one half of each cohort enters general upper secondary education, which is the traditional route to higher education, at 16 years of age. General upper secondary education leads to the national matriculation examination.

The matriculation examination consists of a minimum of four parts measuring knowledge, skills, and maturity in different subjects. The examination in the students' native language and literature is mandatory. The candidate chooses three other compulsory tests from among the following four: a test in the second national language, a foreign language test, a mathematics test, and one test in the general studies battery of tests (sciences and humanities; Matriculation Exam Board, n.d.). The parts need not be taken all at once, but may be spaced during a 1.5-year interval. The examination takes place at schools according to precise regulations stipulated by the national board. Each examination lasts for 6 hours. As for grading, the objective is that each year's results conform to a normal distribution (Matriculation Exam Board, 2006).

The matriculation examination can be considered a better measure of final achievement than high school GPA, as high school GPA is the grade point average of all courses taken during high school.

Sampling and data collection procedure

The sampling strategy was to choose every third 1st-year student in alphabetical order (N = 368). Data were collected by administering a set of two surveys during the school

day. The first survey was administered 2 months after the beginning of high school when the students were, on average, 16 years old. The second survey was administered 2 years later. The number of students who filled in the questionnaire twice was 245 (142 girls and 103 boys). Thirty-seven students dropped out of school before follow-up questioning, and 46 students failed to fill in the questionnaire a second time.

Consent for conducting the study was applied for and granted by the local school authority. The researchers explained to the students that responses to the questionnaires would be confidential and that they could refrain from answering at any stage.

Materials

The students' self-regulation strategies and learning orientations were assessed using the ILS. The ILS was originally constructed in the context of a research project on university students' regulation of learning (Vermunt, 1992). The final version contains 120 statements covering four components: (1) cognitive processing strategies; (2) metacognitive regulation strategies; (3) conceptions of learning; and (4) learning orientations. In this study, we measured (metacognitive) regulation strategies and learning orientations, which are described in detail in Table 1. Self-regulation of learning processes and results contained six items (α = .74/.79); self-regulation of learning content contained three items (α = .64/.73); and personal interest orientation contained three items (α = .50/.61). Based on a confirmatory factor analysis of the present data, students were able to distinguish between the four different types of regulation (see Table 2 for fit indices), but failed to distinguish between the five types of orientations (model did not converge).

In addition, the students' matriculation examination results and final GPA (i.e., average of all grades) were used as indices of student achievement. These data were obtained

Table 1. Regulation and orientation scales of the inventory of learning styles (ILS)

Parts and scales of the ILS	Description of content
Regulation strategies	
Self-regulation	
Learning process and outcomes	Regulating one's own learning processes through regulation activities such as planning learning activities, monitoring progress, diagnosing problems, testing one's outcomes, adjusting, and reflecting
Learning contents	Consulting literature and sources outside the syllabus
External regulation	
Learning process and outcomes	Letting one's own learning processes be regulated by external sources, such as introductions, learning objectives, directions, tests, questions, or assignments provided by teachers or textbook authors
Lack of regulation	Monitoring difficulties with the regulation of one's own learning processes
Learning orientations	
Personal interest	Studying out of interest in the course subjects and to develop oneself as a person
Certificate oriented	Striving for grades and credit points, to pass examinations, and to get a degree
Self-test oriented	Studying to test one's own capabilities and to prove to oneself and others that one is able to cope with the demands of education
Vocation oriented	Studying to acquire professional skill and to obtain a(nother) job
Ambivalent	A doubtful, uncertain attitude towards school, one's own capabilities, the chosen school type, etc.

Table 2. Fit indices for a confirmatory factor analyses (four-factor solution of types of regulation)

CFA	χ^2 (*df*)	CFI	TLI	RMSEA	SRMR
Time 1	330.31 (183)	.85	.83	.05	.07
Time 2	263.69 (183)	.91	.90	.05	.07

Notes. CFI = comparative fit index; TLI = Tucker–Lewis fit index; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual.

directly from the schools. Furthermore, there were student reports regarding their ninth-grade GPA based on the first survey. For the result on the matriculation examination, two indices were used: general scholastic achievement as measured by the total number of points obtained, which reflects the number of subjects chosen for the examination as well as performance, and performance on the test of native language (Finnish or Swedish), as this is the only test taken by all students.

Analyses

T tests for paired samples were employed to assess changes in the level of personal interest and perceived self-regulation. Analysis of the developmental model (Model 1) was carried out within a structural equations modelling framework using Mplus (version 6.1; Muthén & Muthén, Los Angeles, CA, USA). Prior to inclusion, the distributions of all variables and their correlations were examined for conformity to parametric and multivariate assumptions (see Table 3).

The analyses of the expected developmental model were conducted in two phases. First, the expected model (Model 1) was specified, as indicated in Figure 1. Second, as all of the predicted relations did not hold and the modification indices suggested adding new relations, the model was re-specified (Model 2) and tested in relation to all three dependent variables (total score on matriculation examination, high school GPA, and score on native language in the matriculation examination).

Table 3. Sample statistics (N = 244): means, variances, and intercorrelations of variables

Measure	GPA_9	SRa_1	SRb_1	PIOR_1	SRa_2	SRb_2	PIOR_2	ACH
Means	8.686	2.598	2.221	3.153	2.489	2.079	3.087	26.580
Variances	.398	.509	.587	.467	.593	.586	.558	78.585
Correlations								
GPA_9	–							
SRa_1	.166	–						
SRb_1	.159	.518	–					
PIOR_1	.214	.386	.323	–				
SRa_2	.012	.491	.249	.223	–			
SRb_2	.144	.336	.408	.194	.570	–		
PIOR_2	.189	.260	.243	.417	.432	.442	–	
ACH	.613	.156	.057	.188	.179	.220	.267	–

Notes. SRa = self-regulation of process and results; SRb = self-regulation of content; PIOR = personal interest orientation; ACH = total score on matriculation examination; GPA_9 = ninth-grade GPA; suffix_1 = at Time 1; suffix_2 = at Time 2.
N.B. Standard deviations can be calculated by taking the square root of the variances.

Estimation was based on full information maximum likelihood (FIML) with robust standard errors (MLR; Little & Rubin, 2002; Muthén & Muthén, 1998–2010). The goodness-of-fit of the models was assessed by the use of the following indicators: comparative fit index and Tucker–Lewis fit index (CFI and TLI: values range between 0 and 1 and should be >.90, but preferably >.95, Hu & Bentler, 1999); root mean square error of approximation (RMSEA; values .05 or below indicate a good model, Brown & Cudeck, 1993); the standardized root mean square residual (SRMR; values .05 or below indicate a good model, Jöreskog & Sörbom, 1996); and model fit chi-square. As the chi-square is known to be inflated by sample size leading to solutions being routinely rejected even when differences between the expected model and the data are negligible, in this study, values of <2 or 3 times the degrees of freedom were considered to indicate reasonable fit. Nested models were compared using Satorra–Bentler scaled chi-square difference tests (ΔS-Bχ^2).

Results

The level of perceived self-regulation and personal interest throughout high school

First, results based on *T* tests for paired samples indicated that both aspects of perceived self-regulation were reported to *decrease* from the beginning to the end of high school. Personal interest also decreased slightly, but not to a statistically significant extent. Self-regulation of learning processes and results decreased from $M = 2.60$ ($SD = 0.71$) to $M = 2.48$ ($SD = 0.77$), and this effect was statistically significant, $t(244) = 2.33$, $p = .02$. Additionally, self-regulation of content decreased from $M = 2.22$ ($SD = 0.77$) to $M = 2.08$ ($SD = 0.77$), and the effect was statistically significant, $t(244) = 2.60$, $p = .01$. A further analysis revealed that male students reported a statistically significant decrease in these measures, whereas female students did not. In the case of male students, self-regulation of learning processes and results decreased from $M = 2.52$ ($SD = 0.66$) to $M = 2.35$ ($SD = 0.72$), and this effect was statistically significant, $t(102) = 2.35$, $p = .02$. Self-regulation of content decreased from $M = 2.20$ ($SD = 0.80$) to $M = 1.99$ ($SD = 0.74$), and the effect was statistically significant, $t(102) = 2.18$, $p = .03$.

Nature of the developmental relationship between achievement, perceived self-regulation, and personal interest

The expected model

Testing of the expected model in Figure 1 using total score of matriculation examination as the dependent variable revealed some scope for improvement in Model 1. Two expected paths turned out to be non-significant: the path from personal interest at Time 2 to achievement and the path from personal interest at Time 1 to self-regulation at Time 2. Additionally, the path from self-regulation at Time 1 to achievement was non-significant, suggesting a lack of a direct relationship between the two variables. Furthermore, the fit indices suggested less than an ideal fit with the data ($\chi^2(11) = 19.88$, $p = .05$, CFI = .98, TLI = .99, RMSEA = .06, SRMR = .04). Inspection of the modification indices revealed a possible relation from self-regulation at Time 1 to personal interest at Time 2.

The re-specified model (Model 2)

The model was subsequently re-specified by removing the non-significant relations and adding a path from self-regulation at Time 1 to personal interest at Time 2 (See Figure 2). As the relations in the model were to some extent different, depending on the measure of scholastic achievement used (matriculation examination total score, score for native

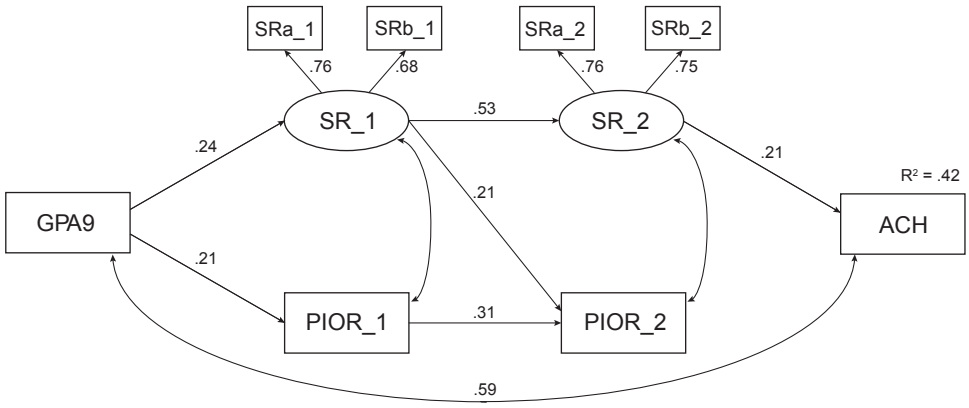

Figure 2. The re-specified model: Model 2 (ACH = total score on matriculation examination, SR = self-regulation, SRa = self-regulation of process and results, SRb = self-regulation of results, PIOR = personal interest orientation, GPA_9 = ninth-grade GPA, suffix_1 = at Time 1, suffix_2 = at Time 2).

language, high school GPA), the results of the three models will be reported separately. In each model, the loadings of the self-regulation subscales were set equal across time (metric invariance).

First, we examined the model predicting the total number of points on the matriculation examination. According to the model, past scholastic achievement (self-reported ninth-grade GPA) was by far the most significant predictor of matriculation examination performance (β = .59), which could be expected. In addition, the path from ninth-grade GPA to perceived self-regulation at Time 1 was statistically significant (β = .24), as expected. In a similar vein, the path from ninth-grade GPA to personal interest at Time 1 turned out statistically significant (β = .21). Perceived self-regulation and personal interest, self-regulation in particular, both manifested continuity from the very beginning of high school to the beginning of the third year (β = .53; β = .31). Perceived self-regulation at Time 2 proved to be a rather modest, but statistically significant predictor of performance on the matriculation examination (β = .21). Furthermore, the standardized specific indirect effect from perceived self-regulation at Time 1 and performance on the matriculation examination proved to be statistically significant (β = .11, $t = 3.49$, $p < .001$). The newly added relation SR_1-<PIOR_2 was statistically significant (β = .21). Thus, perceived self-regulation at the outset not only promoted perceived self-regulation in the long run and achievement, indirectly, but also personal interest in the long run as well. The model accounted for 42% of the variance of the dependent variable, and the fit indices suggested a good fit between the model and the data ($\chi^2(14) = 18.31$, $p = .19$, CFI = .99, TLI = .98, RMSEA = .04, SRMR = .03). In the model, the assumption of metric invariance was checked and it was supported (ΔS-B$\chi^2(1) = .95$, $p = .33$).

As the score of the test of native language, the only mandatory subject on the matriculation examination, is considered the best index for interstudent comparison, Model 2 was tested using this score as the dependent variable. As the dependent variable was not an index of *general* achievement, the model accounted for less variance of the dependent variable (31%). However, fit indices suggested a good fit between the model and the data ($\chi^2(14) = 21.53$, $p = .09$, CFI = .98, TLI = .97, RMSEA = .05, SRMR = .03). In addition, all model parameters were statistically significant.

The model was also tested using final high school GPA as the dependent variable. As expected, the model accounted for more variance of the dependent variable than the other models (57%), and the fit indices suggested a good fit between the model and the data ($\chi^2(14) = 18.83$, $p = .17$, CFI = .99, TLI = .98, RMSEA = .04, SRMR = .03). Additionally, all model parameters were statistically significant.

Finally, we checked that the three models applied for both male and female students. The models predicting total score on the matriculation examination and native language were more applicable to male students, whereas the model predicting GPA was more fitting for female students.

Discussion

The study aimed to explore, first, changes in the mean level of perceived self-regulation and personal interest from the beginning to the third year of high school and, secondly, the nature of the developmental course of personal interest, self-regulation, and achievement over the high school years within a cognitive mediation framework.

Hypothesis 1 received confirmation: perceived self-regulation decreased from the beginning of high school to the beginning of the third year, and this applied to male students in particular. Also, Hypothesis 2 received confirmation: the relatively high autoregression coefficient of perceived self-regulation indicated stability in individual differences. This is in line with the results of Caprara *et al.* (2008) who reported stability in individual differences in self-regulatory efficacy among Italian high school students (from 16 to 18 years). The combination of decreasing means and stability of individual differences implies that students who are low in perceived self-regulation of learning in the beginning of their studies are at risk to be at an even lower level 2 years later. The fact that the level of perceived self-regulation decreased is in line with similar findings from elementary to high school in different parts of the world (e.g., Caprara *et al.*, 2008; Heater, 2005; Mok, Fan, & Pang, 2007; Pajares & Valiante, 2002). Nevertheless, the result is definitely *not* in line with the spirit of the national high school reform. Additionally, Hypothesis 3 received confirmation: perceived self-regulation and personal interest were (to a small extent) reactive to prior achievement. The fact that perceived self-regulation was reactive to achievement was in line with the claim by Zimmerman and Schunk (2011). In addition, our presumption that personal interest could also be reactive to prior achievement received confirmation.

Furthermore, Hypothesis 4 received confirmation: perceived self-regulation at the very beginning of high school had an (indirect) effect on general high school achievement over and above previous achievement. We emphasize that this is an important new finding as the finding by Caprara *et al.* (2008) pertained to self-regulatory efficacy. The finding implies that perceived self-regulation is not a mere reaction to previous achievement as suggested by Zimmerman and Schunk (2001).

However, the predictions regarding the role of personal interest stated in Hypothesis 5 did not hold: the finding that perceived self-regulation predicted personal interest, and not the other way around as expected by theory (Vermunt, 1998), was an unexpected finding. In fact, it raises the question of why perceived self-regulation should promote personal interest. We see two possible explanations. First, it is likely that students, who perceive themselves as self-regulated learners, actually engage in self-regulated learning. This is an intrinsically rewarding experience, which may perpetuate increasing levels of motivation. Alternatively, as originally suggested by Sansone, Weir, Harpster, and Morgan (1992), these students may engage in strategies to make (school) tasks more interesting, resulting,

over time, in a redefinition of the intrinsic value of the tasks (for a review, see Hidi & Ainley, 2008).

Before moving to the implications of the study, we would like to acknowledge its main limitations. First, results pertain to a population that started in high school in 2004. Although there have not been any significant changes in the educational system nor the curriculum since then, we acknowledge that the present generation of adolescents may differ from the adolescents of 2004 in important ways. Characteristic of the new generation is that it has grown up with different forms of social media such as Facebook and Twitter. Although we suspect that the basic relations between scholastic achievement, personal interest, and self-regulation still hold, it may be increasingly difficult to hold the attention of the new high school generation with traditional instructional methods. Second, personal interest was measured by a small number of items resulting in low reliability, especially at Time 1. In part, this was due to the fact that all translations of the English items did not function in the new context, resulting in the discarding of certain items. In addition, as the confirmatory factory analysis revealed, the orientation part of the ILS is not the ideal choice for high school students. These students obviously do not have the variety of learning orientations that more mature students exhibit. A more simple measure of intrinsic versus extrinsic motivation is recommended. The personal interest measure could also be complemented by some domain-specific measures.

Third, we acknowledge that personal interest and perceived self-regulation are likely to be highly domain specific and particularly vulnerable in mathematics and science (see Gottfried *et al.*, 2001). What could be done to facilitate smoother transitions *across* subjects? We emphasize that there is no quick-fix solution. Remedial instruction is needed for those who are falling behind in a particular subject. Moreover, from the point of view of intrinsic motivation, the curriculum could allow for less mandatory courses and more personalized learning paths, a view shared by both the student union and an expert committee (Ministry of Education, 2010). Finally, integrated themes (e.g., evolution of the Baltic Sea) could allow for more exploration and challenge for students and teachers alike than the current focus on teaching individual courses. Multidisciplinary is being gradually promoted by the recent introduction of questions of multidisciplinary nature into the matriculation examination. The expert committee of the Ministry of Education is also proposing the grouping of individual subjects into larger entities. Finally, an important direction for future research is to include measures of co-regulation into the research design (e.g., Efklides, 2008; Volet, Summers, & Thurman, 2009).

There are three theoretical implications of the study. First, the results underscore the centrality of perceived self-regulation (cf. Law & Meyer, 2008): not only did perceived self-regulation measured at the beginning of high school have an effect on ultimate achievement in high school (over and above prior achievement), but it also had an affective effect (i.e., impact on personal interest 2 years later). Second, the results suggest that perceived self-regulation and personal interest are only partially explained by achievement: (1) the path coefficients from ninth-grade GPA to perceived self-regulation and interest are rather modest (in the order of .20); and (2) perceived self-regulation makes a unique contribution to subsequent achievement over and above ninth-grade GPA. Third, the results suggest that perceived self-regulation may impact subsequent personal interest rather than the other way around. If this is, indeed, the case, the model by Vermunt (1998) needs to be modified. However, we need to stress that further research is needed to disentangle the developmental course of various elements.

The study also has important practical implications. First, that students are currently recruited into high school solely on the basis of previous grades appears to be a flawed

procedure. Softer approaches incorporating perceived self-regulation could complement student selection, although social desirability is an issue that would have to be addressed. Second, it is rather concerning that, throughout the world, perceived self-regulation of learning appears to decrease throughout schooling. We urge teachers and schools to keep promoting perceived self-regulation throughout the high school years. It is assumed that this requires training of self-regulatory competences (Sanz de Acedo Lizarraga, Ugarte, Cardelle-Elawar, Iriarte, & Sanz de Acedo Baquedano, 2003) along with experiences of successful application coupled with an emphasis on autonomy support and challenging the students by a gradual increase in the level of self-regulation required by school tasks (Lüftenegger *et al.*, 2012; Vermunt, 2007). However, based on the results, it may also be necessary to take measures to increase the level of personal interest by, for example, reducing the number of mandatory subjects and putting increasing emphasis on personalized learning paths as perceived self-regulation and personal interest go hand in hand. The dilemma is that the ideal of a broad liberal arts education for every student may be threatened.

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Received 23 July 2012; revised version received 1 March 2013