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Academic self-regulation as a function of age: the mediating role of autonomy support and differentiation in school

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Abstract Numerous studies in the tradition of the self-determination theory (Deci and Ryan in Can Psychol 49(1):14–23, 2008) point out the significance of self-determined academic motivation and its relevance for learning processes and well-being. Whereas these results sketch a rather heterogeneous picture of the development of intrinsic and extrinsic motivation, only a limited amount of research results are dedicated to the development of academic self-regulation. This cross-sectional research is based on the data of 432 pupils aged 6–20 from primary to secondary school. With the aid of questionnaires, participants provided information concerning their academic self-regulation and how much autonomy support and differentiation they perceive in school. The results of cluster analysis and structural equation modelling indicated that age is negatively related to academic self-regulation, while intrinsic and (rather) controlled regulation decreased the older the pupils are. The values for rather self-determined regulation remained comparatively stable. In addition, the longer pupils attended school, the less they reported perceived autonomy support and differentiation. Perceived autonomy support had an impact on intrinsic and rather self-determined regulation but not on controlled regulation, whereas perceived differentiation was not related to academic self-regulation. These findings offer novel explanations why settings in schools—

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especially in secondary schools—can become less suitable for learners (Eccles and Roeser in *Handbook of adolescent psychology*, Wiley, Hoboken, pp 404–434, 2009) and how they can assist educators in designing autonomous learning environments that contribute to maintaining and developing intrinsic and self-determined academic regulation strategies.

Keywords Self-determination · Autonomous learning environments · Pupils' motivation

1 Introduction

Self-determined motivation is associated with successful learning and well-being in schools and is therefore an important subject of interest in educational psychology. Empirical research has proven that pupils' intrinsic motivation tends to decrease during their time in school, an effect that has been identified across various subjects (Fischer and Rustemeyer 2007; Gottfried et al. 2001). In addition to intrinsic motivation, pupils' self-perception and perceived task values decline throughout their time in school, a downward trend of subject-related interest that starts in primary school and continues through secondary school (Fredricks and Eccles 2002; Jacobs et al. 2002). The motivation to learn is to a certain extent a variable concept that is influenced by the content and the context in school (Heikkilä and Lonka 2006). A mismatch between pupils' changing needs and the learning environments offered (especially in secondary schools) can have a serious impact on the development of pupils' motivation and self-regulation (Watt 2004). Learning opportunities that foster self-determination are conducive to maintaining and developing intrinsic and autonomous types of motivation (Ratelle et al. 2007), and autonomy supportive environments in schools can help mitigate the decrease in intrinsic motivation (Gottfried et al. 2001).

1.1 Academic self-regulation

One key concern is maintaining and developing pupils' intrinsic motivation in school. Intrinsic and autonomous regulation is linked to perceived competence and better school performance (Benware and Deci 1984; Fortier et al. 1995; Velki 2011). Learners are intrinsically motivated when the activity itself is interesting and spontaneously satisfying. Extrinsic motivation involves engaging in an activity because it leads to desirable separate consequences (Deci and Ryan 2008). The concept of academic self-regulation differentiates types of behavioural regulation in terms of the degree to which they represent autonomous or self-determined functioning. SDT proposes a multidimensional conceptualisation of motivation that postulates the existence of four forms of extrinsic motivation: external, introjected, integrated and identified regulation (Deci and Ryan 2002). Pupils act in an autonomously motivated fashion when they behave with a full sense of volition and choice. Intrinsic motivation is the prototype for autonomous motivation, whereas controlled motivation involves acting due to pressure and external demands. Pupils

strive to act in accordance with their intrinsic motivation, but when they are confronted with uninteresting yet important activities, they are inherently motivated to internalise their behaviour regulation (Ryan and Deci 2002). Learners may be able to accept the importance of a behaviour for themselves (identified regulation), or they might manage to integrate an identification with other aspects of their true or integrated self (integrated regulation). Identified and integrated regulations are relatively autonomous. However, pupils sometimes engage in school activities because they take in external contingency, demand or regulation, but they do not accept it as their own (introjected regulation). Introjection is quite controlled, yet the most controlled type of motivation is externally regulated behaviour—when learners act due to external forces, e.g. in order to obtain a tangible reward or to avoid punishment (Ryan and Connell 1989; Deci and Ryan 2011).

Research has repeatedly found higher scores for intrinsic motivation in elementary students in comparison to adolescents in secondary schools (Lepper et al. 2005; Corpus et al. 2009). One reason for this might be that secondary school environments tend to provide suboptimal learning contexts for pupils (Anderman and Maehr 1994; Eccles and Roeser 2009). Patterns for the development of extrinsic motivation seem to be less clear: Some studies report relative stability (Harter et al. 1992; Lepper et al. 2005), while others have found a decrease in the different forms of extrinsic motivation across academic years (Otis et al. 2005; Corpus et al. 2009). Gillet et al. (2012) documented a decrease in intrinsic and autonomous extrinsic motivation until the age of 15 and an increase after that point, whereas for controlled extrinsic motivation, students exhibited a decrease up to 12 years, with a stabilisation thereafter. Similarly to the last-mentioned findings, we expected to find a general decrease of self-determined regulation from primary to secondary school in the present study, but an upward trend at the end of secondary school, if pupils gain more learning opportunities to choose for themselves, also seemed plausible to us.

One explanation for these inconsistent trends might be that teachers offer different levels of autonomy support and control in schools and this has an influence on pupils' motivation and self-regulation. In the classroom, teachers have a verifiable impact on the motivational climate (Stornes et al. 2008; Hattie 2009; Gillet et al. 2012). Perceived autonomy support promotes internalisation and autonomous self-regulation (Deci et al. 1994; Reeve et al. 1999; Reeve et al. 2003; Ommundsen and KvalØ 2007), whereas a controlling climate is associated with controlled self-regulation (Deci et al. 1981; Flink et al. 1990).

1.2 Autonomy support and differentiation in schools

Pupils experience autonomy in school when they can act in a self-organised and volitional way (Ryan and Deci 2013). Autonomy-supportive learning environments in schools are positively related to a wide range of important educational variables, including higher intrinsic motivation (Reeve et al. 2003), greater perceived competence (Deci et al. 1981), preference for optimal challenge (Boggiano et al. 1988), higher mastery motivation (Ryan and Grolnick 1986), increased conceptual understanding (Benware and Deci 1984), active and deeper information processing

(Grolnick and Ryan 1987; Vansteenkiste et al. 2004), greater engagement (Reeve et al. 2004; Grolnick et al. 2007), positive emotionality (Patrick et al. 1993; Ryan and Connell 1989), enhanced well-being (Black and Deci 2000; Levesque et al. 2004), better academic achievement (Boggiano et al. 1993; Grolnick et al. 1991; Miserandino 1996; Guay and Vallerand 1996) and academic persistence rather than dropping out (Vallerand et al. 1997).

Interestingly, in school settings, it can sometimes be difficult to remember that pupils have a natural desire to learn and that educators can build on their curiosity. Teachers are often involuntarily driven by external influences, such as the constraints of the curriculum and pressure to meet educational standards (Pelletier et al. 2002); this can distract their attention from their pupils' needs. Teachers must act as mediators between external demands and the individual interests and learning abilities of their students. Autonomy-supportive learning environments offer the opportunity to consider both aspects by stressing the influence of social contexts and connecting motivational resources with academic challenges. Studies have shown that teachers' autonomy support has an impact on students' autonomous motivation (Reeve 2002) at the elementary level (Ryan and Grolnick 1986; Assor et al. 2005), secondary level (Trouilloud et al. 2006) and at university level (Williams and Deci 1996). Educators who seek to foster self-determined learning match relevant topics and tasks to the inner motivational resources of their pupils and offer flexible learning opportunities with a variety of meaningful choices. In other words, they focus on differentiation and individualization in their lessons. Autonomy support requires a learner-centred approach and differentiated teaching (McCombs and Miller 2007; Waterman 2005). Differentiated and autonomy supportive teaching behaviour is supported by the conscious use of language and an empathetic attitude towards pupils (Tomlinson 1999; Ryan and Deci 2002; Reeve 2006). An autonomy-supportive and differentiated teaching style fosters intrinsic motivation and the autonomous internalisation of educational activities (Chirkov et al. 2003; Guay et al. 2008) and thus promotes self-determined forms of academic self-regulation.

The aim of this study is to analyse pupils' intrinsic and extrinsic academic self-regulation from the age of 6–20 years with a special focus on perceived autonomy and differentiation in school. Pupils' perceptions of learning environments are a significant predictor of their motivation and achievement (Fischer and Rustemeyer 2007). In our research, we concentrated on pupils' perceptions concerning autonomy support and differentiation in the classroom and how these perceptions relate to academic self-regulation. According to self-determination theory (SDT; Deci and Ryan 2008, 2012), pupils who experience more autonomy support and differentiated tutoring should tend to regulate their learning processes in a more autonomous way. In a longitudinal study of pupils from primary to high school, Ratelle and Duchesne (2014) determined that developmental patterns for the school-related satisfaction of needs for autonomy, competence and relatedness were fairly heterogeneous, but when these needs were reasonably satisfied, pupils reported better adjustment in school. In line with the stage-environment fit model (Eccles and Roeser 2009) it is possible that the autonomy support offered in schools might vary depending on the age of pupils. Teachers probably react—and unintentionally contribute—to the decreasing intrinsic motivation of their students by increasing

coercive pressure and reducing autonomy (Assor et al. 2005). As a result, the longer pupils attend school, the less autonomy they experience. To obtain evidence for this assumption, we collected cross-sectional data from pupils at the beginning of primary school right through to the end of secondary school.

1.3 The present research

The present cross-sectional study focuses on pupils' academic self-regulation from childhood to late adolescence and the mediating role of autonomy support and differentiation in school. The first purpose was to analyse autonomous and controlled academic self-regulation from the age of 6–20 years. In line with past research (Lepper et al. 2005; Otis et al. 2005; Corpus et al. 2009; Gillet et al. 2012), we expected higher scores for intrinsic and autonomous self-regulation in primary school and in the final years of secondary schools, and more controlled forms of self-regulation for the 11–15 year old pupils. Therefore, corresponding with the study by Gillet et al. (2012), a quadratic trend was tested next to the linear trend as well. The second purpose of this study was to assess perceived autonomy support and differentiation from primary school right through secondary school by also analyzing linear and quadratic trends. In the light of past results (Jacobs et al. 2002; Eccles and Roeser 2009), we expected that pupils in primary schools would perceive more autonomy support than pupils in secondary schools. However, bearing the findings of Gillet et al. (2012) in mind, it might be the case that pupils once again begin having more options and choices at the end of secondary school and therefore perceive more autonomy with regard to their schoolwork. Finally, the third purpose of the present research was to use structural equation modelling to test the mediating role of perceived autonomy support and differentiation concerning the age-school self-regulation relationship. We hypothesised negative trends between age and perceived autonomy support and differentiation. In accordance with SDT, we expected that autonomy support and perceived differentiation would be conducive to academic self-regulation (Guay et al. 2008) and, in turn, perceived that autonomy support and differentiation should be positively related to intrinsic and autonomous self-regulation and negatively related to controlled self-regulation (Ryan and Grolnick 1986; Chirkov et al. 2003).

2 Method

2.1 Participants and procedure

In total, 432 pupils aged between 6 and 20 years from one primary school and one secondary school in Austria participated in this study called AGASAD (Age, Academic Self-Regulation, Autonomy Support and Differentiation). As age is essential information for all analyses, 15 students were excluded from the analyses because they did not specify their age; furthermore, we excluded four learners, as we had no information about their self-regulation strategies at all. For this reason, 413 students ($M = 12.31$ years, $SD = 3.63$ years, $Min = 6$ years, $Max = 20$ years) remained in the database.

Pupils answered questions concerning perceptions of autonomy support, perceived differentiation and self-regulation strategies. Young learners in primary school completed the questionnaire with the help of qualified interviewers who read out each item to ensure proper understanding. In primary school a simplified version of the questionnaire was used but items were comparable for all three constructs.

2.2 Measures

2.2.1 Perceived autonomy support

Students' perceived autonomy support was assessed with a 6-item-scale (short version for primary school) or with a 15-item-scale (original version for lower and higher secondary) translated from the Learning Climate Questionnaire (Deci and Ryan 2014). The items completed by the primary school pupils corresponded with six items completed by the lower and higher secondary school pupils and where therefore used for analysis. Answers were given on a 5-point-Likert-scale ranging from "strongly disagree" (1) to "strongly agree" (5). Mean scores were calculated over the six remaining items for primary school and lower and higher secondary school pupils.

We conducted an exploratory factor analysis using principal components analysis for the six remaining items appearing in both questionnaires. One factor with an eigenvalue higher than one was retained explaining 41 % of the variance. Factor loadings ranged from .42 to .75. A confirmatory factor analysis revealed that the one-factor-model reflected the data (CFI = .90, NFI = .90, RMSEA = .08). The respective reliabilities in this sample were $\alpha = .70$.

2.2.2 Perceived differentiation

Students' perceived differentiation was assessed using three items (primary school) or four items (lower and higher secondary) adapted from the PISA 2009 student questionnaires (BIFIE 2010) and specifically chosen for learning contexts of these schools. Participants responded to items on a 3-point scale from "seldom" (1) to "mostly" (3) in primary school and on a 5-point scale from "strongly disagree" (1) to "strongly agree" (5) in lower and higher secondary. The three items completed by the primary school pupils corresponded to three items completed by the lower and higher secondary school pupils. To be able to do analyses over all ages, we adapted the 5-point scale to the 3-point scale in primary school. Mean scores were calculated over the three identical items for all pupils.

We conducted an exploratory factor analysis using principal components analysis for the six remaining items appearing in both questionnaires. One factor with an eigenvalue higher than one was retained explaining 42 % of the variance. Factor loadings ranged from .49 to .73.

A confirmatory factor analysis could not be conducted, as items were measured on a 3-point-scale and one item "all students get the same homework" had not enough variance when taking the 3-point-scale. Cronbachs α of .61 is low but

acceptable (in literature, Cronbachs α is .73 for the original questionnaire items, see Mayr et al. 2010).

2.2.3 *Self-regulation strategies*

Students' self-regulation strategies were assessed using 12 items (primary school) or 16 items (lower and higher secondary) adapted from Müller et al. (2007) based on the Academic Self-Regulation Questionnaire according to Ryan and Connell (1989). The items completed by the primary school pupils corresponded to 12 items completed by the lower and higher secondary school pupils. Answers were given on a 5-point-Likert-scale ranging from "not at all true" (1) to "very true" (5). The original scale from Müller et al. (2007) contains four different types of self-regulation strategies: Intrinsic regulation, identified regulation, introjected regulation and external regulation. Like Ryan and Connell (1989) integrated regulation is not assessed as a subscale because it is very difficult especially with younger children to differentiate intrinsic and integrated regulation on an empirical level (Vallerand et al. 1992). As correlation between introjected regulation and external regulation was very high (r = .45 in our study, in literature c.p. Müller et al. 2007 correlation is even .56), we summarized the items of these two subscales to one scale "(rather) controlled regulation". Thus, we constructed three scales, called

Table 1 Means (M) and standard deviations (SD) on all items

	M	SD
Autonomy_I1	2.50	1.16
Autonomy_I2	3.81	1.04
Autonomy_I3	4.19	.94
Autonomy_I4	3.92	1.08
Autonomy_I5	3.26	1.18
Autonomy_I6	2.99	1.14
Differentiation_I1	1.07	.31
Differentiation_I2	1.30	.58
Differentiation_I3	2.18	.81
Intrinsic Selfregulation_I1	3.08	1.36
Intrinsic Selfregulation_I2	4.00	1.11
Intrinsic Selfregulation_I3	2.95	1.47
Rather self -determined regulation_I1	4.67	.72
Rather self -determined regulation_I2	4.69	.76
Rather self -determined regulation_I3	4.26	1.06
(Rather) controlled regulation_I1	3.20	1.40
(Rather) controlled regulation_I2	3.15	1.40
(Rather) controlled regulation_I3	2.75	1.42
(Rather) controlled regulation_I4	3.50	1.32
(Rather) controlled regulation_I5	2.53	1.44
(Rather) controlled regulation_I6	4.00	1.20

Items for differentiation are measured on a 3-point scale; all other items are measured on a 5-point scale

intrinsic regulation, rather self-determined regulation (=identified regulation) and (rather) controlled regulation (=introjected and external regulation). We calculated mean scores for each of the three regulation strategies (three items for intrinsic regulation, three items for rather self-determined regulation and six items for (rather) controlled regulation).

We conducted an exploratory factor analysis using principal components analysis for the twelve remaining items appearing in both questionnaires. Three factors with an eigenvalue higher than one were retained explaining 56 % of the variance. Loadings were acceptable for all three scales. A confirmatory factor analysis revealed that the three-factor-model reflected the data (CFI = .92, NFI = .89, RMSEA = .08). Cronbachs α is with .70 on average acceptable (in literature, Cronbachs α ranges from .75 for extrinsic regulation to .92 for intrinsic regulation, see Müller et al. 2007) (Table 1).

2.2.4 Data analysis

As pupils were clustered in classes, we considered the interclass-correlations for all three constructs in calculating a random intercept and random slope mixed model. ICC was low for all constructs and most of the variance was explained on individual level. This means that differences between classes were comparable to differences within classes and, therefore, that children within classes were almost as similar to each other as children between classes. We thus analysed both self-regulation as well as perceived autonomy support and differentiation as a function of age related to the individual level.

First, relationships between students' ages and self-regulation strategies (intrinsic, rather self-determined and [rather] controlled regulation) were examined. Second, pupils' perceptions of perceived autonomy support and differentiation in school was inspected. Finally, the mediating role of perceived autonomy support and differentiation in the age—self-regulation relationships was explored. These analyses were performed using structural equation modelling with M PLUS 7.4. As Chi-square statistics are dependent on sample size and correlation sizes (Kline 2005), we suggested using the CFI, the NNFI, the RMSEA and the SRMR (in case data are complete) to estimate model fit. According to Hu and Bentler (1999), the CFI should be about .95, the RMSEA should be smaller than .06 and the SRMR should be smaller than .11.

3 Results

Age is significantly and negatively correlated with self-regulation strategies ($-.48 < r < -.23$), self-regulation strategies among each other are significantly and positively correlated ($.31 < r < .40$) as well as perceived autonomy support and perceived differentiation ($r = .37$). Self-regulation strategies correlate also positively with perceived autonomy support ($.17 < r < .38$) and with perceived differentiation ($.20 < r < .34$).

Means, standard deviations and correlations among all variables used in the study appear in Table 2.

3.1 Self-regulation as a function of age

To analyse whether the decrease in self-regulation strategies (see above) with age is linear, we first conducted descriptive analyses and modelled the relationship between age and self-regulation strategies. Results revealed that there is a stronger decrease in intrinsic regulation and in (rather) controlled self-regulation with age compared to the decrease of rather self-determined regulation. With respect to the gradients, we observed a linear trend for all three self-regulation strategies (Fig. 1).

Calculating a linear structural equation model with age as observed variable and self-regulation strategies as latent variables with three (intrinsic regulation and rather self-determined regulation) and six [(rather) controlled regulation] indicators and covariance paths between intrinsic regulation and rather self-determined regulation and between rather self-determined regulation and (rather) controlled regulation, we get acceptable fit to the data (CFI = .97, NNFI = .97, RMSEA = .14, SRMR = .04).

Age is negatively correlated to all self-regulation strategies. The older pupils are, the lower the scores concerning academic self-regulation ($\beta = -.48$, $p = .000$ for intrinsic regulation, $\beta = -.23$, $p = .000$ for rather self-determined regulation and $\beta = -.40$, $p = .000$ for [rather] controlled regulation) (Fig. 2).

In a similar survey, Gillet et al. (2012) found that age was linearly and negatively related to intrinsic motivation and non self-determined extrinsic motivation, but age was quadratically and positively related to intrinsic motivation, self-determined extrinsic motivation and non self-determined extrinsic motivation, and further analyses revealed a differentiated development concerning motivation starting with the age of 12 years. Building on these results on academic motivation, we sought to

Table 2 Means, standard deviations and correlations among all study variables

Variables	M	SD	1	2	3	4	5	6
1. Age	12.31	3.63		−.48**	−.23**	−.40**	−.23**	−.44**
2. Intrinsic Regulation	3.34	1.15		.67	.40**	.31**	.38**	.34**
3. Rather self-determined regulation	4.53	.62			.59	.20**	.34**	.20**
4. (Rather) controlled regulation	3.64	.65				.74	.17**	.22**
5. Perceived autonomy support	3.45	.66					.71	.37**
6. Perceived differentiation	1.52	.39						.54

KMO-coefficients are shown in the diagonal (scores >.5 mean, that items can be factorised, see Janssen and Laatz 2010); Items for differentiation are measured on a 3-point scale; all other items are measured on a 5-point scale

* $p < .05$, ** $p < .001$

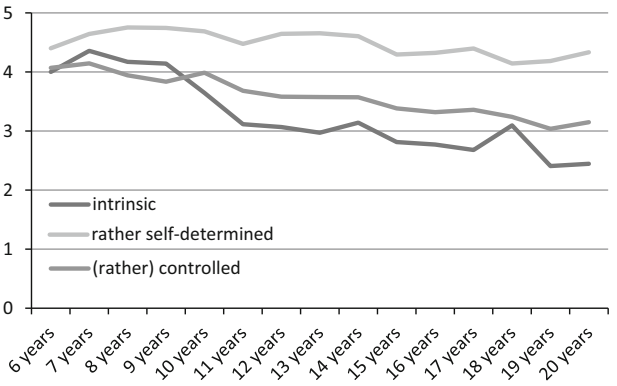

Fig. 1 Regulation strategies and age—linearity check

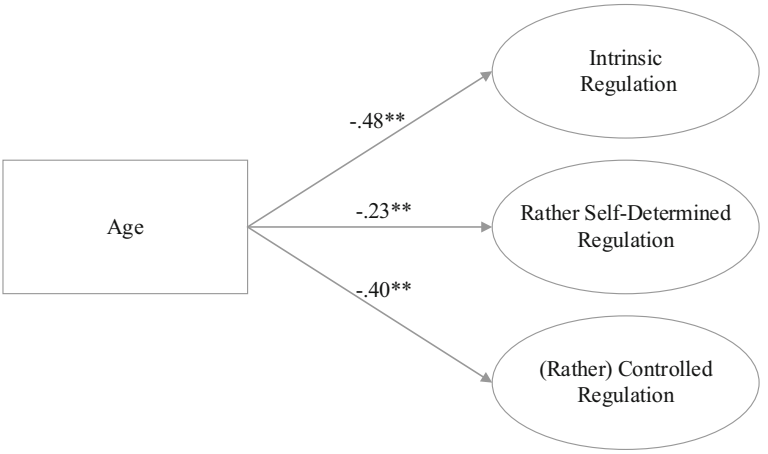

Fig. 2 Regulation strategies as a function of age (model 1, $^{**}p < .01$)

determine if a similar pattern concerning academic self-regulation could be observed and therefore analysed the relations with age as a squared variable as well.

For this reason, the second model tested in the present study was composed of two observed (age and quadratic age) and three latent variables (self-regulation strategies) with three indicators for two of the latent variables (intrinsic regulation and rather self-determined regulation) and six indicators for one of the latent variables [(rather) controlled regulation]. Six paths were specified between age/quadratic age and the three defined self-regulation strategies; furthermore covariance paths among self-regulation types were estimated.

The model had acceptable but worse fit to the data (CFI = .92, NNFI = .90, RMSEA = .10) than the model taking only linear age into account. Explained variance is best when calculating a linear model. Furthermore, the Akaike information criterion and Bayesian information criterion scores were worse for the

second model, meaning that quadratic age is not an appropriate predictor variable, which can also be seen in the descriptive analysis. For this reason, this model is not reported in a figure.

3.2 Perceived autonomy support and perceived differentiation as a function of age

To analyse whether the decrease in perceived autonomy and in perceived differentiation with age is linear, we conducted descriptive analyses and modelled the relationship between age and perceived autonomy as well as between age and perceived differentiation. Results revealed that there is a decrease in both perceived autonomy support and perceived differentiation. Regarding the gradients, we observe a linear trend for both constructs (Fig. 3).

The third model tested in this study was therefore composed of one observed (age) and two latent variables with six indicators (perceived autonomy) and three indicators (perceived differentiation). Two paths were specified. Furthermore, covariance paths between autonomy and differentiation were estimated. Model fit was acceptable (CFI = .95, NNFI = .94, RMSEA = .08).

Age is negatively correlated to perceived autonomy support and to perceived differentiation. The older pupils are, the lower they score when asked for perceived autonomy support and for perceived differentiation ($\beta = -.23$, $p = .000$ for perceived autonomy support and $\beta = -.44$, $p = .000$ for perceived differentiation) (Fig. 4).

3.3 Perceived autonomy support and perceived differentiation as a mediator for self-regulation

The fourth model tested in the present study served to analyse a possible mediating effect of perceived autonomy support and differentiation. The model was composed

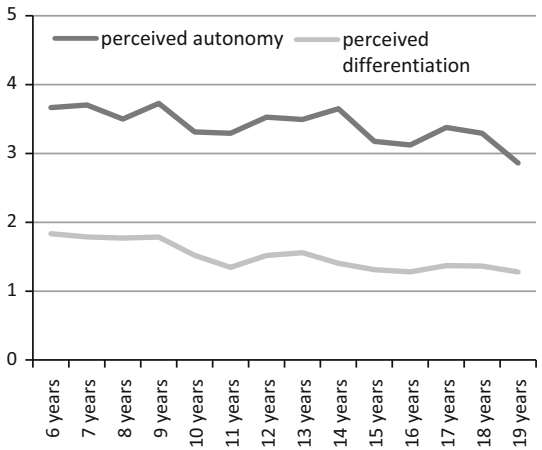

Fig. 3 Perceived autonomy/perceived differentiation and age—linearity check

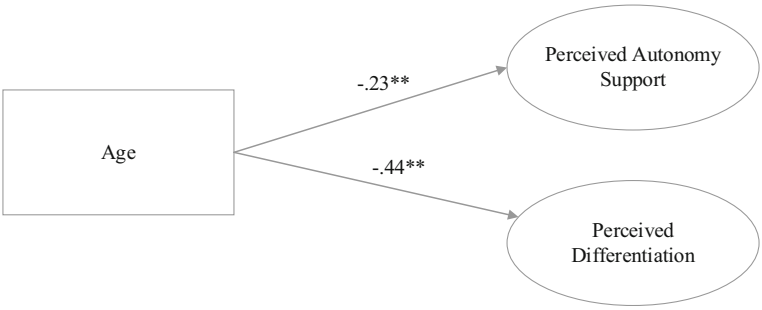

Fig. 4 Perceived autonomy support and perceived differentiation as a function of age (model 3, $^{**}p < .01$)

of one observed (age) and five latent variables with three indicators for intrinsic, rather self-determined regulation and for perceived differentiation, six indicators for (rather) controlled regulation and for perceived autonomy support. Ten paths were specified: four between age and autonomy/differentiation and six between autonomy/differentiation and the three self-regulation strategies (intrinsic, rather self-determined and (rather) controlled strategies). Furthermore, covariance paths between the three types of self-regulation strategies and among autonomy support and perceived differentiation were estimated. The model had acceptable fit to the data (CFI = .98, NNFI = .98, RMSEA = .13, SRMR = .03) (Fig. 5).

Results revealed that perceived autonomy is a mediator between age and intrinsic and rather self-determined regulation. Perceived autonomy support had no mediating role considering the relationship between age and (rather) controlled regulation. Perceived differentiation did not mediate the age—self-regulation relationship.

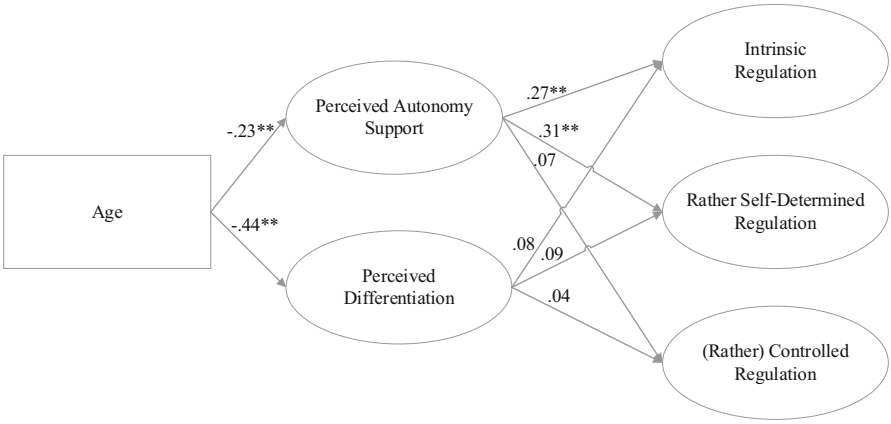

Fig. 5 The mediating role of perceived autonomy support and perceived differentiation in the development of academic self-regulation (model 4, $^{**}p < .01$)

We also did a hierarchical cluster-analysis to compare groups of students with regard to their self-regulation strategies. We reached best fit when building two clusters: Students in cluster one have high scores in perceived autonomy and perceived differentiation, students in cluster two have low scores in perceived autonomy and perceived differentiation. Cluster one consists of 210 (50.8 %) students, cluster two includes 203 students (49.2 %). Among primary school pupils, 77.9 % are in cluster one and the remaining 22.1 % belong to cluster two. In lower secondary 47.2 % of the students are allocated in cluster one and in higher secondary only 25.8 % of the pupils remain in cluster one.

To evaluate whether clusters show differences in self-regulation strategies, we conducted a multivariate analysis of variance with cluster as factor and self-regulation strategies as dependent variables. The main effect of group was significant ($F(1,409) = 22.87$, $p = .00$, $\eta^2 = .144$). Self-regulation strategies were significantly higher for cluster one for all self-regulation strategies ($F > 17.93$, $p = .000$, $\eta^2 > .034$). Effect was lowest for (rather) controlled strategies ($F = 14.25$, $\eta^2 = .034$) and highest for intrinsic regulation ($F = 64.23$, $\eta^2 = .135$).

4 Discussion

The main aim of this study based on the self-determination theory was to analyse trends in the academic self-regulation of primary and secondary school pupils and to get empirical evidence for the mediating role of perceived autonomy support and differentiation in class. Similar to studies which focus on intrinsic and extrinsic motivation (Harter et al. 1992; Lepper et al. 2005; Otis et al. 2005; Corpus et al. 2009; Gillet et al. 2012), the results of this research document that self-determined and controlled forms of self-regulation decrease throughout attending school, although by comparison, we found the smallest loss with respect to identified regulation. Pupils also reported that they perceive less autonomy support and differentiation the longer they attend school. This is especially critical as perceived autonomy support was ultimately identified as a mediator in the development of intrinsic and self-determined academic regulation.

4.1 Age effects on academic self-regulation, perceived autonomy support and differentiation

First of all, it is hardly surprising that pupils' intrinsic regulation decreases significantly with their increase in age. Developmental psychology suggests that the increasing availability of formal-operational thinking (Oerter and Dreher 2008) allows adolescents to expound their problems through thought processing. This enables juveniles to step out of the intuitive connection to their surroundings that play a central role in childhood. During this novel configuration process based on the resource of thinking (Kuhl 2010), the readiness to unquestioningly accept a task—such as concerning the aspect as to whether the assignment was chosen by oneself or someone else—is in some ways disturbed. Considering the aspect of intrinsic motivation concerning the absolute implicitness to work on a task without

explicitly switching to thought processing, to feel completely engrossed with what you do and to experience flow and taking the impeding effect of the availability of cognitive thought processing resources into account, can possibly explain why the barriers for an unquestioned involvement with tasks grow more and more in time. From this point of view, it seems clear that intrinsic regulation clearly decreases with age.

Aside from the developmental perspective, these results can, on the one hand, also be discussed in light of the design of (controlling) learning environments and on the other, in terms of the general structure of schools. Findings from educational research and pedagogical psychology indicate that schools—especially secondary schools—do not always provide supportive learning environments for pupils who enjoy a natural and self-determined increase in knowledge and competence (Jacobs et al. 2002; Assor et al. 2005; Jang et al. 2010). This corresponds with the results of our study, which demonstrates that the longer they attend school, the less pupils perceive autonomy support and differentiation. One important reason for this, amongst others, could be the increasing significance of performance reviews perceived as external control through teachers in secondary schools (Eder et al. 2009). Moreover, learning in schools is always learning in groups (qua classes) and within these settings the dynamics of social reference norms—often spontaneously used by pupils and intensified through the behaviour of teachers (Rheinberg 2002)—can lead to individuals exercising influence, although the use of a social reference norm is against school laws in Austria. These reasons seem to impair school-related learning behaviour that involves process-oriented and self-determined behaviour in significant ways. If pupils retain some immunity against an "impression management" in schools—such as highly skilled pupils (Ruble and Flett 1988) and intrinsically motivated learners do—this immunity is put to the test over the course of a school career lasting a decade, and this is reflected in the results of our cross-sectional study.

4.2 Perceived autonomy and differentiation as a mediator

Our study also provides an interesting result with respect to the impact of perceived autonomy support and differentiation on self-regulation. Although older pupils experienced as expected less autonomy support and differentiation in school, only autonomy support affected the self-regulation of learners by supporting their intrinsic and rather self-determined regulation. On the one hand, it is possible that the 3-item-scale for differentiation impaired the reliability of the data, on the other hand, it is also likely that learners, corresponding with research by Mayr et al. (2010), hardly experienced differentiation in schools and therefore this variable had no impact on self-regulation. In summary, these findings stress the importance of autonomy support and its relevance for teaching strategies (Ryan and Deci 2013; Reeve, Nix, and Hamm 2003) and show that the interaction between self-determination and differentiated tutoring requires further research.

A seminal approach aiming to enable pupils to retain their pleasure in learning, their curiosity and their drive to explore new aspects and to contribute to maintaining intrinsic and rather self-determined extrinsic motivation, could be an

integration of strategies for self-determined and differentiated teaching (Martinek 2014) with teachers' support for pupils' self-regulation strategies (Hofmann 2014). Pupils with well-adjusted self-regulation strategies might be more successful to find a balance between their individual interests and goals in school and life and external demands associated with e.g. the curriculum, achievement tests, grades and qualifications, and this could be one reason for the high and rather stable values of identified regulation. School, due to its heteronym structure (Fend 2008), is a constant challenge for the individual internalization and integration of compulsory aims and subjects with individual career expectations and content-based interests. This is reflected in the results for rather controlled motivation which demonstrate that apparently next to rather more self-determined and self-regulated behaviour, pupils also develop compliant behaviour without actively trying to test the compatibility of external requirements with their personal interests and values. Teachers need to be cognisant of their impact on the behavioural regulation of their pupils, because controlled motivation, which has intrapsychic negative consequences in the long run, can be reinforced with teaching strategies. If pupils lose their ability to make self-congruent decisions and to act (rather) self-determined, they face eventually problems when confronted with occupational choices (Eder 2012), where they might tend to follow peers or other external forces like career perspectives or parents' expectations (Deci and Ryan 1985).

4.3 Limitations and future research

The present research requires consideration of some limitations. The cross-sectional design of the study limits the results and causality cannot be inferred. In addition the selectivity of the sample, the covariance between variables and the fact that the data is based only on the perceptions of the pupils and that the survey with primary school pupils was not anonymous need to be considered, when interpreting the results. Another weakness is the conceptualisation of differentiation that needs to be considered in prospective studies. Future longitudinal research integrating objective measures, like observers' reports, could contribute to clarifying the impact of autonomy support and differentiation on self-regulation and furthermore the impact of other social factors on self-regulation, e.g. parental support, influence of peers, organisational and school climate, teachers' level of competence could be analysed (Ryan and Deci 2002). Based on these findings intervention programmes could be developed enabling teachers to better consider their pupils' need for self-determination.

5 Conclusion

An extensive line of research states that learning environments in schools do not always provide ideal opportunities for pupils to learn. The present study documents that pupils perceive less autonomy support, the longer they attend school and it shows that autonomy support plays a central role in maintaining and developing (rather) self-determined regulation, which is considered to be vital for successful

learning (Ratelle et al. 2007). However, further research is required to clarify the interaction of school-related variables and additional factors on pupils' self-regulation and to be able to design supportive intervention programmes for teachers.

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