The Decline of Academic Motivation during Adolescence: An Accelerated Longitudinal Cohort Analysis on the Effect of Psychological Need Satisfaction

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Abstract

Adolescents typically exhibit a marked decline in academic intrinsic motivation throughout their school careers. Following self-determination theory it is hypothesized that traditional school environments insufficiently satisfy three basic psychological needs of youths during maturation, namely the needs for autonomy, competence and relatedness. As a consequence, insufficient need satisfaction might account for the decline in intrinsic academic motivation during adolescence. This hypothesis was tested in an accelerated longitudinal cohort design on $N = 600$ students (286 girls) between 11 and 16 years of age. The results showed that students exhibited a marked decline in intrinsic motivation during adolescence. Moreover, differences in need satisfaction predicted the decline in motivations. These results support the notion that an adequate satisfaction of three basic psychological needs in school is crucial for the maintenance of intrinsic academic motivation during adolescence.

Keywords: intrinsic motivation, basic needs, self-determination theory, adolescence, longitudinal

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Motivational processes play a pivotal role in educational learning and achievement (Bye, Pushkar, & Conway, 2007; Richardson, Abraham, & Bond, 2012). The pursuit of internalized, autonomous motivation promotes, for example, the use of deep processing learning strategies (Rijavec, Saric, & Miljkovic, 2003), higher academic engagement (Otis, Grouzet, & Pelletier, 2005), and even leads to better grades (Lepper, Corpus, Iyengar, 2005). However, despite the importance of intrinsic motivation in school, beginning at an early age academic intrinsic motivation starts to decline (Bouffard, Marcoux, Vezeau, & Bordeleau, 2003; Corpus, McClintic-Gilbert, & Hayenga, 2009; Gottfried, Fleming, & Gottfried, 2001). Following self-determination theory (SDT; Ryan & Deci, 2004), it is hypothesized that this decline can partially be attributed to changes in the satisfaction of three basic psychological needs, the need for autonomy, competence, and relatedness, that are crucial for the development and maintenance of intrinsic motivation. During adolescence school gradually becomes less pivotal in adolescents' cognitive, emotional and social life and, thus, is probably less successful at adequately addressing students' basic needs. In a longitudinal cohort study spanning one year on a sample of teenaged students it is demonstrated that intrinsic motivation remains fairly stable during adolescence when controlling for variations in needs satisfaction.

Academic Intrinsic Motivation and its Decline during Adolescence

Self-determination theory of motivation (Ryan & Deci, 2004) distinguishes a continuum with different qualities of motivation, ranging from non-internalized (external) to more internalized, intrinsic motivation. Whereas the external forms of motivation are primarily driven by some kind of external pressure or reinforcement that are more or less

independent from the specific activity, intrinsic motivation results from the task itself without considering potential consequences. Intrinsically motivated individuals derive enjoyment and positive feelings from the inherent satisfaction of doing rather than from some separable outcomes (Ryan & Deci, 2004).

Intrinsic motivation is a crucial factor in school that holds various desirable ramifications for students, such as the adoption of elaborated learning strategies (e.g. Krapp, 2005; Lam, Cheng Wing Yi, & Ma, 2009; Lepper et al., 2005; Rijavec et al., 2003), better task performance (Grolnick & Ryan, 1987), the experience of positive affect (Bye et al., 2007), and also higher levels of general life satisfaction (Burton, Lydon, D'Alessandro, & Koestner, 2006). Moreover, intrinsic aspirations are significant predictors of high school adjustment in adolescence (Mouratidis, Vansteenkiste, Lens, Michou, & Soenens, 2013). A 3-year longitudinal study (Otis et al., 2005) even identified intrinsic motivation as *the* essential resilience factor that protected students from negative long-term effects associated with the transition from junior to high school. Furthermore, in adulthood greater intrinsic motivation is associated with higher job-satisfaction, innovative performance, and even life satisfaction (e.g., Hammond, Neff, Farr, Schwall, & Zhao, 2011). Overall, pronounced intrinsic motivation is a crucial factor in students' life, influencing not only their academic achievements, but also their lives in general outside school.

Despite the manifold advantages of intrinsic motivation, it does not remain stable throughout adolescence. Typically, it declines with increasing age, beginning as early as elementary school (Bouffard et al., 2003; Corpus et al., 2009; Gottfried et al., 2001). For example, in a cross-sectional sample of students from 3rd to 8th grade, Lepper and colleagues (2005) found the same age differences in intrinsic motivation as Harter (1981) did almost 30 years earlier. Similar results were observed in longitudinal studies: Corpus and colleagues (2009) observed a steady decline of intrinsic motivation in elementary students and

adolescents within one academic year. During childhood and adolescence intrinsic motivation starts to decline from the age of nine and continues up to the age of 16 (Gottfried et al., 2001). The overall pattern of change is similar for general academic motivation and motivations in different domains of academic achievement; although the decline in intrinsic motivation seems to be slightly more pronounced in math and science (Gottfried et al., 2001). A similar trend can be found for related constructs such as students' learning motivations (Spinath & Spinath, 2005), pursuit of mastery goals (Anderman, Maehr, & Midgley, 1999), enjoyment of academic activities (Sansone & Morgan, 1992) and also overall ratings of school's usefulness in general (Wigfield et al., 1997). All studies report a continuous decline of internalized, autonomous motivation throughout students' school careers.

Altogether, the decline of intrinsic motivation during childhood and adolescence can be observed since over three decades in cross-sectional and also longitudinal designs, virtually without contradictory results. However, the reason for the decreasing intrinsic motivation in school is not yet clear. In line with basic needs theory, it is proposed that the observed decline in academic intrinsic motivation is a consequence of an insufficient satisfaction of students' basic psychological needs that are less adequately addressed by traditional school settings as students grow older (La Guardia & Ryan, 2002).

The Role of Basic Psychological Needs

In their motivational theory Ryan and Deci (2004) mainly focus on the fulfillment of the three fundamental psychological needs that are supposed to be essential preconditions for an individual's development of intrinsic motivation. Cross-sectional as well as some longitudinal data clearly link higher satisfaction of the need for autonomy (Flink, Boggiano, & Barrett, 1990; Krapp, 2005; Patall, Cooper, & Wyss, 2010), the need for competence (Faye & Sharpe, 2008; Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2002; MacIver, Stipek, & Daniels, 1991), and also the need for social relatedness (Ryan, 2001; Vitoroulis, Schneider,

Vasquez, de Toro, & Gonzáles, 2012; Wentzel, 1998) to increases in academic intrinsic motivation. Satisfaction of these three needs is associated with a number of positive outcomes, including higher levels of intrinsic motivation (Li, Wang, Pyun, & Kee, 2013). An insufficient need satisfaction might serve as an explanation for the age-related decline in academic intrinsic motivations in youths:

The need for autonomy refers to one's freedom of choice in the sense that one is not coerced or controlled by others. In educational settings, this is reflected, for example, in students' freedom to make independent decisions regarding the content and organization of their assignments. Several studies (e.g., Assor, Kaplan, & Roth, 2002; Patall et al., 2010; Reeve, Jang, Carrell, Jeon, & Barch, 2004; Thomas & Müller, 2014) showed that students are more engaged when teachers use various autonomy-supportive practices during instruction, such as allowing students to express dissatisfaction with learning tasks or providing opportunities to make own choices. Teachers supporting autonomy generate greater school-related interest and confidence and, thus, facilitate academic intrinsic motivation (Flink et al., 1990). Findings from a longitudinal study (Krapp, 2005) showed that satisfaction of autonomy (and also competence) needs even predict general, long-term interest orientation, an indicator of intrinsic motivation, in later life. The emphasis on grades and rules comes at a time when students typically have a greater need to assert their individuality and feel that they should receive more, rather than less freedom (Midgley & Feldlaufer, 1987). In line with these observations, a cross-sectional study identified autonomy support by teachers as an important mediator of the age effect on intrinsic motivation (Gillet, Vallerand, & Lafrenière, 2012).

The need for competence reflects students' trust in their personal mastery of academic tasks instead of feeling inept or incompetent. In school, this need is addressed, for example, by mastering assignments that are neither too easy and nor too difficult, but optimally

challenging, or by teachers that encourage students to try to solve problems on their own. If students do not believe they can master an assigned task adequately, they frequently will not even attempt it; perceptions of incompetence even contribute to the decision to drop out of school altogether. In a national, longitudinal survey on educational attainment (Berktold, Geis, & Kaufman, 1998) about a third of all dropouts claimed they left school because they could not keep up with the demands in school. Changes in the perception of competence are also a highly powerful predictor of respective changes in course interests and the motivation to actively participate in class (MacIver et al., 1991). A longitudinal study on youths from grades 1 through 12 found that declines in feelings of competence accounted for significant portions of the age-related decline in subject-specific interests in school (Jacobs et al., 2002).

The need for relatedness represents the importance of belonging, to be meaningfully connected to significant others. In school, it can be satisfied, for example, by perceiving oneself to be an important part of the class and being accepted by peers and teachers. Students who report caring and supportive interpersonal relationships in school have more positive academic attitudes (Ryan, Stiller, & Lynch, 1994), are more satisfied with school in general (Erath, Flanagan, & Bierman, 2008; Wentzel, Barry, & Caldwell, 2004; Verkuyten & Thijs, 2002), and are also more engaged in academic assignments (Murray, 2009; Simons-Morton, & Chen, 2009). In a network analysis, Ryan (2001) demonstrated that the context provided by the peer group represents a focal predictor of seventh graders' intrinsic enjoyment and liking of school. Highly similar patterns also emerged across different cultures (Vitoroulis et al., 2012): perceived peer support predicted academic intrinsic motivation in less and also highly individualistic countries. However, early adolescence is a period of transition. The peer group becomes increasingly important and authoritative influences on behavior (i.e. by parents or teachers) tend to decline in importance (Simons-Morton & Haynie, 2002). As adolescents grow older, they become more concerned about their position

among peers (Gavin & Furman, 1989; LaFontana & Cillessen, 2010) and rely on peers for social comparison and emotional support (Hay & Ashman, 2003). Thus, as students grow older, satisfaction of the need for social relatedness happens outside of school as well as or even better than within school.

To sum up, according to SDT (Ryan & Deci, 2004) and increasing empirical evidence meeting basic psychological needs are essential for the maintenance of academic intrinsic motivation. Therefore, it is hypothesized that changes in needs satisfaction might serve as an explanation for the decline in motivation during adolescence. As students grow older, school environments become less successful in satisfying students' basic needs which, in turn, leads to lower academic intrinsic motivation for older students:

Hypothesis 1: Intrinsic motivation gradually declines throughout adolescence.

Hypothesis 2: Changes in the satisfaction of basic needs predict the decline in intrinsic motivation.

Despite a sizeable body of available research on SDT (Ryan & Deci, 2004), previous studies on academic motivation and need satisfaction have some limitations. First, previous studies, for the largest part, relied on cross-sectional research designs that reported between-group comparisons of age cohorts (e.g., Gillet et al., 2012; Vitoroulis et al., 2012). Although these studies provided important information on the relationship between motivations and need satisfaction, they are less appropriate to examine developmental *changes*. The variability of psychological constructs at a given time point is frequently rather different from its variability over time (Maxwell & Cole, 2007). As a consequence, cross-sectional research often provides little insight into how constructs change over time. Therefore, the present study adopts an accelerated longitudinal cohort design (ALD; Bell, 1953) that scrutinizes the effects of need satisfaction on intrinsic motivation prospectively over time. This approach facilitates the observation of within-person changes and, thus, the identification of true

development changes. Furthermore, the interpretation of the order of change for two or more psychological constructs is more straightforward in longitudinal designs (Avey, Luthans, & Mhatre, 2007; Ployhart & Vandenberg, 2010). Second, previous studies primarily focused on changes in intrinsic motivation across adolescence (e.g., Bouffard et al., 2003). To gather a more comprehensive understanding of academic motivations the present study includes the full range of motivations from self-determined (i.e. intrinsic and identified) to non-self-determined motivations (i.e. introjected and extrinsic). Third, the study empirically addresses a central assumption in SDT (Ryan & Deci, 2004) with regard to the mediating role of need satisfaction for academic motivations; that is, after accounting for the satisfaction of the needs for autonomy, competence and relatedness intrinsic motivation should remain fairly stable during adolescence. This proposition has been repeatedly posited on theoretical accounts (e.g., Deci & Vansteenkiste, 2004; Krapp, 2005) but, so far, has been rarely demonstrated in a longitudinal context. Fourth, the hypotheses are addressed among students from grades 5 to 10 to examine motivational trajectories across a broad age range. For the most part, previous research focused either on younger students (e.g., Corpus et al., 2009; Lepper et al., 2009) or on a rather limited age range (e.g., Otis et al., 2005).

Overall, as compared to previous research the present study strives to gather a more comprehensive picture of changes in academic motivation by linking motivational change over time to basic psychological concepts in a naturalistic school setting.

Present Study

Using an accelerated longitudinal design (Bell 1953), changes in intrinsic academic motivation are analyzed in a sample of adolescents aged from 11 to 16 years. In contrast to a long-term longitudinal design that follows individuals across their entire adolescence, an ALD involves different age cohorts, groups of individuals that were born within a given time interval, that are investigated over a short period of time. The short-term longitudinal data

from different age cohorts are linked to create a combined growth trajectory in order to study the mean change of intrinsic motivation throughout adolescence. In particular, the effects of three basic psychological needs as outlined in SDT (Ryan & Deci, 2004), the needs for autonomy, competence and relatedness, are examined to explain adolescents' decline of academic intrinsic motivation.

Method

Participants and Procedure

The sample included 600 adolescents (286 girls) from 52 secondary schools across rural and urban localities in Austria. To reach a diverse sample of students all major school types were included: About 39% attended higher general secondary schools, 48% went to secondary schools providing vocational education, and the remaining 12% encompassed students in several specialized school branches (e.g., schools with Waldorf education). A random sample of students from grades 5 to 10 were invited to participate in the study. The Austrian school system covers 12 grades. Because after four years of elementary school students typically move on to various types of secondary school housed in different locations, grade 5 represents a transitional year for most students. They completed the survey twice in one school year. At the first measurement occasion their ages ranged from 11 to 15 years representing five age cohorts: 11 years (N = 94), 12 years (N = 116), 13 years (N = 157), 14 years (N = 136) and 15 years (N = 97). Data collection was conducted during class in groups of 20 to 30 students by trained teachers.

Instruments

The four motivational styles (example item for intrinsic motivation: "I work and learn because I like to learn new things.") were assessed with four items each of the German Self Regulation Questionnaire (Gnambs & Hanfstingl, 2014), a modified version of the Academic Self Regulation Questionnaire (Ryan & Connell, 1989) validated for German-speaking

students. Satisfaction of three psychological needs as described in SDT (Ryan & Deci, 2000) was measured with 12 items designed to tap adolescents' experience of relatedness (e.g., "I get along well with my class mates."), competence (e.g., "If I have questions about a subject matter, I can ask my teacher."), and autonomy (e.g., "My teachers trust me to work on my own.") at school (Prenzel, Kramer, & Drechsler, 2001; see also Hanfstingl, Andreitz, Müller, & Thomas, 2010). The instrument allows for the context-specific measurement of perceived need satisfaction comparable to instruments for the measurement of need satisfaction at work (Deci et al., 2001), in relationships (La Guardia, Ryan, Couchman, & Deci, 2000), or in exercise (Vlachopoulos, 2008). The scales are designed for adolescents with sufficient reading comprehension and as such are appropriate for students in secondary schools from the age of 10 and upwards. Responses to all items were indicated on five-point response scales from "strongly agree" to "strongly disagree". The same instruments were administered at both measurement occasions. Confirmatory factor analyses with seven correlated latent traits resulted in a good fit at the first, $\chi^2(327) = 612$, CFI = .95, TLI = .94, RMSEA = .04 [.034, .043], and the second measurement occasion, $\chi^2(327) = 725$, CFI = .95, TLI = .95, RMSEA = .05 [.041, .050] with all indicators having satisfactory loadings on their respective factor, $\bar{\lambda} =$ .83 / .87 (intrinsic motivation), $\bar{\lambda} =$ .77 / .82 (identified motivation), $\bar{\lambda} =$ .63 / .66 (introjected motivation), $\bar{\lambda} =$ .61 / .56 (extrinsic motivation), $\bar{\lambda} =$ .52 / .52 (need for relatedness), $\bar{\lambda} =$ .67 / .77 (need for competence), and $\bar{\lambda} =$ .70 / .77 (need for autonomy). All scales exhibited good latent factor reliabilities (Hancock & Mueller, 2001) between H = .75 and .96 (see Table 1).

INSERT TABLE 1 ABOUT HERE

Statistical Analyses

Measurement Invariance. Longitudinal analyses require invariant measurement models across time. If the factor structure does not change, latent constructs can be compared across measurement occasions. Longitudinal factorial invariance was tested separately for each administered scale by comparing models that constrained factor loadings (*metric invariance*) and intercepts (*scalar invariance*) to be equal over time to models without equality constraints (cf. Little, 2013). Due to the well-known problems with χ^2-difference tests in large samples, the Comparative Fit Index (CFI) was used for model comparisons; differences in CFI that do not exceed a threshold of .01 are indicative of invariant measurements (Cheung & Rensvold, 2002). Following prevalent recommendations (Little, 2013), all models included autocorrelations among the residuals of a given item, which accounts for the systematic variance associated with each item.

Latent growth modeling (LGM). Changes in motivational styles across adolescence were analyzed using latent growth modeling (Collins, 2006; Meredith & Tisak, 1990). LGM establish a growth trajectory, that is, an increase or decrease in motivation over time, by estimating two focal parameters: the intercept indicating the average initial status across individuals and the slope reflecting the underlying change process across measurement occasions. Subsequently, these models were extended to a parallel-processes latent growth models (PP-LGM) that simultaneously fit two LGMs to the data (Cheong, MacKinnon, Khoo, 2003): an LGM for one motivational style and another LGM for satisfaction of one of the three basic needs. The influence of need satisfaction on motivational change was examined by regressing the latent slope factor of motivation on the latent growth factors for either satisfaction of need for relatedness, competence or autonomy. All analyses were conducted in Mplus 6 (Muthén & Muthén, 1998-2010) with a robust maximum likelihood algorithm. To account for the non-independencies of observations resulting from the

grouping of students within classes, the Huber/White sandwich estimator (Williams, 2000) was applied that corrects the standard errors of the parameter estimates by taking the clustering into account. Model fit is evaluated in line with conventional standards (Schermelleh-Engel & Moosbrugger, 2003) using the comparative fit index (CFI), Tucker-Lewis index (TLI) and root mean square error of approximation (RMSEA).

INSERT FIGURE 1 ABOUT HERE

Accelerated longitudinal design (ALD). In an ALD different age cohorts are repeatedly assessed, resulting in overlapping measurements of different age groups. A long-term longitudinal design is approximated by linking short-term segments of longitudinal data from one age cohort with an overlapping segment from an adjacent cohort to form a common growth trajectory (Bell, 1953; Collins, 2006). Thereby, each age cohort contributes a different section of the overall growth trajectory. Following the multi-group approach for the analysis of ALDs (cf. Duncan, Duncan, & Hops, 1996; McArdle & Hamagami, 1991) each age cohort is treated as a subgroup having the same pattern of missing data. Figure 1 illustrates the model for the five age cohorts. Cohort 1 represents adolescents aged 11 years at the first measurement occasion, cohort 2 the 12 year olds, cohort 3 students at age 13 and so on. The factor loadings of the latent intercept factor were fixed at 1 and the loadings for the slope factor were fixed at 0 to 5 representing linear growth. By constraining all free parameters equally across groups an overall or "converged" (Bell, 1953) growth trajectory is estimated spanning from 11 to 16 years. This converged growth trajectory approximates the trajectory of a long-term longitudinal design, if the youngest age cohort had been followed for the full time span. Comparative analyses indicate that growth trajectories from ALD and true

longitudinal designs are highly comparably and converge to a large extent (Duncan et al., 1996).

Results

The bivariate correlations between all measures are summarized in Table 1. As expected, intrinsic motivation was negatively associated with age, indicating a decline in motivation through adolescence.

INSERT TABLE 2 ABOUT HERE

Longitudinal Measurement Invariance

The unconstrained measurement model for intrinsic motivation resulted in a good fit to the data, $\chi^2(15) = 46$, CFI= .99, TLI = .99, RMSEA = .06 [.05, .08]. Placing constraints on the factor loadings, ΔCFI = .000, and the intercepts, ΔCFI = .000, did not result in a significant loss of fit. Thus, the measurement properties of the intrinsic motivation scale remained stable over time. Comparable analyses for the other administered instruments, identified motivation, extrinsic motivation, and the three need scales, also supported metric and scalar measurement invariance across the two time points (see Table 2), thus, allowing meaningful longitudinal comparisons. In contrast, for the introjected motivation scale one item displayed significantly different intercepts across measurement occasions, thus, reflecting partial scalar invariance. However, sensitivity analyses that excluded the respective item from the longitudinal models did not indicate substantial different conclusions.

INSERT FIGURE 2 ABOUT HERE

Unconditional Accelerated Growth Models

A linear accelerated growth model for intrinsic motivation resulted in a satisfactory fit to the data, $\chi^2(154) = 261$, CFI = .97, TLI = .97, RMSEA = .08 [.06, .09]. This supports the suitability of an ALD to approximate a long-term longitudinal design and to estimate a combined growth trajectory across all age groups. The model resulted in a significant, $p = .002$, mean slope, $M = -.14$ ($SD = .24$), indicating a steady decline of intrinsic motivation throughout adolescence (Hypothesis 1). Including a quadratic slope did not improve the model significantly, $p = .55$; therefore, only linear trends were examined. Figure 2 illustrates the combined growth trajectory for the ages from 11 to 16 years (solid black line) and also the individual growth trajectories for each individual age cohort (grey lines). The latter converge with the combined growth trajectory to a large degree, giving further support to the validity of the ALD. Comparable analyses for the remaining motivational styles (see Table 3) identified a significant, $p < .05$, albeit smaller decline in identified motivation, $M = -.08$ ($SD = 0.01$), and introjected motivation, $M = -0.10$ ($SD = 0.09$), across adolescents (see Figure 2). In contrast, for extrinsic motivation the mean of the latent growth factor $M = -0.06$ ($SD = 0.17$) was only marginally significant, $p = .055$. Overall, these analyses indicate that all four motivational styles exhibited a marked decline from age 11 to 16. However, respective changes were most pronounced for intrinsic motivation.

INSERT TABLE 3 ABOUT HERE

Parallel-Processes Accelerated Growth Models

The second hypothesis was examined by regressing the latent slope factor for intrinsic motivation on the latent intercept and growth factors of respective models for need satisfaction. The respective models for need for relatedness, $\chi^2(608) = 999$, CFI = .93, TLI

= .93, RMSEA = .07 [.07, .08], need for competence, $\chi^2(624) = 951$, CFI = .95, TLI = .95, RMSEA = .07 [.06, .08], and need for autonomy, $\chi^2(624) = 992$, CFI = .94, TLI = .94, RMSEA = .07 [.06, .08], showed satisfactory fit to the data. As summarized in Table 4, the latent slopes for satisfaction of all three needs significantly, $p < .05$, predicted the change trajectory of intrinsic motivation. The mean latent slope of intrinsic motivation fell at $M = 0.03$ ($p = .74$) after controlling for need for relatedness, $M = 0.15$ ($p = .22$), after controlling for need for competence, and $M = 0.04$ ($p = .75$) after controlling for need for autonomy.

INSERT TABLE 4 ABOUT HERE

Thus, after controlling for need satisfaction intrinsic motivation remained fairly stable throughout adolescence or even increased slightly (see Figure 3). In contrast, changes in the three external motivational styles were not associated with need satisfaction (see Table 4). Thus, need satisfaction is primarily relevant for the maintenance of intrinsic motivation whereas external motivations are hardly affected.

INSERT FIGURE 3 ABOUT HERE

Discussion

The study examined the role of the three basic psychological needs for the decline of academic intrinsic motivation in an accelerated longitudinal cohort design among teenaged students. The results permit two main conclusions. First, in line with prior evidence (e.g., Bouffard et al., 2003; Corpus et al., 2009; Gottfried et al., 2001), intrinsic motivation gradually declined between the ages of 11 and 16 years. The observed decline within 1-year replicated across all age cohorts, albeit it seemed strongest for the transition from 13 to 14

years. A similar effect has been previously noted. Corpus and colleagues (2009) reported the sharpest decline in intrinsic motivations between grades 7 and 8. Similarly, Gottfried et al. (2001) observed that academic intrinsic motivation decreased primarily between the years 13 and 16. Different explanations have been proposed for this effect. Some authors (e.g., Blakemore, den Ouden, Choudhury, & Frith, 2007) have put forward neuropsychological accounts and attributed the observed motivational changes to adolescents' still developing brain structures. Others (e.g., Gottfried et al., 2001) called into focus aspects of the school curricula because intrinsic motivation declines more strongly in math or reading but even slightly increases for social studies (Gottfried, 1985). These domain-specific differences might reflect developmental changes when adolescents increasingly value social aspects of their life and explore their own identity (LaFontana & Cillessen, 2010; Simons-Morton & Haynie, 2002). Some authors have speculated (Lepper et al., 2005) that the decline of intrinsic motivation might be a result of emerging extrinsic constraints and contingencies in this age. Learning in school becomes more and more decontexualized and performance-oriented in adolescence (Anderman et al., 1999) which, thus, undermines intrinsic motivation.

In line with SDT (Ryan & Deci, 2004), this study pursued a need-driven explanation. As second major conclusion, it was demonstrated that academic intrinsic motivations do not change considerably but remain rather stable when the satisfaction of the three basic psychological needs are accounted for. Satisfaction of the needs for autonomy, competence, and relatedness concordantly buffered the decline of youths' intrinsic motivations. This confirms basic assumptions in SDT that have been repeatedly formulated on theoretical accounts (e.g., Deci & Vansteenkiste, 2004; Krapp, 2005) but rarely empirically tested. However, given that according to SDT basic need fulfillment should not only foster the maintenance of intrinsic motivation but also its development, one could have even expected an increase of intrinsic motivation after accounting for need satisfaction. However, in the

present study need satisfaction did not increase intrinsic motivation, but merely stopped its decline (see also Spinath & Steinmayr, 2012; Pulfrey, Darnon, & Butera, 2012). It will have to be shown in future studies if merely a stabilization of intrinsic motivation during adolescence is enough or an increase would be beneficial.

Third, SDT (Ryan & Deci, 2004) postulates a continuum from rather self-determined to non-self-determined motivations. Whereas previous research on motivational change during adolescence primarily focused on intrinsic motivation (e.g., Bouffard et al., 2003; Gottfried et al., 2001; Spinath, & Steinmayr, 2012), the present study adopted a multidimensional approach and acknowledged the entire motivational spectrum. These analyses revealed different longitudinal patterns: Whereas extrinsic motivation remained rather stable over time and decreased only marginally (for similar results see Corpus et al., 2009, and Lepper et al., 2005), identified and introjected motivation showed a similar, albeit smaller, decline across adolescents as intrinsic motivation. Overall, the pattern of change for the four motivational styles closely followed similar patterns as previously reported by Otis and colleagues (2005). However, despite the observed decline in identified and introjected motivation, these changes were not associated with respective changes in need satisfaction. Thus, although the satisfaction of basic psychological needs is crucial for the maintenance of intrinsic motivation, it is not for less self-determined motivations. So far, the reason for the lack of effects for the latter is unclear and remains an open area for future research.

Implications

The findings of the present study hold intriguing implications. They do not only empirically confirm a basic theoretical premise of SDT with regard to the interplay of need satisfaction and academic motivation (Ryan & Deci, 2004), but they also have important ramifications for practice: The decline of intrinsic motivation across adolescence is not an inevitable developmental imperative, but, rather, is strongly influenced by the degree that the

current school environment can meet students' psychological needs (cf. Stiglbauer, Gnambs, Gamsjäger, & Batinic, 2013). Thus, in line with Hattie's (2009) well known synthesis of meta-analyses on the determinants of student achievement, the present results reinforce the importance of teacher behavior at school. If teachers manage to adequately address students' need for competence, autonomy, and social relatedness intrinsic motivation—with all its positive academic consequences (e.g., grades or well-being; cf. Cerasoli, Nicklin, & Ford, 2014; Milyavskaya, M, & Koestner, R., 2011; Taylor et al., 2014)—can be properly maintained throughout students' school careers.

Limitations

Some caveats that might limit the generalizability of the presented results should be noted. The longitudinal research design included only two measurement points. Although prior research demonstrated that results from ADL and true longitudinal designs converge to a large degree (Duncan et al., 1996), stronger support would be given if the same individuals were followed for a longer period of time and more measurement occasions had been included. Furthermore, due to the self-report nature of the administered measures their validity might be somewhat compromised, for example due to socially desirable responding (e.g., Gnambs & Kaspar, 2014) or common method bias (e.g., Podsakoff, MacKenzie, & Podsakoff, 2012). Future studies would also benefit from including more objective criteria such as observer reports or even implicit measures. An important topic for future studies is to consider what level of intrinsic motivation seems optimal. Is it already a success if academic intrinsic motivation during adolescence remains stable and does not decline? Or is it more important to concentrate on how to increase motivation in early childhood? Moreover, it is still rather unclear how basic needs themselves develop and contribute in maintaining intrinsic motivation.

Conclusions

In conclusion, the presented results confirm basic premises of SDT. The satisfaction of three basic psychological needs in adolescence helps maintenance of academic intrinsic motivation in school. The typically observed decline in intrinsic motivation gradually fades once basic needs are satisfied.

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Table 1.

Descriptive Statistics and Correlations between Study Variables

		M	*SD*	*H*	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
First measurement occasion	1. Intrinsic motivation	3.34	1.04	.95	*.90*													
	2. Identified motivation	3.74	1.03	.93	.47*	*.85*												
	3. Introjected motivation	2.88	0.97	.82	.29*	.26*	*.74*											
	4. Extrinsic motivation	2.94	0.95	.80	-.15*	.06	.33*	*.70*										
	5. Need for relatedness	4.04	0.70	.86	.37*	.23*	.17*	-.14*	*.68*									
	6. Need for competence	4.12	0.74	.86	.48*	.29*	.17*	-.11*	.47*	*.76*								
	7. Need for autonomy	3.72	0.83	.88	.50*	.26*	.18*	-.12*	.57*	.68*	*.77*							
Second measurement occasion	8. Intrinsic motivation	3.13	1.12	.96	.65*	.40*	.18*	-.10*	.33*	.38*	.35*	*.93*						
	9. Identified motivation	3.61	1.18	.95	.36*	.57*	.15*	-.02	.14*	.22*	.18*	.49*	*.89*					
	10. Introjected motivation	2.77	1.01	.84	.22*	.21*	.44*	.16*	.15*	.15*	.11*	.34*	.35	*.77*				
	11. Extrinsic motivation	2.84	0.91	.75	-.03	.05	.21*	.40*	-.08*	-.01	-.06	.00	.18*	.42*	*.64*			
	12. Need for relatedness	3.96	0.80	.91	.28*	.21*	.13*	-.08	.55*	.35*	.38*	.47*	.29*	.27*	-.02	*.70*		
	13. Need for competence	3.94	0.92	.92	.33*	.21*	.17*	-.06	.34*	.51*	.40*	.53*	.36*	.29*	.09*	.57*	*.85*	
	14. Need for autonomy	3.54	0.99	.93	.35*	.20*	.14*	-.09*	.37*	.46*	51*	.53*	.31*	.27*	.04	.60*	.74	*.84*
	15. Age	13.04	1.30		-.11*	-.09*	-.11*	-.01	-.09*	-.18*	-.17*	-.11*	-.04	-.14*	-.03	-.15*	-.18*	-.17*

Notes. $N = 600$. Cronbach's alpha reliabilities in diagonal. *M* = mean, *SD* = standard deviation, *H* = Latent factor reliability (Hancock & Mueller, 2001), scale range = 1 to 5.
* $p < .05$.

Table 2.

Summary of Results for Tests of Longitudinal Measurement Invariance

	χ^2	*df*	CFI	TLI	RMSEA	[90% CI]	ΔCFI
Intrinsic motivation							
1.Configural invariance	46	15	.992	.986	.059	[.040, .079]	
2. Metric invariance	50	18	.992	.987	.055	[.038, .074]	.000
3. Scalar invariance	52	21	.992	.990	.050	[.033, .067]	.000
Identified motivation							
1.Configural invariance	64	15	.979	.960	.074	[.056, .093]	
2. Metric invariance	70	18	.978	.965	.070	[.053, .087]	.001
3. Scalar invariance	78	21	.975	.967	.068	[.052, .084]	.004
Introjected motivation[a]							
1.Configural invariance	34	13	.979	.854	.052	[.031, .074]	
2. Metric invariance	36	16	.980	.964	.046	[.025, .066]	.000
3. Scalar invariance	52	19	.966	.950	.054	[.037, .072]	.013
4. Partial scalar invariance[b]	41	18	.976	.962	.047	[.028, .066]	.003
Extrinsic motivation							
1.Configural invariance	52	15	.953	.912	.065	[.046, .084]	
2. Metric invariance	53	18	.956	.931	.057	[.040, .076]	.000
3. Scalar invariance	56	21	.956	.942	.053	[.036, .070]	.000
Need for relatedness[a]							
1.Configural invariance	14	11	.997	.994	.020	[.000, .050]	
2. Metric invariance	17	15	.998	.997	.016	[.015, .043]	.000
3. Scalar invariance	19	17	.998	.997	.013	[.000, .041]	.000
Need for competence							
1.Configural invariance	21	15	.998	.996	.026	[.000, .050]	
2. Metric invariance	44	18	.990	.985	.049	[.031, .068]	.008
3. Scalar invariance	50	21	.989	.986	.048	[.031, .066]	.009
Need for autonomy							
1.Configural invariance	33	15	.993	.987	.045	[.023, .066]	
2. Metric invariance	34	18	.994	.990	.038	[.017, .058]	.000
3. Scalar invariance	33	21	.995	.993	.031	[.004, .051]	.000

Note. [a] Includes correlated uniqueness for two items. [b] Includes free intercept for one item.

Table 3.

Summary of Results for Tests of Unconditional Accelerated Growth Models

	M_s	SD_s	χ^2	*df*	CFI	TLI	RMSEA	[90% CI]
1. Intrinsic motivation	-0.14	0.24	261	154	.97	.97	.08	[.06, .09]
2. Identified motivation	-0.08	0.01	290	155†	.94	.95	.07	[.09, .10]
3. Introjected motivation	-0.10	0.09	206	151	.95	.96	.06	[.03, .07]
4. Extrinsic motivation	-0.06	0.17	224	154	.93	.93	.06	[.04, .08]

Note. M_s (SD_s) = Mean and standard deviation of latent growth factor. † Correlation between latent intercept and slope fixed to zero due to non-identification.

Table 4.

Parameter Estimates for Parallel Processes Latent Growth Models

	Need for relatedness			Need for competence			Need for autonomy		
	M_s (SD_s)	*B* (*SE*)	β	M_s (SD_s)	*B* (*SE*)	β	M_s (SD_s)	*B* (*SE*)	β
Intrinsic motivation	0.03 (0.11)			0.15 (0.09)			0.04 (0.08)		
Initial status of need satisfaction		-0.15* (0.06)	-.45		-0.39* (0.09)	-.61		-0.49* (0.14)	-.66
Change in need satisfaction		1.92* (0.50)	.89		2.68* (1.20)	.79		2.72* (0.68)	.75
Identified motivation	-0.09 (0.01)			-0.08 (0.03)			-0.02 (0.06)		
Initial status of need satisfaction		-0.06 (.06)	-.98		-0.08 (0.09)	-.67		-0.19 (0.13)	-.82
Change in need satisfaction		0.00† (-)	-		0.00† (-)	-		0.96 (0.68)	.57
Introjected motivation	-0.09 (0.04)			-0.08 (0.04)			-0.09 (0.04)		
Initial status of need satisfaction		-0.07 (0.06)	-.61		-0.08 (0.07)	-.64		-0.10 (0.07)	-.86
Change in need satisfaction		0.00† (-)	-		0.00† (-)	-		0.00† (-)	-
Extrinsic motivation	-0.04 (0.01)			-0.06 (0.02)			-0.05 (0.03)		
Initial status of need satisfaction		-0.09* (0.05)	.50		0.09 (0.06)	.42		0.13 (0.08)	.46
Change in need satisfaction		0.00† (-)	-		0.00† (-)	-		0.00† (-)	-

Note. M_s (SD_s) = Mean and standard deviation of latent growth factor for motivational style; † constrained to 0 due to non-identification

* $p < .05$

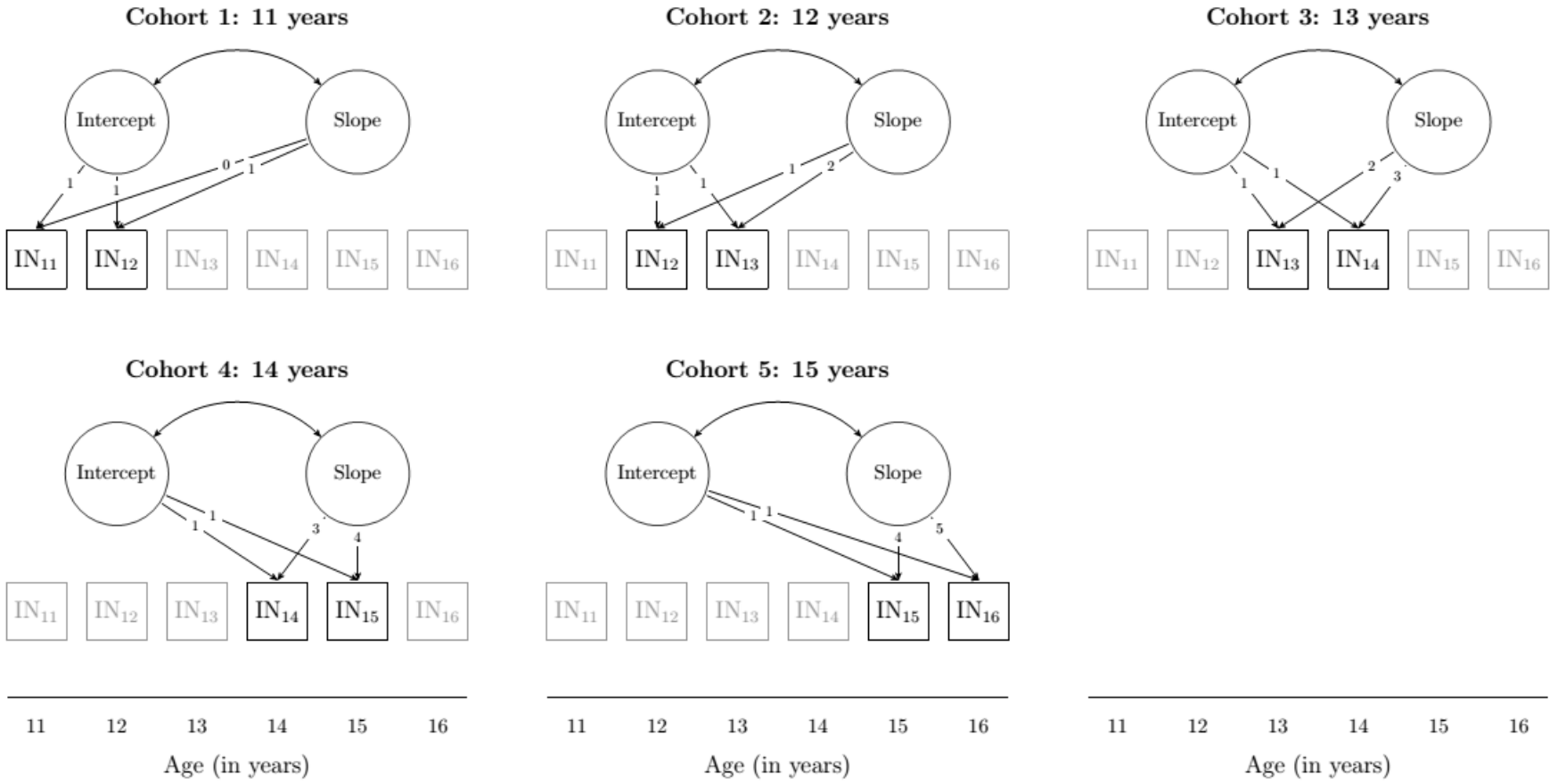

Figure 1. Accelerated longitudinal design from ages 11 to 16 for intrinsic motivation. Boxes in grey represent missing data by design for each cohort

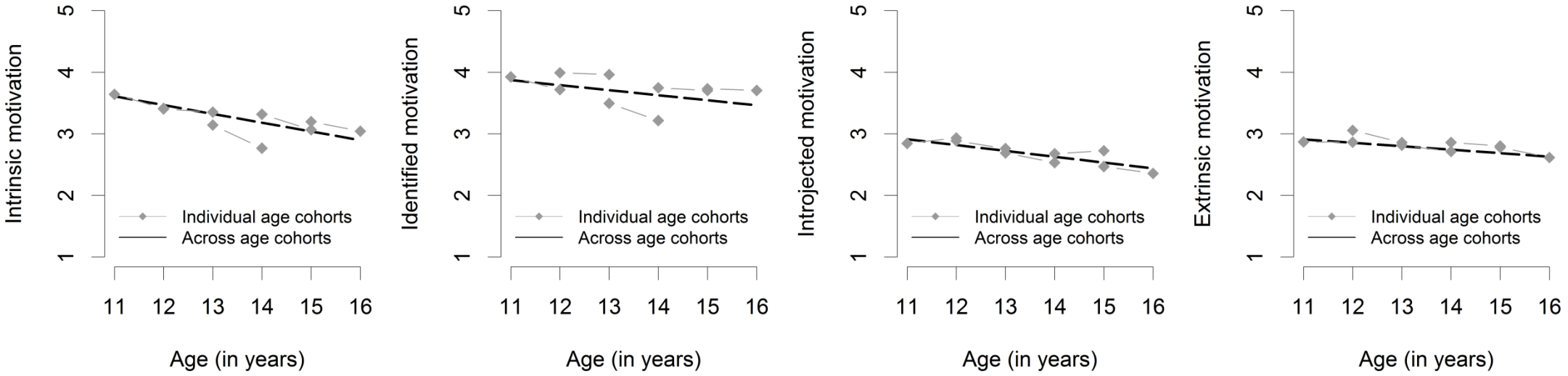

Figure 2. Model-implied growth trajectories across age cohorts (black) and growth trajectories for individual age cohorts (grey) for motivational styles

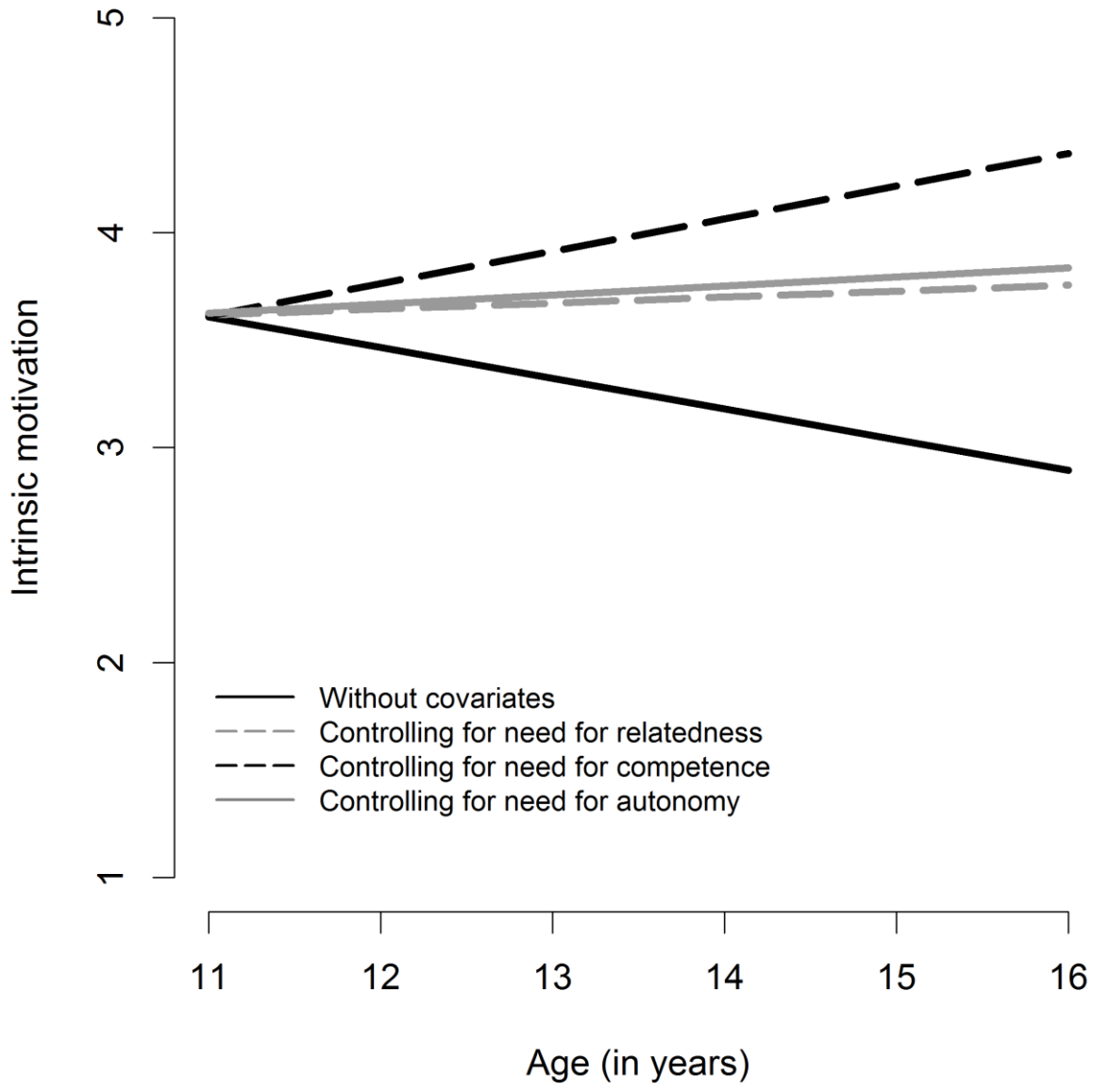

Figure 3. Growth trajectory for intrinsic motivation after controlling for need satisfaction