

The developmental trajectory of intrinsic reading motivation: measurement invariance, group variations, and implications for reading proficiency

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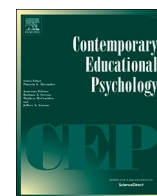
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The developmental trajectory of intrinsic reading motivation: Measurement invariance, group variations, and implications for reading proficiency

Ai Miyamoto^{a,b,*}, Kou Murayama^c, Clemens M. Lechner^b

^a University of Freiburg, Germany

^b GESIS – Leibniz Institute for the Social Sciences, Germany

^c University of Reading, United Kingdom

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ABSTRACT

The goal of the present study is to extend previous research on the developmental trajectory of intrinsic reading motivation during early adolescence. Using large-scale panel data on secondary school students in Germany, we examined: (1) the longitudinal measurement invariance of intrinsic reading motivation, (2) the generalizability of the developmental trajectory of intrinsic reading motivation across students' gender, parental socioeconomic status (SES), and school tracks (academic vs. vocational), and (3) the associations between the developmental trajectory of intrinsic reading motivation and the developmental trajectory of reading proficiency. The scale we used to measure intrinsic reading motivation showed the (strict) measurement invariance across six occasions of measurement from Grades 5 to 10, indicating the high structural similarity (e.g., factor loadings, intercepts) of intrinsic reading motivation during early adolescence. Our analyses of latent growth curve models also confirm previous findings that students tend to experience a steady and significant linear decline in intrinsic reading motivation from Grades 5 to 10. This developmental decline also seems to be more pronounced in size ($\Delta = -0.772, p < .001$) than previously reported. The developmental decline in intrinsic reading motivation was observed irrespective of students' gender, parental SES, and school tracks. Male students expressed lower mean-levels of intrinsic reading motivation across the waves and exhibited a steeper motivational decline compared to female students. Despite mean-level differences across the waves, students showed similar degrees of a motivational decline across parental SES and school tracks. Finally, the larger decline in students' intrinsic reading motivation was associated with the smaller growth of their reading proficiency from Grades 5 to 10. Our study provides further support for the high prevalence of the developmental decline in intrinsic reading motivation during early adolescence, its generalizability across students' demographic characteristics, and its implications for the development of reading proficiency.

1. Introduction

Intrinsic motivation, defined as one's willingness to engage in learning activities for their interest and enjoyment without expecting any extrinsic rewards in return (Ryan & Deci, 2017), has been repeatedly shown as one of the most powerful predictors of academic achievement (Cerasoli, Nicklin, & Ford, 2014; Kriegbaum, Becker, & Spinath, 2018; Taylor et al., 2014). However, a recent meta-analysis by Scherrer and Preckel (2019) revealed that students tend to experience a developmental decline in a variety of motivational constructs (e.g., self-concept, interest, goal orientations) across subjects (e.g., language, math, general) throughout the primary and secondary schooling. This issue is particularly alarming for students' intrinsic *reading* motivation as reading is a fundamental means of learning all subjects (e.g.,

understanding textbooks, homework instructions, and exam questions). Despite the relevance of this matter, there is still a lack of longitudinal research investigating the developmental decline in intrinsic reading motivation. In the meta-analysis (Scherrer & Preckel, 2019), among 22 studies which investigated the longitudinal changes in intrinsic motivation, only five were specific to the context of reading (Bouffard, Boileau, & Vezeau, 2001; Kolić-Vehovec, Rončević Zubković, & Pahljina-Reinić, 2014; Van de gaer, Pustjens, Van Damme, & De Munter, 2009; Viljaranta, Lazarides, Aunola, Räikkönen, & Nurmi, 2015; Viljaranta, Tolvanen, Aunola, & Nurmi, 2014.) Moreover, these five studies did not fully address several important issues concerning the developmental trajectory of intrinsic reading motivation: (1) the longitudinal measurement invariance of the instruments they used to measure intrinsic reading motivation, (2) the generalizability of their

* Corresponding author at: Department of Educational Science, University of Freiburg, Rempartstrasse 11, Freiburg 79098, Germany.

E-mail address: ai.miyamoto@ezw.uni-freiburg.de (A. Miyamoto).

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findings on the developmental decline in intrinsic reading motivation across students' demographic characteristics such as gender, family backgrounds, and school tracks, and (3) the implications of their findings on the developmental decline in intrinsic reading motivation for the development of reading proficiency. The goal of the present study is to contribute to and extend the previous knowledge on the developmental trajectory of intrinsic reading motivation by addressing the aforementioned shortcomings.

First, we advance our knowledge on the structural similarity (i.e., measurement invariance) in the construct of students' intrinsic reading motivation during early adolescence (from Grades 5 to 10). Testing the longitudinal measurement invariance enables us to make a more precise and accurate estimate of the magnitude of the developmental decline in intrinsic reading motivation in comparison to previous research (e.g., see van De Schoot, Schmidt, De Beuckelaer, Lek, & Zondervan-Zwijnenburg, 2015; Widaman, Ferrer, & Conger, 2010, for the importance of measurement invariance for longitudinal analyses). Second, our study extends our understanding of the generalizability of the developmental trajectory of intrinsic reading motivation across students' demographic characteristics such as gender, family backgrounds, and school tracks. Our findings may help us identify potential subgroups who may be particularly at risk of experiencing a severe decline in their intrinsic reading motivation and who may need specific support from their schools and teachers. Lastly and most importantly, our study improves our understanding of the long-term implications of the developmental decline in intrinsic reading motivation for students' learning outcomes—in particular—the development of reading proficiency. This is an important matter to investigate because it has direct relevance to educational researchers and practitioners who aim to promote students' reading development.

1.1. The developmental decline in intrinsic reading motivation

Several theoretical frameworks offer possible explanations of adolescents' developmental decline in intrinsic motivation, which may also apply to intrinsic reading motivation more specifically. Stage-environment fit theory (Bollmer et al., 2016; Eccles et al., 1997) proposes that students' intrinsic motivation changes due to a "mismatch" between their developmental needs and their learning environments¹. Cognitive evaluation theory, a mini-theory developed within the framework of self-determination theory (Ryan & Deci, 2017; Reeve, Ryan, & Deci, 2018), suggests that students' intrinsic motivation changes due to their exposure to external events which either facilitate or undermine their basic psychological needs (i.e., autonomy, competence, and relatedness). Both theories converge in the idea that as students get older, their desire for a greater sense of autonomy from adults and more social acceptance from peers grows. Students are initially more willing to read for their own curiosity and for mutual interests with their peers. However, as students move to upper grades, schools typically provide less autonomy in deciding what students read in class and require students to read for mandatory assignments and exams. In addition, schools often prompt students to engage in social competitions by putting greater emphasis on performance evaluations. Subsequently, students may become more motivated to read for their duties and assessments instead of reading for their own enjoyment, and therefore experience a developmental decline in their intrinsic reading motivation.

However, previous findings from short-term (e.g., less than one year) longitudinal studies do not always support these theoretical assumptions. Some studies indicate a developmental decline whereas others indicate no change in intrinsic reading motivation, possibly due

to the short study duration. For instance, Schaffner, Philipp, and Schiefele (2016) found that students' intrinsic reading motivation decreased from Grades 5 to 6 in a sample of German elementary school students. By contrast, Schiefele, Stutz, and Schaffner (2016) observed no substantial changes in intrinsic reading motivation over one year in a sample of second and third-graders in Germany. Similarly, Lau (2016) observed no developmental change in intrinsic reading motivation over one year among Chinese secondary school students with 12–18 years of age.

Compared to other domains such as math (e.g., Gottfried, Marcoulides, Gottfried, & Oliver, 2013; Gottfried, Marcoulides, Gottfried, Oliver, & Guerin, 2007), there are fewer long-term longitudinal studies (e.g., more than two years) investigating the developmental trajectory of intrinsic reading motivation. In the recent meta-analysis (Scherrer & Preckel, 2019), among 22 studies that investigated the longitudinal changes in intrinsic motivation, only five of them were specific to reading. Bouffard et al (2001) observed that elementary school children experienced a developmental decline in intrinsic reading motivation from Grades 1 to 3 in the French-speaking part of Canada. Kolić-Vehovec et al (2014) also found a decrease in intrinsic reading motivation from Grades 4 to 8 among elementary school students in Croatia. Van de gaer et al (2009) found a developmental decline in students' intrinsic reading motivation from Grades 7 to 9 and from Grades 9 to 11 in two subsamples of Dutch-speaking secondary school students in Belgium. Finally, studies by Viljaranta et al (2014, 2015) observed a developmental decline in students' intrinsic reading motivation through lower (Grades 1–4) and upper-grade levels (Grades 7–9) of Finnish comprehensive school children. Although the study by McElvany et al (2008) was not included in the meta-analysis (possibly because this study was published in German language), they found that students' intrinsic reading motivation decreased from Grades 3 to 6 over three years in a sample of German elementary school children.

To summarize, the longitudinal studies involving more than two years all seem to agree on the general tendency of a developmental decline in intrinsic reading motivation throughout the elementary and secondary schooling. However, these studies still seem to vary largely in the magnitude of the developmental decline (see Scherrer & Preckel, 2019 for an overview of the effect sizes in the reviewed studies). As the relevant previous studies come from various countries where they possibly differ in their school systems, instructional styles, and social norms, it is still not clear to what extent, the magnitude of the developmental decline observed in the previous studies generalizes to another cultural context. Moreover, the relevant previous studies also have several limitations which we discuss in more detail in the following subsections.

1.2. Longitudinal measurement invariance of intrinsic reading motivation

Over the past years, there has been an increase in research testing the measurement invariance of intrinsic reading motivation across various groups. Overall, previous studies seem to agree that various scales measuring intrinsic reading motivation tend to show fairly strong measurement invariance across gender, school tracks, and levels of reading proficiency (De Naeghel, Van Keer, Vansteenkiste, & Rosseel, 2012; Schaffner et al., 2016; Schiefele & Schaffner, 2016; Stutz, Schaffner, & Schiefele, 2016; 2017). However, so far, little attention has been given to the issue of longitudinal measurement invariance of the scales used to measure intrinsic reading motivation. Most relevant studies used manifest scale scores that do not take into account measurement error or did not report whether they tested longitudinal measurement invariance or not (e.g., Bouffard et al., 2001, Kolić-Vehovec et al., 2014, McElvany et al., 2008). This is not a trivial issue (Stoel, van den Wittenboer, & Hox, 2004) —without ensuring the longitudinal measurement invariance of the motivational scales, one cannot disentangle whether the observed changes in motivation are due to true individual changes in the mean-levels of motivation or reflect

¹ Although stage environment fit theory was originally developed for American adolescents, it has been applied to German-speaking adolescents as well (Dietrich, Dicke, Kracke, & Noack, 2015; Hagenauer & Hascher, 2010).

structural changes (e.g., non-invariance of factor loadings and intercepts) in the construct of motivation itself (van De Schoot et al., 2015; Widaman et al., 2010). Thus, measurement non-invariance that goes undetected entails the risk of drawing erroneous conclusions about purported developmental changes in intrinsic reading motivation. Because childhood and adolescence are periods of rapid cognitive and affective development, it is not guaranteed that students will understand, and respond to, questionnaire items in the same way across time, which is among the possible reasons for structural changes in constructs.

1.3. Group variations in the developmental decline in intrinsic reading motivation

Another important question about the developmental decline in intrinsic reading motivation that previous research has not fully answered is the generalizability of the developmental decline in intrinsic reading motivation across different subgroups of students: Do all subgroups experience this decline to the same extent or are there certain subgroups that are exempt from this pattern? Previous research hints at possible variations in both the (cross-sectional) levels and the (longitudinal) developmental trajectories of intrinsic reading motivation across students' demographic characteristics such as gender, family backgrounds, and school tracks.

One of the strongest cross-sectional differences in intrinsic reading motivation emerged along the lines of students' gender. According to the PISA study (OECD, 2010), the average effect size (Cohens'd) of gender differences on intrinsic reading motivation (i.e., enjoyment in reading) amounts to 0.68, with female students showing higher mean-levels in intrinsic reading motivation than male students. Previous literature suggests two competing hypotheses about the emergence of such gender differences in the developmental changes in intrinsic reading motivation. The *gender intensification hypothesis* (Hill & Lynch, 1983) suggests an *increase* in the gender gap in motivational constructs during adolescence because of an intensification of gender-differential socialization shortly after the beginning of puberty. By contrast, the *gender convergence hypothesis* suggests a *decrease* in the gender gap in motivational constructs during adolescence as children progress through school and receive more realistic perceptions about themselves independent of gender roles and stereotypes (Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2002; Watt, 2004).

However, neither the gender intensification nor the gender convergence hypothesis on the developmental changes in intrinsic reading motivation has received consistent empirical support in previous literature. Dotterer, McHale, and Crouter (2009) examined the developmental changes in academic (domain-general) interests from Grades 1 to 12 in a sample of American students. They found that although boys and girls both experienced a substantial decline in academic interests over the school years, the rate of decline was significantly faster for boys compared to girls. This result indicates an increase in the gender gap in academic interests across age, in line with the gender intensification argument. By contrast, Watt (2004) examined the age-related changes in intrinsic language motivation from Grades 7 to 11 among Australian students and found that boys and girls experienced a similar decline in intrinsic language motivation, in favor of neither the gender intensification nor the gender convergence hypothesis.

Students with different levels of parental socioeconomic status (SES) also tend to vary in their mean-levels of intrinsic reading motivation. Although SES-related differences are not as pronounced as gender differences, students who come from higher-SES families tend to show higher mean-levels of intrinsic reading motivation than students who come from lower-SES families ($d = 0.47^2$; OECD, 2010). This is not

surprising as parental SES is found to serve as an underlying factor for language development and school achievement (e.g., see Letourneau, Duffett-Leger, Levac, Watson, & Young-Morris, 2013; Sirin, 2005; White, 1982 for meta-analyses).

In addition to parental SES, a school context (e.g., ability-grouping) has been shown as an important factor which differentiates students' intrinsic motivation across countries (e.g., in the U.S., Fuligni, Eccles, & Barber, 1995; in Slovenia, Peklaj, Zagar, Pecjak, & Puklek Levpuscek, 2006; in Nigeria, Adodo & Agbayewa, 2011). In Germany, where the present study was conducted, most federal states place students in a different school track based on their school grades and teachers' recommendations after Grade 4. Although there is a great variety in school systems across different federal states, there is one basic distinction: the academic-oriented track (i.e., Gymnasium), typically leading to tertiary education, and the vocationally-oriented track (i.e., Realschule and Hauptschule), typically leading to vocational training and directly into the labor market.

Previous research has shown that students attending an academic school track tend to show higher mean-levels of intrinsic reading motivation than students attending a vocational school track in Germany (Miyamoto, Pfof, & Artelt, 2018; Roeschl-Heils, Schneider, & van Kraayenoord, 2003; Schaffner et al., 2016). This may be because students in an academic school track are a selective group of students who have higher mean-levels of academic achievement (e.g., Baumert, Watermann, & Schümer, 2003; Becker, Lüdtke, Trautwein, & Baumert, 2006) which often go along with higher mean-levels of intrinsic motivation (e.g., Miyamoto et al., 2018). In addition, teachers in an academic school track tend to have higher mean-levels of content and pedagogical content knowledge compared to those in a vocational school track possibly due to differences in the curriculum of teacher training and the standards of teacher certificates across school tracks (Baumert et al., 2010), which may explain for potential differences in students' intrinsic motivation between school tracks.

In contrast to the aforementioned cross-sectional studies comparing the mean-levels of intrinsic reading motivation across students' parental SES levels and school tracks, there is a lack of longitudinal studies comparing the developmental changes in intrinsic reading motivation across these groups. However, it is plausible to assume that students from higher-SES families and academic track schools are less susceptible to the developmental decline in intrinsic reading motivation in comparison to students from lower-SES families and vocational track schools. This is because students from higher-SES families and academic track schools may receive more financial and academic resources and support from their parents and teachers for helping them maintain their intrinsic reading motivation.

1.4. Implications of the developmental decline in intrinsic reading motivation for the development of students' reading proficiency

Most educational researchers would probably agree that the motivational decline is detrimental to students' learning processes and educational outcomes as lower mean-levels of intrinsic motivation go along with lower mean-levels of academic achievement across subjects (e.g., see a meta-analysis by Kriegbaum et al., 2018). However, so far, there is a lack of large-scale longitudinal research that examined the extent to which a developmental decline in intrinsic reading motivation is associated with age-related changes in students' learning outcomes, in particular, the development of reading proficiency. Otis, Grouzet, and Pelletier (2005) examined the relationships between the developmental decline in intrinsic (domain-general) motivation and various types of educational consequences (i.e., frequency of doing homework, school drop-out intentions, class absenteeism, and educational

² Higher and lower SES families are defined as those with scores on the top and the bottom quarters of the PISA index of economic, social and cultural

(footnote continued)
status respectively.

aspirations) of secondary school students in Canada. They found that students who experienced a motivational decline to a lesser extent between Grades 8 and 10 had a better academic adjustment (i.e., higher frequency of homework, higher levels of educational aspirations, and lower chances of drop-out intentions and absenteeism) in Grade 10. However, intrinsic motivation in the study of Otis et al (2005) was not specific to reading and their study also did not provide an objective measure of students' learning outcomes (e.g., reading proficiency).

A few previous studies (Gottfried et al., 2007, 2013) investigated the relationship between the developmental decline in intrinsic math motivation and math achievement among school students aged 9–17 years in the United States. Those studies found that, over the years of the study duration, both intrinsic math motivation and math achievement showed significant average declines. Moreover, the declines in motivation and achievement were positively related, indicating that students who experienced a stronger decline in their intrinsic math motivation also experienced a stronger decline in their math achievement. As reading is a fundamental means to learning all subjects (e.g., understanding textbooks, homework instructions, and exam questions) in our current educational system, it seems important to extend previous research to the context of reading and investigate whether a potential decline in intrinsic reading motivation may hamper the development of reading proficiency.

1.5. The present study

In the present study, we replicate and extend previous research on the longitudinal changes in intrinsic motivation during early adolescence. We focus on the development of intrinsic reading motivation in German secondary school students as a case in point. We use large-scale, long-running panel data spanning five years from Grades 5 to 10 and comprising six measurement occasions for intrinsic reading motivation (and three for reading proficiency). Our study's aims are threefold.

First, as a key prerequisite to the subsequent substantive analyses—one that has not been firmly established by prior research—we examine the longitudinal measurement invariance of intrinsic reading motivation from Grades 5 to 10. In addition, we test the longitudinal measurement invariance while also taking into account the group measurement invariance across key demographic characteristics of students, namely, gender, parental SES, and school track (academic vs. vocational).

Second, we examine the generalizability of the developmental patterns in intrinsic reading motivation. In so doing, we aim to establish whether the magnitude of the developmental decline in intrinsic reading motivation observed in earlier studies generalizes to German secondary school students. Moreover, we examine variations in the developmental trajectories of intrinsic reading motivation across students' demographic subgroups defined by gender, parental SES, and school track. We expect that all students experience a decline in intrinsic reading motivation regardless of the subgroups they belong to, but the degree of observed changes may differ across certain subgroups of students. Specifically, we hypothesize that students from higher-SES families and students attending academic track schools would experience a smaller decline in intrinsic reading motivation than students in lower-SES families and students attending vocational track schools. This is because students from higher-SES families and academic track schools may receive more financial and academic support from their parents and teachers for helping them maintain their levels of intrinsic reading motivation compared to their counterparts. We do not formulate a specific hypothesis on gender differences in the magnitude of developmental changes in intrinsic reading motivation as there seems to be mixed evidence in previous research on this matter.

Our third aim is to investigate the associations between the developmental decline in intrinsic reading motivation and the development of students' reading proficiency across the same period. Given the

importance of intrinsic reading motivation for reading proficiency development (e.g., Miyamoto, Pfost, & Artelt, 2019; Schiefele, Schaffner, Möller, & Wigfield, 2012), we hypothesize that there is a positive relationship between the changes in intrinsic reading motivation and the changes in reading proficiency, indicating that the larger the decline in intrinsic reading motivation students experience, the smaller the growth of reading proficiency students exhibit over time.

2. Method

2.1. Data and sample

We used the data from the German National Educational Panel Study (NEPS), Starting Cohort 3 (SC3)³. The data and documentation are public and can be accessed after registration from the NEPS website at <https://www.neps-data.de/en-us/home.aspx>. NEPS is a framework with a multi-cohort longitudinal design to investigate educational developments and outcomes through a life course (Blossfeld, Roßbach, & von Maurice, 2011). NEPS SC3 is a representative sample of secondary school students in Germany. These students were first tested in 2010 when they were in Grade 5 (this is after students were placed in different school tracks in a majority of federal states) and have been followed every year afterward. The original SC3 sample consisted of 6112 students at wave 1 (in Grade 5). In some Federal States, Grade 5 students sampled in NEPS leave their institutional contexts in which they were originally sampled and surveyed for; therefore, a refreshment sample was added in wave 3 (in Grade 7) to compensate the attrition of the students who could not be followed up. This increased the total sample size in wave 3 to $N_{\text{total}} = 8317$ (see Steinhauer & Zinn, 2016, for more information on the refreshment sample and the attrition rates in NEPS SC3). We included both the original and the refreshment samples in our analyses but restricted our analytical sample to those who attended regular secondary schools and who had information on intrinsic reading motivation in at least one of the six waves. Descriptive statistics and information on missing values of all manifest indicators can be found in the Appendix (Table A1). On average, students in our analytical sample were 10.64 years old ($SD = 0.37$) at wave 1 in Grade 5. Roughly half (48%) attended academic track schools whereas the rest attended vocational track schools. Approximately half (48%) of them were female. The analytical sample included students coming from a wide range of socioeconomic backgrounds; ISEI (International Socio-Economic Index of Occupational Status) varied from 11.74 to 88.96 on a scale with a possible range between 10 and 90. On average, the levels of students' mothers' and fathers' SES were similar ($M = 48.68$, $SD = 3.31$ for mothers and $M = 48.56$, $SD = 4.52$ for fathers). 26% of participants had an immigration background (i.e., both parents were not born in Germany).

2.2. Measures

2.2.1. Intrinsic reading motivation

We operationalized intrinsic reading motivation as students' inherent interest and enjoyment of reading. In NEPS SC3, intrinsic reading motivation was measured based on students' self-reports across six waves from Grades 5 to 10 with a one-year interval. The scale of intrinsic reading motivation included the items selected from the

³ The NEPS study is conducted under the supervision of the German Federal Commissioner for Data Protection and Freedom of Information and in coordination with the German Standing Conference of the Ministers of Education and Cultural Affairs and – in the case of surveys at schools – the Educational Ministries of the respective Federal States. All data collection procedures, instruments and documents were checked by the data protection unit of the Leibniz Institute for Educational Trajectories. Participation in the NEPS study was completely voluntary, and participants could withdraw from the study at any time. All participants gave informed consent.

Habitual Reading Motivation Questionnaire (HRMQ; Möller & Bonerad, 2007). The HRMQ is an established German scale with its high internal consistency and strong factorial, convergent (e.g., related to reading activity), and discriminant (e.g., unrelated to interests for sports) validity (Möller & Bonerad, 2007; Schiefele, et al., 2012). It has been widely used by researchers in Germany, in particular within large scale assessments (e.g., Miyamoto et al., 2018, 2019; Retelsdorf, Köller, & Möller, 2011, 2014).

The NEPS experts selected the items from the original HRMQ according to several rationales. First, as the number of items that can be included in the large-scale assessment was limited, the experts chose the items which cover the breadth of the construct in a general context. In addition, the length and the linguistic level of the items were also taken into account with the compatibility to other age cohorts of the NEPS data. In our present analyses, we included four of these items that reflected intrinsic reading motivation, that is, interest in and enjoyment of reading for its own sake. The selected items included the following four statements: (1) “I enjoy reading books”, (2) “I think that reading is interesting”, (3) “If I had enough time, I would read even more”, and (4) “I like reading about new things”.⁴ Those items were not specific to reading activities at school; instead, they were designed to measure habitual motivation for reading activities in general, regardless of the context in which reading takes place. Students answered all items on a four-point rating scale ranging from 1 (*do not agree at all*) to 4 (*completely agree*). In the present sample, the internal consistencies of the scale (Raykov's Rho) ranged between 0.86 and 0.92 across the six waves.

2.2.2. Reading proficiency

NEPS administered standardized reading proficiency tests in Grades 5, 7, and 9. This reading proficiency test was developed by experts in the NEPS based on various text comprehension theories (Gehrer, Zimmermann, Artelt, & Weinert, 2013). The test included five types of continuous texts with a length of approximately 200–550 words (i.e., informational, commenting, literacy, instructional, and advertising texts). For each text type, participants were asked to find information in a text, draw text-related conclusions, and understand an overall message of a text. Questions were answered in the forms of multiple-choice, decision-making, or matching (see Gehrer, Zimmermann, Artelt, & Weinert, 2012, for a more detailed description of the tests). The test was not a part of school assessment and was designed to measure students' reading proficiency that is beyond their knowledge of school reading. All tests contained approximately 30–40 items and took about 30 min to complete. For longitudinal analyses, NEPS provides the proficiency test scores in the form of uncorrected weighted likelihood estimates (WLE), which were estimated based on item response theory (IRT) models. The WLE scores were statistically linked across waves and were found to be longitudinally measurement invariant (Fischer, Rohm, Gnamb, & Carstensen, 2016; Pohl, Haberkorn, Hardt, & Wiegand, 2012). The internal consistency of the WLE scores ranged between 0.77 and 0.79 across waves (see NEPS technical reports: in Grade 5, Pohl et al., 2012; in Grade 7, Krannich et al., 2017; in Grade 9, Scharl, Fischer, Gnamb, & Rohm, 2017).

2.2.3. Gender

We coded gender such that male students represented the reference group (0 = male; 1 = female).

2.2.4. Parental SES

Parental SES was measured with students' mothers' and fathers'

occupational status based on the ISEI (International Socio-Economic Index of Occupational Status) scale (Ganzeboom, Graaf, & Treiman, 1992) from the parental questionnaire. The scale ranged between 10 and 90, where 10 indicates the occupations with the lowest SES and 90 indicates the occupations with the highest SES. We obtained the information on parental SES from the first time point. With regard to the refreshment sample (who joined the study only after the third wave), we obtained this information from the third wave instead of the first wave. For the latent growth curve model analysis, we specified a latent factor of parental SES as a time-invariant covariate using two manifest indicators: the mothers' and the fathers' occupational status scores on the ISEI scale. For other descriptive analyses and measurement invariance testing, we re-coded the mothers' occupational status scores as a binary variable (0 = low SES; 1 = high SES) using a median split.

2.2.5. School tracks

The types of school track students attended were categorized as either vocational (coded = 0) or academic (coded = 1). Vocational tracks included German *Realschule* and *Hauptschule* schools or equivalent tracks in comprehensive schools. These school tracks typically lead to vocational education or the labor market after Grade 9 or Grade 10. Students in an academic school track included those who attended *Gymnasium* schools or equivalent tracks in comprehensive schools. These school tracks typically lead to tertiary education after Grade 12 or 13.

2.3. Statistical analyses

Our statistical analyses proceeded in the following four steps. In the first step, we used confirmatory factor analysis (CFA) to examine whether a single-factor model measuring intrinsic reading motivation with four observed indicators fit the data and exhibited a measurement invariance over time across six occasions. The measurement invariance test involves four levels that vary in the number of model parameters that are invariant across the time-points. We started with the configural invariance model followed by the metric, the scalar, and the strict invariance models (Chen, 2007). This procedure is practiced typically for testing group measurement invariance, but it has also been applied for testing longitudinal measurement invariance (e.g., Frenzel, Pekrun, Dicke, & Goetz, 2012).

A *configural invariance model* was specified in which six correlated factors (i.e., intrinsic reading motivation at Time 1 through Time 6). All factor means were fixed to 0 and all factor variances were fixed to 1 for model identification. Factor covariances and residual covariances between the same indicators across occasions were freely estimated. We then examined a *metric invariance model*. In this model, the factor variance was fixed to 1 at Time 1 for model identification but was freely estimated from Times 2 and 6. All factor loadings were constrained to be equal across time. Following that, we tested a *scalar invariance model*, in which all factor loadings and indicator intercepts were constrained to be equal across time. Finally, we examined a *strict invariance model*. All factor loadings, indicator intercepts, and residual variances were constrained to be equal across time. At least partial scalar invariance was required to study mean-level changes over time without incurring bias. We also replicated the analyses of longitudinal measurement invariance together with the group measurement invariance for each subgroup: gender (male and female), parental SES (high and low), and school tracks (academic and vocational).

In the second step, we specified latent growth curve models to investigate possible group variations in the developmental decline in intrinsic reading motivation across gender, parental SES, and school tracks. We specified an unconditional model without any time-invariant covariates and a conditional model with gender, parental SES, and school tracks as time-invariant covariates. In both models, two additional latent factors were specified: the intercept and the slope factors. The intercept factor indicated the initial state of intrinsic reading

⁴ The data comprised two additional items that capture instrumental aspects of reading motivation instead of intrinsic motivation, which we did not include in our analyses. These items read: “I am convinced that I can learn a lot by reading”, and “Reading is important to understand things right”.

motivation, whereas the slope factor referred to as the changes in intrinsic reading motivation over time. We used a latent basis model specification (Grimm, Ram, & Hamagami, 2011); in this specification, the loading of the slope factor on the first time point is fixed to zero, that on the last time point is fixed to unity, and loadings on the time points in between are freely estimated. Instead of imposing a particular form of growth (e.g., linear) upon the data, the latent basis specification allows the development trajectory modeled by the slope to take any shape including a non-linear, and thus enables better fit to the data. In this model, the factor loadings, and the latent means of the four indicators were constrained to be equal across six occasions of measurement.

In the last step, to examine the associations between the developmental decline in intrinsic reading motivation and the developmental growth of reading proficiency, we estimated a parallel (bivariate) latent growth curve model in which we specified an intercept and a slope of reading proficiency over three-time points (in Grades 5, 7, and 9) in addition to the intercept and the slope of intrinsic reading motivation from six-time points (in Grades 5 through 10). This model can provide information on (1) how the initial state of intrinsic reading motivation is related to the initial state of reading proficiency, (2) how the initial state of intrinsic reading motivation is related to the changes in reading proficiency, (3) how the initial state of reading proficiency is related to the changes in intrinsic reading motivation, and most importantly, (4) how the changes in intrinsic reading motivation are related to the changes in reading proficiency.

To evaluate the model fit, we relied on the comparative fit index (CFI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR). Chi-square statistic was not used as a sole indicator of model fit as it can be sensitive to a large sample size (Hooper, Coughlan, & Mullen, 2008). We used the recommended cut-offs of $CFI > 0.95$, $RMSEA < 0.05$, and $SRMR < 0.05$ as indicating a good model fit, and $CFI > 0.90$, $RMSEA < 0.08$, and $SRMR < 0.08$ as indicating an acceptable model fit (Hooper et al., 2008; Kline, 2011; McDonald & Ho, 2002). In addition, we further relied on Chen (2007)'s recommendations for evaluating the measurement invariance. That is, for testing metric invariance, a change of ≥ 0.010 in CFI, supplemented by a change of ≥ 0.015 in RMSEA or a change of ≥ 0.030 in SRMR would indicate noninvariance; for testing scalar and residual invariance, a change of ≥ 0.010 in CFI, supplemented by a change of ≥ 0.015 in RMSEA or a change of ≥ 0.010 in SRMR would indicate noninvariance.

All analyses were conducted using Mplus 8.1 (Muthén & Muthén, 1998–2017). All models were estimated with the maximum likelihood estimation with robust standard errors (MLR) which corrects standard errors of the estimates for non-normality. To deal with missing values, we applied the full information maximum likelihood method (FIML). This method allows us to analyze each case available in the data and compute maximum likelihood estimates of parameters. We were unable to control for the nested structure of the data in our analyses (i.e., students are nested in schools) because many students switched their schools across waves. Nevertheless, as a robustness check, we replicated all analyses with the subsample of students who did not change their schools during the study period ($N = 3370$).

3. Results

3.1. Is students' intrinsic reading motivation measurement invariant across time and groups?

Table 1 represents the results of the longitudinal measurement invariance testing of intrinsic reading motivation. Our results showed that our CFA model measuring intrinsic reading motivation with four observed indicators exhibited up to the most restricted level of measurement invariance (*strict invariance*). This implies that the structure of intrinsic reading motivation stayed the same across the six-time points.

Tables 2–4 indicate the results of the longitudinal measurement invariance testing combined with the testing of group measurement invariance for gender, parental SES, and school tracks separately. The multiple-group CFA models suggested that intrinsic reading motivation showed strict measurement invariance for all combinations of the longitudinal and group measurement invariance. In other words, we found a high structural similarity in the construct of intrinsic reading motivation across time and groups (gender, parental SES, and school tracks). This methodological condition also allowed us to statistically compare the mean-levels and changes across time and groups simultaneously.

3.2. How large is the developmental decline in intrinsic reading motivation?

Table 5 indicates latent means, standard deviations, and inter-correlations for intrinsic reading motivation from Grades 5 to 10. The latent means of students' intrinsic reading motivation decreased from $M = 3.11$ ($SD = 0.79$) in Grade 5 to $M = 2.50$ ($SD = 0.94$) in Grade 10 which implies a drop of more than half a scale point in the raw metric of the items. The graphical representation of the estimated mean changes in intrinsic reading motivation throughout the waves (Fig. 1) also indicates a steady and approximately linear decline in intrinsic reading motivation from Grades 5 to 10. The rank-order stabilities (correlations between measurement occasions) of intrinsic reading motivation was $r = 0.56$ for the five years between Grade 5 and Grade 10. The one-year stabilities increased every year, from $r = 0.73$ between Grade 5 and 6 to $r = 0.89$ between Grade 9 and 10.

Table 6 represents the results of the latent growth curve model⁵ without time-invariant covariates. The model showed a good fit ($\chi^2 = 2284.69$, $df = 219$, $p < .001$, $CFI = 0.977$, $RMSEA = 0.034$, $SRMR = 0.052$). A negative and significant latent mean of slope factor indicates a significant decline in intrinsic reading motivation from Grades 5 to 10. On average, the trajectory of intrinsic reading motivation was 3.10 at Grade 5 and declined -0.598 units over five years. As a robustness check, we replicated the analyses using a Type = Complex command in Mplus in a sample of students who did not change their schools throughout the waves ($N = 3379$) to control for the nested structure of the data (i.e., students are nested in schools). Similar results emerged. On average, the trajectory of intrinsic reading motivation was 3.19 at Grade 5 and declined -0.612 units over five years.

To further quantify the magnitude of the changes in intrinsic reading motivation over five years, we calculated the pretest-posttest raw score effect size, known as Glass's Δ ⁶ (Morris & DeShon, 2002), which has also been used by a recent meta-analysis (Scherrer & Preckel, 2019). This effect size is calculated by subtracting the mean score of a construct at the earlier time point from the mean score of the construct at the later time point and dividing this difference by the SD of the earlier measure. Glass's Δ for the changes in the latent mean from Grade 5 to Grade 10 was estimated to be $\Delta = -0.772$, $p < .001$, indicating that the mean level of intrinsic reading motivation decreased by more than three-quarters of a standard deviation over five years, which can be considered a relatively large effect.

The results of an (unconditional) latent growth curve model also

⁵ We also ran a latent class growth model and a growth mixture model to see whether there are different latent classes of trajectories in intrinsic reading motivation. Three to four different latent class trajectories emerged. However, those class trajectories only differed in the initial levels of intrinsic reading motivation and the amount of changes over time, and not the shape of the curve. This finding is a very strong indication that the underlying population model does not consist of distinct class trajectories but of continuous dimensions (higher vs. lower intercept and slope).

⁶ We used Glass's Δ as the measure of our effect size because Glass's Δ is a more appropriate measure of an effect size than other measures (e.g., Cohen's d) if two time points have dissimilar SD s, which was in our case.

Table 1
Measurement invariance of intrinsic reading motivation across time.

Invariance test	χ^2	df	p-value	CFI	RMSEA	SRMR	Δ CFI	Δ RMSEA	Δ SRMR
Configural	1141.106	177	$p < .001$	0.989	0.026	0.024			
Metric	1498.512	192	$p < .001$	0.985	0.029	0.042	0.004	0.003	0.018
Scalar	1904.026	207	$p < .001$	0.981	0.032	0.046	0.004	0.003	0.004
Strict	2395.812	227	$p < .001$	0.976	0.034	0.046	0.005	0.002	0.000

Table 2
Measurement invariance of intrinsic reading motivation across time and gender.

Invariance test	χ^2	df	p-value	CFI	RMSEA	SRMR	Δ CFI	Δ RMSEA	Δ SRMR
Configural	1282.785	354	$p < .001$	0.989	0.026	0.022			
Metric	2518.140	405	$p < .001$	0.975	0.036	0.043	0.014	0.010	0.021
Scalar	2874.089	420	$p < .001$	0.971	0.038	0.045	0.004	0.002	0.002
Strict	3586.984	524	$p < .001$	0.964	0.038	0.046	0.007	0.000	0.001

Table 3
Measurement invariance of intrinsic reading motivation across time and parental SES.

Invariance test	χ^2	df	p-value	CFI	RMSEA	SRMR	Δ CFI	Δ RMSEA	Δ SRMR
Configural	1041.415	354	$p < .001$	0.988	0.028	0.026			
Metric	1359.112	405	$p < .001$	0.983	0.031	0.046	0.005	0.003	0.020
Scalar	1627.697	420	$p < .001$	0.979	0.034	0.048	0.004	0.003	0.002
Strict	2122.807	464	$p < .001$	0.971	0.038	0.050	0.008	0.004	0.002

Table 4
Measurement invariance of intrinsic reading motivation across time and school tracks.

Invariance test	χ^2	df	p-value	CFI	RMSEA	SRMR	Δ CFI	Δ RMSEA	Δ SRMR
Configural	1217.248	354	$p < .001$	0.988	0.028	0.026			
Metric	1721.809	405	$p < .001$	0.982	0.033	0.047	0.006	0.010	0.021
Scalar	2073.431	420	$p < .001$	0.977	0.036	0.051	0.005	0.003	0.004
Strict	2570.208	464	$p < .001$	0.971	0.039	0.052	0.006	0.003	0.001

Table 5
Latent means, standard deviations, and inter-correlations of intrinsic reading motivation across time.

	Grade 5	Grade 6	Grade 7	Grade 8	Grade 9	Grade 10
Grade 5						
Grade 6	0.73					
Grade 7	0.70	0.78				
Grade 8	0.68	0.79	0.81			
Grade 9	0.63	0.76	0.79	0.87		
Grade 10	0.56	0.71	0.75	0.84	0.89	
M (SD)	3.11 (0.79)	2.90 (0.83)	2.77 (0.88)	2.71 (0.83)	2.65 (0.86)	2.50 (0.94)

showed that there was a significant and negative covariance between the intercept and the slope factor, indicating that a higher initial level of intrinsic reading motivation is associated with a steeper decline in intrinsic reading motivation. Moreover, there were significant variances in both the intercept and the slope factors, reflecting individual variability in the average initial levels and the changes in intrinsic reading motivation.

3.3. Is the developmental decline in intrinsic reading motivation generalizable across gender, parental SES, and school tracks?

Tables 7–9 show the results of the group differences in the latent means, standard deviations, and Cohen's d , and Figs. 2–4 indicate the graphical representations of the estimated latent mean changes for each group. On average, students who are female, who come from higher-SES families, and who attend academic track schools tend to have higher mean-levels of intrinsic reading motivation compared to those

who are male, who come from lower-SES families, and who attend vocational track schools throughout the waves. The effect sizes (Cohen's d) of gender differences increased throughout the waves, ranging from 0.38 to 0.64. The effect sizes of parental SES and school track ranged from 0.27 to 0.34 and from 0.48 to 0.55 respectively, and they stayed relatively stable across the waves. Table 10 shows the results for the latent growth curve model with gender, parental SES, and school tracks as time-invariant covariates. The model showed a good fit ($\chi^2 = 3066.82$, $df = 285$, $p < .001$, CFI = 0.969, RMSEA = 0.035, SRMR = 0.051). All time-invariant covariates showed statistically significant effects on the initial state (intercept) of intrinsic reading motivation. With regard to the change (slope) in intrinsic reading motivation, all students experienced a significant decline in intrinsic reading motivation from Grades 5 to 10 regardless of their gender, parental SES, and school tracks. Moreover, the rate of decline in intrinsic reading motivation was significantly faster for boys compared to girls. Contrary to our hypothesis, parental SES and school tracks did not

Estimated Latent Mean-Changes in Intrinsic Reading Motivation Over Six Time Points

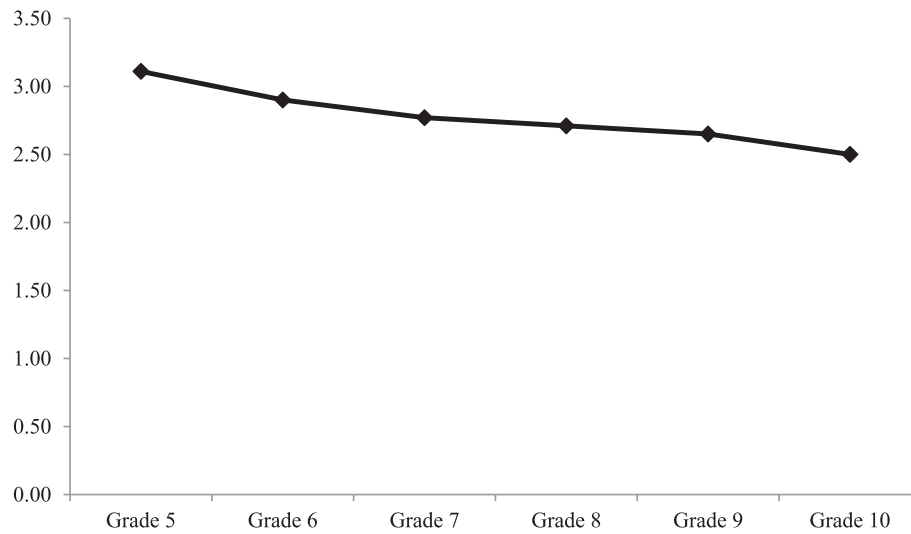


Fig. 1. Estimated Latent Mean-Changes in Intrinsic Reading Motivation Over Six Time Points.

have any effects on the rate of decline in intrinsic reading motivation.

3.4. How is the decline in intrinsic reading motivation related to the growth of students' reading proficiency?

Fig. 5 shows the results for the parallel (bivariate) latent growth curve model of intrinsic reading motivation and reading proficiency. The model showed a good fit ($\chi^2 = 3077.33$, $df = 307$, $p < .001$, CFI = 0.972, RMSEA = 0.033, SRMR = 0.049). While students' intrinsic reading motivation declined by -0.62 , their reading proficiency increased by 1.27 units over five years. The intercept of intrinsic reading motivation was significantly and positively correlated with the intercept of reading proficiency ($r = 0.41$, $p < .001$), implying that students with higher intrinsic reading motivation tend to have higher reading proficiency in Grade 5. Moreover, the intercept of intrinsic reading motivation was significantly and negatively associated with the slope of reading proficiency, indicating that students with a higher initial state of intrinsic reading motivation tend to exhibit a slower growth in reading proficiency over time ($r = -0.07$, $p < .05$). Furthermore, the intercept of reading proficiency was significantly and positively related to the slope of intrinsic reading motivation, suggesting that students with a higher initial state of reading proficiency tend to exhibit a smaller decline in intrinsic reading motivation

Table 7

Latent means, standard deviations, and Cohen's d for gender differences.

	Male M (SD)	Female M (SD)	Cohen's d
Grade 5 Intrinsic reading motivation	2.94 (1.00)	3.29 (0.83)	0.38
Grade 6 Intrinsic reading motivation	2.72 (0.96)	3.12 (0.87)	0.44
Grade 7 Intrinsic reading motivation	2.57 (0.95)	3.02 (0.90)	0.49
Grade 8 Intrinsic reading motivation	2.47 (0.89)	2.97 (0.88)	0.57
Grade 9 Intrinsic reading motivation	2.37 (0.91)	2.92 (0.90)	0.61
Grade 10 Intrinsic reading motivation	2.19 (0.99)	2.83 (1.02)	0.64

($r = 0.11$, $p < .001$). Finally, and most importantly, the slope of intrinsic reading motivation was significantly and positively correlated with the slope of reading proficiency, implying that a larger decline in intrinsic reading motivation was associated with smaller growth in reading proficiency ($r = 0.18$, $p < .001$).

4. Discussion

The goal of the present study was to replicate and extend previous research on the longitudinal changes in intrinsic reading motivation during early adolescence from Grades 5 to 10. Using large-scale panel

Table 6

Latent growth curve model without covariates.

	Unstandardized estimate (SE)	Standardized estimate (SE)
<i>Slope factor loadings</i>		
Intrinsic reading motivation (Grade 5)	0.000	0.830 (0.011) ***
Intrinsic reading motivation (Grade 6)	0.336 (0.019) ***	0.826 (0.011) ***
Intrinsic reading motivation (Grade 7)	0.542 (0.018) ***	0.816 (0.012) ***
Intrinsic reading motivation (Grade 8)	0.664 (0.017) ***	0.844 (0.012) ***
Intrinsic reading motivation (Grade 9)	0.789 (0.013) ***	0.818 (0.012) ***
Intrinsic reading motivation (Grade 10)	1.000	0.733 (0.011) ***
<i>Covariance</i>		
Intercept, Slope	-0.186 (0.021) ***	-0.289 (0.024) ***
<i>Latent means</i>		
Intercept	3.102 (0.014) ***	3.993 (0.064) ***
Slope	-0.598 (0.017) ***	-0.721 (0.026) ***
<i>Variances</i>		
Intercept	0.603 (0.017) ***	1.000
Slope	0.687 (0.032) ***	1.000

Note. Model fit: CFI = 0.977; RMSEA = 0.052; SRMR = 0.034.

Table 8
Latent means, standard deviations, and Cohen's *d* for socioeconomic differences.

	Low SES <i>M</i> (<i>SD</i>)	High SES <i>M</i> (<i>SD</i>)	Cohen's <i>d</i>
Grade 5 Intrinsic reading motivation	3.06 (0.95)	3.30 (0.85)	0.27
Grade 6 Intrinsic reading motivation	2.86 (0.95)	3.13 (0.86)	0.30
Grade 7 Intrinsic reading motivation	2.70 (0.95)	3.02 (0.91)	0.34
Grade 8 Intrinsic reading motivation	2.62 (0.93)	2.94 (0.87)	0.36
Grade 9 Intrinsic reading motivation	2.58 (0.95)	2.85 (0.92)	0.29
Grade 10 Intrinsic reading motivation	2.46 (1.05)	2.74 (1.04)	0.27

data on secondary school students in Germany, we examined: (1) the longitudinal measurement invariance of intrinsic reading motivation from Grades 5 to 10, (2) the developmental decline in intrinsic reading motivation in the sample at large, and its generalizability across gender, parental SES, and school tracks, and (3) the associations between the developmental trajectories of intrinsic reading motivation and the developmental trajectories of reading proficiency. The findings of the present study extend our knowledge on the developmental decline in intrinsic reading motivation and provide important implications for educational researchers and practitioners.

First, the present findings broaden our methodological perspectives on the development of structural changes in the construct of intrinsic reading motivation during early adolescence. Our results confirmed the assumption of the most restricted level of measurement invariance (strict measurement invariance) of intrinsic reading motivation across six occasions of measurement, spanning five years, from Grades 5 to 10. Moreover, the level of longitudinal measurement invariance stayed the same even when we additionally constrained all parameters (e.g., intercepts, variances) to be equal across each subgroup (i.e., gender, parental SES, and school tracks). This finding emphasizes the stability and the generalizability of the structural differences in the construct of intrinsic reading motivation across students' age and demographic characteristics.

With the assumption of strict longitudinal measurement invariance, we were able to make a considerably more precise and accurate estimation of the magnitude of the developmental decline in intrinsic reading motivation compared to most previous research. In our study, Glass's Δ for the change of the latent means of intrinsic reading motivation from the first (Grade 5) to the last measurement occasion (Grade 10) was estimated to be $\Delta = -0.772$, $p < .001$. This indicates that the mean-level of intrinsic reading motivation tends to decrease by more than three-quarters of a standard deviation (0.77 *SD*) over five years. By comparison, a recent meta-analysis (Scherrer & Preckel, 2019) estimates the average effect size of the motivational change (Glass's Δ) in a variety of motivational indicators (i.e., self-concept, interest, goal orientation) across various academic domains (language, math, general) to be $\Delta = -0.108$, $p < .001$. On average, the mean-level of intrinsic motivation in that meta-analysis decreased by 0.108 *SD* over 1.654 school years, which would imply a per-year decrease of 0.065 *SD* and a five-year decrease of 0.326 *SD*. That is, the declines in intrinsic reading motivation in our study were more than double in size of the declines in intrinsic motivation reported in the meta-analysis (Scherrer & Preckel, 2019). Because the vast majority of the studies in the meta-analysis investigated domains other than reading, our findings tentatively

suggest that the declines in intrinsic reading motivation may be larger than the declines in intrinsic motivation in other domains. This is alarming to educational practitioners as reading is essential for all forms of learning. Moreover, because many earlier studies did not consider the measurement invariance of the instruments they used to measure intrinsic reading motivation, the magnitude of the declines observed by those studies could have been underestimated due to the non-invariance of the instruments. The fact that the scale used in our study met the precondition of (at least scalar) measurement invariance over time allowed us to validly compare the mean-levels of constructs across multiple time points. We recommend future research to take this condition seriously and always examine the measurement invariance of their variables before they investigate the mean-level differences across time points (van De Schoot et al., 2015; Widaman et al., 2010).

Second, the present study is among the first to test the generalizability of the developmental decline in intrinsic reading motivation across students' various demographic subgroups, namely, gender, parental SES, and school tracks. Throughout the early adolescence, students who are female, from higher-SES families, and academic track schools tend to show higher mean-levels of intrinsic reading motivation than their counterparts. Despite those mean-level differences across subgroups, all students tend to experience a developmental decline in intrinsic reading motivation. Moreover, the rate of decline also did not differ across students with different parental SES and from different school tracks, which implies that the initial gaps in intrinsic reading motivation did not further grow (or shrink) over time. As our study shows no evidence that students from higher-SES families or academic track schools are less prone to the developmental decline in intrinsic reading motivation, schools and teachers may want to be keen on students' developmental changes in intrinsic reading motivation regardless of their students' parental or school backgrounds.

In contrast to parental SES and school tracks, the rate of decline in intrinsic reading motivation seems to differ across gender. Male students tend to exhibit a steeper decline in intrinsic reading motivation compared to female students. This is in line with the gender intensification hypothesis (Hill & Lynch, 1983); the assumption that gender differences in intrinsic reading motivation tend to intensify over time due to the acceleration of gender-differential socialization during adolescence. The increase in the gender gap in intrinsic motivation has also been reported in other academic domains (i.e., math). For instance, Frenzel, Goetz, Pekrun, and Watt (2010) investigated the developmental decline in intrinsic math motivation in a sample of German students from Grades 5 to 9. They found that both male and female students showed a substantial decline in intrinsic math motivation over

Table 9
Latent means, standard deviations, and Cohen's *d* for differences across school tracks.

	Vocational <i>M</i> (<i>SD</i>)	Academic <i>M</i> (<i>SD</i>)	Cohen's <i>d</i>
Grade 5 Intrinsic reading motivation	2.93 (0.98)	3.38 (0.78)	0.51
Grade 6 Intrinsic reading motivation	2.72 (0.96)	3.19 (0.83)	0.52
Grade 7 Intrinsic reading motivation	2.55 (0.96)	3.06 (0.88)	0.55
Grade 8 Intrinsic reading motivation	2.49 (0.91)	2.98 (0.87)	0.55
Grade 9 Intrinsic reading motivation	2.42 (0.92)	2.90 (0.91)	0.52
Grade 10 Intrinsic reading motivation	2.28 (1.03)	2.77 (1.03)	0.48

Estimated Latent Mean Changes in Intrinsic Reading Motivation Across Gender

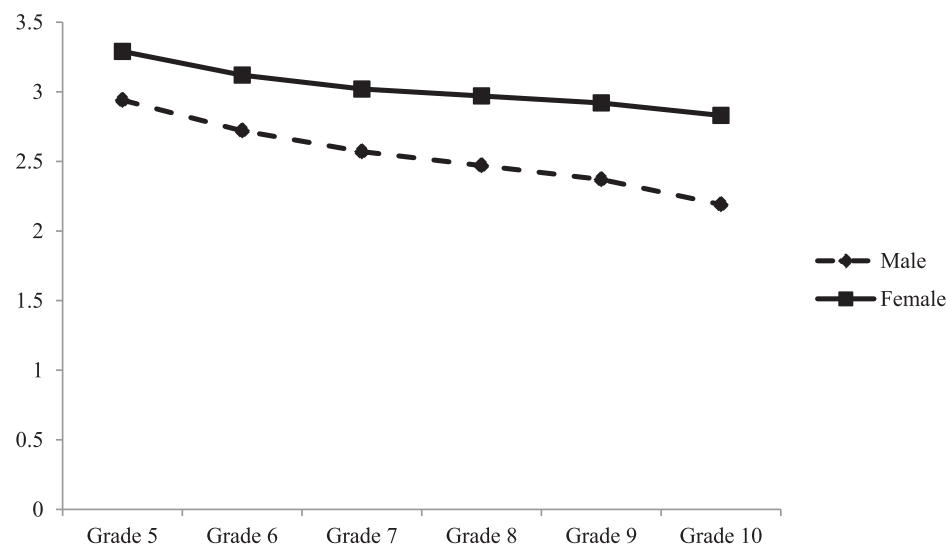


Fig. 2. Estimated Latent Mean Changes in Intrinsic Reading Motivation Across Gender.

time, but the degree of declines was significantly larger for female students compared to male students. Our results together with Frenzel et al. (2010) imply that male students tend to be more susceptible to the developmental decline in female gender-typed subjects (e.g., reading), whereas female students tend to be more prone to the developmental decline in male gender-typed subjects (e.g., math). Further research is needed to clarify the role of gender-typing in the development of gender differences in students' intrinsic motivation across subjects.

Finally, our results provide important insights into the relationship between the developmental change in intrinsic reading motivation and the developmental change in reading proficiency during early adolescence. Our findings imply that the larger the decline in students' intrinsic reading motivation, the smaller the growth of their reading proficiency. Due to the correlational nature of the data, we cannot determine the causality of the observed relationship. However, we believe that this correlation may reflect the reciprocity of the relationship between intrinsic reading motivation and reading proficiency (e.g., Miyamoto et al., 2018; Schiefele, et al., 2012); A steeper decline in

intrinsic reading motivation may disrupt the future growth of reading proficiency, and a smaller gain in reading proficiency may inhibit the further development of intrinsic reading motivation. To prevent such a vicious cycle, we encourage educational researchers and practitioners for continuing to develop and implement instructional methods that facilitate intrinsic reading motivation and reading proficiency simultaneously. One very well-known example of a reading intervention program is the Concept-Oriented Reading Instruction Program (CORI; see Guthrie, 2004 for a detailed description of the framework). This program provides teachers with extensive support for enhancing students' reading development by promoting their autonomy and choices in reading, using interesting and thought-provoking reading materials, and facilitating their collaborations in classrooms.

5. Limitations and directions for future research

The present study has several limitations that future research should address. First, the assessment of intrinsic reading motivation in NEPS

Estimated Latent Mean Changes in Intrinsic Reading Motivation Across Parental SES Levels

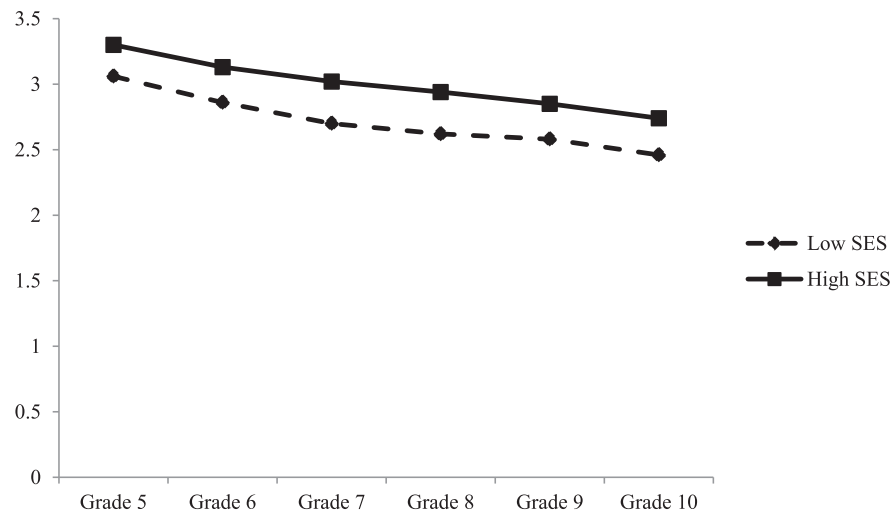


Fig. 3. Estimated Latent Mean Changes in Intrinsic Reading Motivation Across Parental SES Levels.

Estimated Latent Mean Changes in Intrinsic Reading Motivation Across the Types of School Tracks

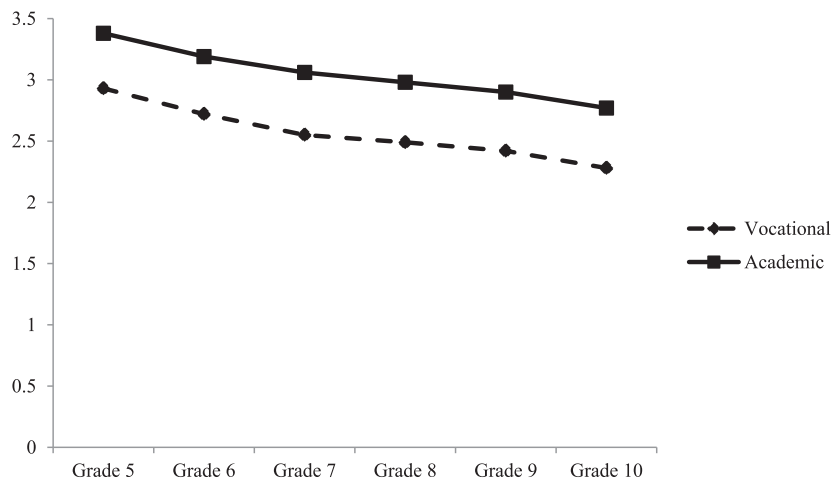


Fig. 4. Estimated Latent Mean Changes in Intrinsic Reading Motivation Across the Types of School Tracks.

Table 10

Latent growth curve model with time-invariant covariates (gender, SES, and school tracks).

	Unstandardized estimate (SE)	Standardized estimate (SE)
<i>Slope factor loadings</i>		
Intrinsic reading motivation (Grade 5)	0.000	0.825 (0.010) ***
Intrinsic reading motivation (Grade 6)	0.325 (0.019) ***	0.821 (0.011) ***
Intrinsic reading motivation (Grade 7)	0.526 (0.019) ***	0.814 (0.012) ***
Intrinsic reading motivation (Grade 8)	0.653 (0.017) ***	0.841 (0.012) ***
Intrinsic reading motivation (Grade 9)	0.785 (0.013) ***	0.813 (0.011) ***
Intrinsic reading motivation (Grade 10)	1.000	0.729 (0.011) ***
<i>Intercept</i>		
Gender (female)	0.296 (0.023) ***	0.191 (0.015) ***
Parental SES	0.015 (0.002) ***	0.253 (0.030) ***
School tracks (academic)	0.278 (0.037) ***	0.180 (0.024) ***
<i>Slope</i>		
Gender (female)	0.335 (0.031) ***	0.202 (0.019) ***
Parental SES	0.003 (0.002)	0.041 (0.038)
School tracks (academic)	−0.044 (0.048)	−0.026 (0.029)
<i>Covariance</i>		
Intercept, Slope	−0.206 (0.020) ***	−0.363 (0.024) ***
<i>Latent means</i>		
Intercept	2.822 (0.027) ***	3.649 (0.070) ***
Slope	−0.739 (0.033) ***	−0.892 (0.043) ***
<i>Variances</i>		
Intercept	0.489 (0.016) ***	0.818 (0.015) ***
Slope	0.656 (0.031) ***	0.958 (0.008) ***

Note. Model fit: CFI = 0.970; RMSEA = 0.034; SRMR = 0.050.

was based on the self-report items. The use of a self-report questionnaire for psychological variables is often criticized for its subjectivity and possible biases (e.g., Winne, Jamieson-Noel, & Muis, 2002). Thus, the use of a more objective measure of intrinsic reading motivation (e.g., assessments by teachers or parents) may be necessary for cross-validation of our findings in the future. In addition, the measure of intrinsic reading motivation also did not distinguish between “in school” and “out of school” contexts of reading; however, this distinction may be particularly relevant for understanding the role of school reading in explaining the developmental decline in students’ intrinsic reading motivation.

Self-determination theory (Ryan & Deci, 2017; Reeve et al., 2018) posits four types of motivation including external, introjected, identified, and intrinsic regulation which vary in their levels of sense of self-determination. External regulation is the least autonomous and the most extrinsic form of motivation (e.g., doing something to obtain a reward or avoid punishment), whereas intrinsic regulation (in line with our definition of intrinsic reading motivation) is the most autonomous and the least extrinsic form of motivation (e.g., doing something for our own sake). As students move to upper grades, they generally have less time to read for what they perceive as “enjoyment” or “interests” as they are increasingly required to spend their free time reading for school (e.g., completing assignments and preparing for exams). Reading for school involves a greater range of purposes and content, which likely corresponds to greater individual variability in their intrinsic reading motivation. Therefore, those who don’t inherently find the content of school reading interesting may rather rely their motivation on more extrinsic (i.e., introjected and external) forms of regulation to keep up with their school work.

For example, Nishimura and Sakurai (2017) found that intrinsic and identified regulation for school decreased whereas introjected and external regulation for school increased during three consecutive grades from Grades 7 to 9 in a sample of Japanese middle school students. Their findings imply that due to an increase in the amount of school reading, students may gradually learn to shift their motivation from intrinsic (more self-determined) to extrinsic (less self-determined) forms of motivation in order to adapt to the changes in their reading situations at school. More longitudinal research is needed to improve our knowledge regarding the inter-relations of the developmental changes in “in school” and “out of school” reading motivation, and how those two context-specific reading motivation interact with each other in influencing the developmental growth of reading proficiency.

Furthermore, as a measure of parental SES, we used the occupational status (ISEI) scores of both mothers and fathers to specify a latent variable of parental SES. However, there may be different levels of occupational status between mothers and fathers. We replicated analyses with the mothers’ occupational status alone, the fathers’ occupational status alone, and the composite score of both mothers’ and fathers’ occupational status. The findings were similar. Despite the mean-level differences, the rate of the decline in intrinsic reading motivation did not matter across parental SES. Although other possible measures of parental SES (e.g., household income) were not used in our study due to the large missing, future research may also consider other possibilities for measuring parental SES levels. Finally, we used parental SES and school tracks as possible contextual features that may influence the

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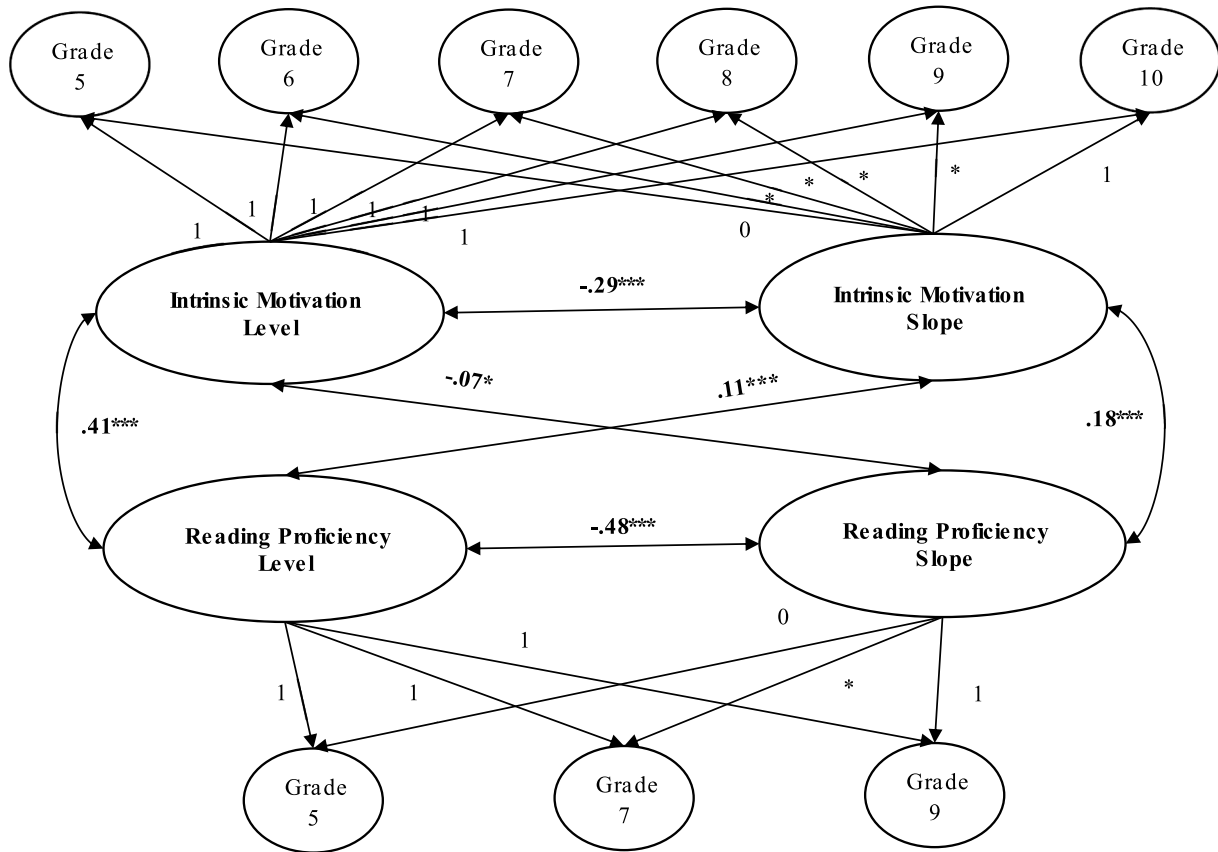


Fig. 5. Parallel Latent Growth Curve Model of Intrinsic Reading Motivation and Reading Proficiency.

developmental decline in intrinsic reading motivation. However, those factors are only a “glimpse” into contextual influences and do not provide a whole picture of the role of families and schools in the developmental decline in intrinsic reading motivation. Therefore, we call for future research to replicate our analyses with other measures of contextual features to further examine the role of family and school contexts in the developmental decline in intrinsic reading motivation during adolescence.

6. Conclusion

In sum, our study confirms previous findings that students tend to experience a steady and significant linear decline in intrinsic reading motivation throughout early adolescence (age between 10 and 16). This developmental decline, however, may be more pronounced in size than previously reported ($\Delta = -0.772$, $p < .001$). Notwithstanding differences in the initial levels of intrinsic reading motivation across these subgroups, the rate of decline in intrinsic reading motivation was similar across subgroups defined by parental SES and school track (academic vs. vocational). The rate of decline was even larger for male students compared to female students, in line with the gender intensification hypothesis. Various theories speak about potential reasons for the developmental decline in intrinsic reading motivation during school years. They converge in the idea that students may adapt their levels of intrinsic reading motivation in response to their contextual changes in their learning environments (e.g., less autonomy, more extrinsically imposed goals, and greater emphasis on performance

evaluations).

Our findings further suggest that students who experience a larger decline in intrinsic reading motivation tend to gain less reading proficiency during adolescence. Due to the reciprocal nature of the relationship between intrinsic reading motivation and reading proficiency, a larger decline in intrinsic reading motivation may disrupt the future growth of reading proficiency, while a smaller reading proficiency gain may inhibit the further development of intrinsic reading motivation. To put an end to such a vicious cycle, educational researchers and practitioners need to keep developing and implementing instructional methods that would promote both intrinsic reading motivation and reading proficiency at the same time. Such interventions should take place as early as possible (preferably before the fifth grade) for all students regardless of their family or school backgrounds but especially among male students who may be particularly at risk of experiencing a severe decline in intrinsic reading motivation compared to their female peers.

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Appendix

See Table A1.

Table A1

Descriptive statistics for all manifest indicators across six time points.

Indicators	<i>N_{valid}</i>	min	max	<i>M</i>	<i>SD</i>
<i>Intrinsic Reading Motivation (Grade 5)</i>					
Item 1	5303	1.00	4.00	3.14	1.00
Item 2	5218	1.00	4.00	3.11	0.99
Item 3	5239	1.00	4.00	2.86	1.09
Item 4	5240	1.00	4.00	2.94	1.01
<i>Intrinsic Reading Motivation (Grade 6)</i>					
Item 1	5169	1.00	4.00	2.94	1.05
Item 2	5137	1.00	4.00	2.90	1.03
Item 3	5135	1.00	4.00	2.61	1.11
Item 4	5119	1.00	4.00	2.72	1.01
<i>Intrinsic Reading Motivation (Grade 7)</i>					
Item 1	6448	1.00	4.00	2.80	1.04
Item 2	6418	1.00	4.00	2.77	1.02
Item 3	6411	1.00	4.00	2.54	1.08
Item 4	6398	1.00	4.00	2.62	0.96
<i>Intrinsic Reading Motivation (Grade 8)</i>					
Item 1	6087	1.00	4.00	2.76	1.01
Item 2	6059	1.00	4.00	2.74	0.99
Item 3	6074	1.00	4.00	2.44	1.09
Item 4	6057	1.00	4.00	2.59	0.92
<i>Intrinsic Reading Motivation (Grade 9)</i>					
Item 1	5548	1.00	4.00	2.70	1.03
Item 2	5546	1.00	4.00	2.72	1.00
Item 3	5534	1.00	4.00	2.52	1.10
Item 4	5531	1.00	4.00	2.65	0.90
<i>Intrinsic Reading Motivation (Grade 10)</i>					
Item 1	5336	1.00	4.00	2.53	1.10
Item 2	5329	1.00	4.00	2.56	1.08
Item 3	5331	1.00	4.00	2.38	1.14
Item 4	5326	1.00	4.00	2.42	1.00
Reading WLE (Grade 5)	5193	−4.71	3.96	−0.02	1.27
Reading WLE (Grade 7)	6062	−4.34	5.78	0.81	1.35
Reading WLE (Grade 9)	4416	−2.12	6.33	1.33	1.12

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