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Predictors of adolescents' change in reading literacy: the role of reading strategies, reading motivation, and declarative metacognition

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Abstract
Declarative metacognition, use of reading strategies and reading motivation are important predictors of reading literacy. Moreover, reading motivation's strong links with reading strategy use and declarative metacognition raise questions about whether motivation moderates the effects of the latter on reading literacy and its development during secondary school. Whereas most previous research implemented cross-sectional analyses focusing on one or more of the aforementioned variables, this study takes a longitudinal perspective to examine how reading motivation (reading for enjoyment versus interest), declarative metacognition and reading strategy use – directly or in interaction – concurrently predict reading literacy in Grade 7 and subsequent changes until Grade 9. Applying structural equation models to a sample of 4,037 secondary school students from the German National Educational Panel Study, the results revealed that reading for enjoyment and declarative metacognition had strong effects on reading literacy in Grade 7. In contrast, reading for interest exhibited a small negative effect and the effects of strategy use were negligible. Longitudinal analyses replicated the cross-sectional pattern with more modest effect sizes. Contrary to our hypotheses, the effects of declarative metacognition and reading strategy use on reading literacy at Grade 7 as well as changes in reading literacy until Grade 9 were not moderated by aspects of reading motivation. Finally, regarding the trajectory of reading literacy, our results challenge previous assumptions on the importance of reading for interest and reading strategies use, but also confirm earlier findings on the relevance of declarative metacognition and reading for enjoyment.

Keywords Reading literacy development · Reading for enjoyment · Reading for interest · Use of reading strategies · Declarative metacognition · Middle adolescence

Introduction

Reading literacy is of fundamental importance in everyday life. It is a basic prerequisite for the use of texts for one's own educational, informational, or entertainment purposes and ultimately enables social participation. Therefore, the acquisition of reading literacy is the most important educational goal during the school years. Nonetheless, large-scale studies consistently reveal that many students struggle to achieve this objective and that the proportion of these students increases over the years. According to the Program for International Student Assessment (PISA), in 2015, on average about 20% of 15-year-olds in all OECD countries (OECD, 2016) and about 16% of the students in Germany (Weis et al., 2016) do not reach the baseline level in reading literacy. Moreover, between 2000 and 2018, the results in Germany simultaneously indicate growing numbers of strong readers, but also of persons with low reading literacy (Weis et al., 2019). Overall, from an international perspective, these results on reading literacy levels among many 15-year-olds indicate, on the one hand, that there is a strong need for support in reading. On the other hand, these outcomes raise questions about the causes and also predictors of change and determinants of reading literacy, respectively, which may offer starting points for intervention and support programs. However, longitudinal studies that can provide explanations for these findings and identify determinants

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of secondary students' reading literacy have rarely been conducted. Therefore, this study implements a longitudinal analysis that addresses these unanswered questions and examines determinants of reading literacy among students between Grades 7 and 9.

Determinants of reading literacy in secondary school

Following the earlier PISA studies, reading literacy is defined as "understanding, using, reflecting on and engaging with written texts, in order to achieve one's goals, to develop one's knowledge and potential, and to participate in society" (OECD, 2009, p. 23). Regardless of what goal, knowledge, or future potential one uses reading to achieve, reading literacy encompasses text comprehension capabilities in different situations for being able to use written texts to achieve one's goals. Following Kintsch (1998) and other authors, text comprehension is based on processes at various hierarchical levels, which place different cognitive requirements on readers, including a) finding information, b) drawing text-related conclusions, and c) reflecting and assessing (Gehrer et al., 2013).

According to current models of reading research (Artelt et al., 2007; RAND, 2002), success in these processes of text comprehension is determined by characteristics of the text, the task, the learning goals, and by reader-specific characteristics including cognitive, metacognitive and motivational components. Regarding the relationships and interactions of these determinants, we assume processes comparable to those described for self-regulated learning. Following Boekaerts' (1999) 3-layer model, self-regulated learning is described as an interplay of regulation at three levels, relating specifically to the processing mode, for example, through the choice of cognitive strategies, the learning process, for example, through the use of metacognitive strategies, and the self, primarily through the selection of goals and motivational characteristics. Thus, reading literacy can be viewed as the ability of self-regulated learning from texts. In this context, the use of reading strategies (e.g., Pereira-Laird & Deane, 1997) as a cognitive learning or processing style of readers, knowledge of these strategies or declarative metacognition respectively (e.g., Artelt & Schneider, 2015) as metacognitive characteristic, and motivational characteristics, specifically intrinsic reading motivation (e.g., Guthrie et al, 1996; Schiefele et al., 2012), are assumed to support processes of text comprehension and thus determine reading literacy. Against this background, use of reading strategies, particularly, elaboration, monitoring, and regulation, declarative metacognition and intrinsic reading motivation, particularly, reading for enjoyment and reading for interest are investigated in this study (see Fig. 1).

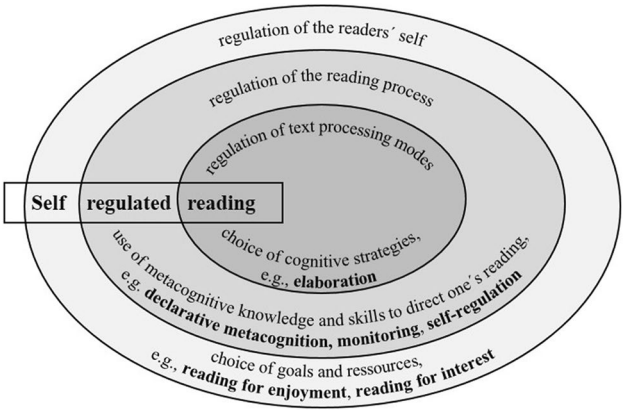

Fig. 1 Reading Literacy from the view of self-regulated learning from texts (adapted from the 3-layer model of self-regulated learning of Boekarts, 1999, p. 449)

Reading strategies are characterized as goal-directed, metacognitively controlled thoughts and behaviors that serve to enhance reading and text comprehension (e.g., Weinstein et al., 2000). For example, Pintrich (1989) distinguishes among cognitive strategies (comprising rehearsal, organization and elaboration), metacognitive strategies (comprising planning, monitoring and self-regulation) and resource-related strategies. Elaboration strategies specifically refer to behaviors that find connections between the content of a text and prior knowledge, thus supporting the establishment of local and global coherence, drawing of inferences, and reflection on a text (Artelt et al., 2007; McElvany & Richter, 2009). Metacognitive strategies, on the other hand, refer to planning, monitoring, and regulating reading activities to promote text comprehension (Artelt et al., 2007). While monitoring strategies encompass behaviors assessing text comprehension, regulation strategies refer to initiating or modifying reading activities to improve text comprehension processes (e.g., McElvany & Richter, 2009).

According to Flavell's (1979) approach, *declarative metacognition* refers to the conditional and relational knowledge about the effectiveness of different cognitive, metacognitive, and resource strategies in various situations to achieve different goals (Lockl, 2013): While conditional knowledge denotes a person´s awareness of the usefulness of strategies for achieving specific goals, relational knowledge refers to knowledge concerning the efficacy of certain strategies compared to others (e.g., Schneider et al., 2017). In addition to procedural metacognition, which refers to the knowledge of how learning processes are planned, monitored, and regulated, declarative metacognition refers to one aspect of metacognition that relates to cognition and knowledge about one's own cognitive abilities and about the requirements of various tasks and strategies.

Intrinsic reading motivation, as another determinant of reading literacy, refers to a person's willingness to read for object- or activity-related reasons: While reading for object-related reasons is driven by interest in the information to be gained through reading, reading for activity-related reasons refers to the activity of reading for its own sake, for example, having the positive experience of being immersed in a text (Schiefele et al., 2012). In accordance with this and similar concepts of reading motivation (e.g., Guthrie et al., 1996), Möller and Bonerad (2007) distinguish between two aspects of habitual intrinsic reading motivation, namely reading to gain information (*reading for interest*) versus reading for entertainment (*reading for enjoyment*).

To date, few studies have cross-sectionally or longitudinally investigated the interrelationships and concurrent effects of the above-mentioned characteristics on reading literacy in secondary school. Against this background, based on the view of reading literacy as self-regulated learning from texts and with reference to the findings presented below, this study examines the effects and interactions of 1) the use of various reading strategies, 2) declarative metacognition, and 3) intrinsic reading motivation in Grade 7 to explain reading literacy in Grade 7 and its change through Grade 9.

Use of reading strategies

According to previous assumptions, appropriate use of reading strategies supports text comprehension (e.g., Artelt et al., 2007) and hence reading literacy. Concerning reading literacy, many cross-sectional studies have reported positive effects of using reading strategies in general (e.g., Pereira-Laird & Deane, 1997). In particular, studies have provided both evidence and inconsistent results on the effects of elaboration, monitoring, and regulation strategies. Concerning elaboration, early analyses of PISA revealed positive correlations (Artelt et al., 2001), while later studies with ninth and tenth graders indicated no substantial associations with reading literacy (Artelt & Schneider, 2015) or text comprehension (Samuelstuen & Bråten, 2005). Further analyses of PISA (Artelt et al., 2001; Artelt & Schneider, 2015; Artelt & Neuenhaus, 2010) indicated moderate positive associations (r's and β's of 0.21–0.25) between reading literacy and control strategies, which were measured as a general indicator of planning, monitoring, and regulation. Concerning regulation strategies, previous results have found positive correlations with text comprehension and reading literacy: For example, tenth graders who had previously participated in a training used reading strategies more effectively and achieved better text comprehension with higher levels of self-regulation, which includes self-observation, self-assessment, and changes in their own reading activities (Leopold & Leutner, 2015). Consistent with these results, tenth graders' reported use of monitoring while reading—comprising assessment and regulation of learning and reading—significantly predicted their text comprehension (Samuelstuen & Bråten, 2005). Concerning the relation between the use of reading strategies and reading motivation, studies have revealed moderate to high correlations in different age groups (e.g., Cox & Guthrie, 2001: $r_{grade3} = 0.66$, $r_{grade5} = 0.36$).

From a longitudinal perspective, at least moderate effects of regular use of reading strategies on the development of reading literacy are expected (e.g., Artelt et al., 2007). In particular, elaboration strategies are assumed to support higher-order text comprehension processes, for example, constructing situational models. Furthermore, monitoring and regulation strategies are expected to enable students to identify and overcome inconsistencies in text comprehension, thereby improving their reading literacy in the long run. However, few studies have been conducted to date that have examined long-term effects of the use of reading strategies on reading literacy (see the overview in Schiefele et al., 2012). For example, in Andreassen and Bråten´s (2010) study, strategic reading competence of 5th Grade students were measured using participants´ logs of their predictions, questions, explanations, and summaries of a given text and predicted their reading comprehension six months later. Moreover, evaluations of reading strategy trainings have found long-term positive effects on text comprehension. For example, children who were trained to draw inferences and generate questions based on a given text—examples of elaboration—and to detect inconsistencies in their understanding while reading—a form of monitoring—improved their text comprehension (Oakhill & Cain, 2007).

Declarative metacognition

Previous research has assumed that declarative metacognition facilitates the goal-related selection of appropriate strategies and therefore more effective use of reading strategies (Schneider et al., 2017), which ultimately supports text comprehension processes (Artelt & Schneider, 2015). Individuals who have a sophisticated knowledge of reading strategies may therefore be able to use them appropriately during reading and thus experience an advantage in their reading literacy (Artelt & Schneider, 2015). Accordingly, previous studies, particularly analyses of PISA (e.g., Artelt et al., 2010; Artelt & Schneider, 2015; Artelt & Neuenhaus, 2010; Diedrich et al., 2019), have revealed strong correlations between declarative metacognition and reading literacy (r's between 0.48 and 0.56), exceeding the associations between reading literacy and use of reading strategies. Although these studies concentrated on domain-specific metacognitive knowledge in the area of reading, similar results could

be expected for domain-general metacognitive knowledge as studies on the structure of metacognitive knowledge indicate that domain specific metacognitive knowledge and general metacognitive knowledge are highly correlated (Neuenhaus et al., 2011, Schneider et al., 2017). Furthermore, it has to be acknowledged that students do not have to use their declarative metacognition in every situation, and its effects on text comprehension might be influenced by situational conditions, for example, motivational aspects (Artelt & Schneider, 2015), as described below.

From a longitudinal perspective, declarative metacognition was shown to increase between Grades 5 and 9 (Schneider et al., 2017) and to predict later reading literacy (Schneider et al., 2017; Miyamoto et al., 2019), even when controlling for autoregressive effects (Artelt et al., 2012). Moreover, a study by Author and colleagues (Artelt et al., 2012; Schneider et al., 2017) found a reciprocal relation between reading literacy and declarative metacognition between Grades 5 and 6, that is, earlier reading literacy increased later declarative metacognition, and vice versa, earlier declarative metacognition influenced later reading literacy. Additionally, Miyamoto and colleagues (2019) found that declarative metacognition mediated the effects of earlier intrinsic reading motivation on later reading literacy, as reported in more detail in the following section.

Intrinsic reading motivation

According to current conceptions, intrinsic reading motivation is expected to increase a person's amount and quality of reading activities, depth of text comprehension processes, and appropriate use of reading strategies (e.g., Guthrie et al., 1996; Schiefele et al., 2012). Moreover, it is assumed that a certain degree of motivation is required to perform strategic reading activities, particularly to activate knowledge about reading strategies and declarative metacognition respectively and use reading strategies purposefully while reading (Artelt & Schneider, 2015; Guthrie et al., 1996). Hence, readers with higher intrinsic motivation are expected to read more and in the pursuit of a more profound understanding, to use reading strategies more appropriately, and ultimately to achieve higher reading literacy compared to readers with lower intrinsic motivation. In line with this, several studies have found strong associations between intrinsic reading motivation and the use of reading strategies (see overview in Schiefele et al., 2012). Additionally, a large number of studies revealed strong associations between reading literacy and different aspects of reading motivation, for example, with reading enjoyment in PISA 2009 (Artelt et al., 2010: $r = 0.46$) and with intrinsic reading motivation in Grades 3, 4 and 6 (McElvany et al., 2008: r's between 0.20 and 0.24) as well as Grade 7 (Miyamoto et al., 2019: $r = 0.37$). With respect to the relation between reading literacy and the two aspects of intrinsic reading motivation introduced above, a cross-sectional study by Möller and Bonerad (2007) revealed no correlation with reading for interest but a moderate correlation with reading for enjoyment among 11-year-old students. These differential effects were explained by the fact that reading for interest might be characterized by picking out the facts one is seeking from a text, which does not necessarily require or promote higher-order text comprehension processes and thus does not foster reading literacy (Möller & Bonerad, 2008). Consistently, a cross-sectional analysis by Retelsdorf and colleagues (2011) with 5th Grade students showed that reading for enjoyment explained a considerable proportion of reading literacy ($\beta = 0.11$), whereas reading for interest did not contribute to explaining it, when controlling for cognitive, family, and demographic characteristics.

From a longitudinal perspective, habitual intrinsic reading motivation is also expected to promote the quality and amount of reading activities over time, particularly the regular use of reading strategies and declarative metacognition, which provide practice in text comprehension processes and thus enhance reading literacy (e.g., Miyamoto et al., 2019; Schiefele et al., 2012). From a theoretical viewpoint, such positive effects can be expected for both aspects of intrinsic reading motivation mentioned above. Nevertheless, longitudinal analyses by Retelsdorf and colleagues (2011) showed no significant effect of reading for enjoyment, while reading for interest at Grade 5 explained the longitudinal development of reading literacy until Grade 8 to a substantial amount ($\beta = 0.17$). This difference in the influence of reading for interest on reading literacy from a longitudinal compared to a cross-sectional perspective was explained by the fact that even poor readers at Grade 5 valued reading as a way to get information about their interests and thus improved their reading literacy until Grade 8 by reading regularly to satisfy their need for information. Contrary to this argument, which implies that reading for interest is stable over time, McElvany and colleagues (2008) argued that students' general interests—and thus their need for information—change over time. Therefore, the intrinsic motivation to read and thus its impact on reading literacy decline. Accordingly, in their study, intrinsic reading motivation at Grade 3 significantly predicted later reading literacy at Grades 4 and 6 (β's between 0.10 and 0.13), whereas intrinsic reading motivation at Grade 4 did not predict reading literacy at Grade 6. Nevertheless, the found effects did not persist when further variables were taken into account, particularly initial reading literacy. Finally, results from additional analyses of these data emphasized the strong importance of earlier reading literacy in accounting for later differences in reading literacy (Becker et al., 2010). Concerning older students, Miyamoto and colleagues (2018) found that intrinsic reading motivation of German-speaking students in Grade 5 significantly

predicted their reading literacy in Grade 7. According to the results of another study by Miyamoto and colleagues (2019), the effect of intrinsic reading motivation in Grade 5 on reading literacy in Grade 7 was mediated to a significant but negligible extent by declarative metacognition in Grade 6 (beyond reading amount). Hence, earlier intrinsic reading motivation fostered improvements in declarative metacognition at Grade 6, which in turn positively affected later reading literacy.

Reading literacy in the context of using reading strategies, declarative metacognition, and intrinsic reading motivation

Summarizing previous reading research, various studies that separately investigated intrinsic reading motivation, declarative metacognition, or the use of reading strategies each showed positive effects in explaining differences in reading literacy. Nevertheless, to date, few studies have simultaneously investigated the effects and interrelations of these variables in secondary school, such as the study by Artelt and colleagues (2010). With respect to German students in PISA 2009, this study found that declarative metacognition was the strongest predictor of reading literacy, followed by reading enjoyment, and that these effects persisted even when additional variables were included in the model. Furthermore, reading in one's spare time and further variables exhibited negligible effects. In contrast, use of control strategies, choosing diverse reading materials, migration generation, gender and possession of cultural properties did not predict reading literacy in the complete model. Against this background, there is still a lack of knowledge on how the previously introduced variables concurrently predict secondary students' reading literacy. In particular, questions remain about whether the effects of strategic reading activities (e.g., use of reading strategies or declarative metacognition) on reading literacy are moderated by motivational aspects and whether there are differences in the importance of using reading strategies compared to declarative metacognition.

In addition, longitudinal effects of intrinsic reading motivation, declarative metacognition, or the use of reading strategies on reading literacy have been shown in studies that have each focused on one of these aspects. Yet, few studies to date have simultaneously investigated the longitudinal effects of these characteristics in secondary education to account for differences in reading literacy development over time. One example is the study by Retelsdorf and colleagues (2011), mentioned earlier, which investigated similar aspects of intrinsic reading motivation in Grades 5 and 8 and showed results that were partially inconsistent with previous findings and assumptions. Thus, how both aspects of intrinsic reading motivation promote reading literacy over time and how they interact with strategic reading activities to explain changes in literacy have yet to be elucidated.

In summary, there are still open questions on the importance and the relations between different aspects of intrinsic reading motivation, reading strategy use and declarative metacognition in accounting for differences and changes in reading literacy during secondary school. Therefore, this study focuses on questions on the effects and interactions of these characteristics at Grade 7 and their predictive power to account for changes in students' reading literacy until Grade 9 which are introduced in the following section.

Research questions

This study's first research question (RQ1) addresses to what degree differences in reading literacy in Grade 7 are explained by the use of reading strategies (elaboration, monitoring, and regulation), declarative metacognition, and aspects of intrinsic reading motivation (reading for enjoyment vs. interest) from a cross-sectional perspective (although it has to be noted that declarative metacognitive was assessed already one year before). In light of the aforementioned previous research (Artelt et al., 2001; Artelt et al., 2010; Artelt & Schneider, 2015; Artelt & Neuenhaus, 2010; McElvany et al., 2008), we expect the highest effects for declarative metacognition and reading for enjoyment, but lower positive effects for reading for interest and use of reading strategies. Regarding intrinsic reading motivation in general, we expect positive effects on reading literacy (e.g., Artelt et al., 2007; Guthrie et al., 1996; Miyamoto et al., 2018). However, focusing separately on the two aspects of intrinsic reading motivation, previous results suggest higher effects for reading for enjoyment on reading literacy compared to reading for interest (Möller & Bonerad, 2007; Retelsdorf et al., 2011). Concerning the use of various reading strategies, we assume higher effects for monitoring and regulation strategies compared to elaboration (Artelt & Schneider, 2015; Artelt & Neuenhaus, 2010; Leopold & Leutner, 2015; Samuelstuen & Bråten, 2005).

Second, from a longitudinal perspective, we examine how these earlier characteristics of students predict changes in their reading literacy (RQ2): To what degree are differential changes in students' reading literacy until Grade 9 explained by the use of reading strategies (elaboration, monitoring and regulation), aspects of intrinsic reading motivation (reading for enjoyment vs. interest) at Grade 7 and declarative metacognition at Grade 6? In light of previous results, we expect the highest effects for initial reading literacy at Grade 7 (Becker et al., 2010) and strong longitudinal effects for declarative metacognition, but lower effects for the use of reading strategies (e.g., Artelt & Schneider, 2015; Schneider

et al., 2017; Oakhill & Cain, 2007). Concerning intrinsic reading motivation in general, we expect positive effects of both motivational aspects on reading literacy in the long run (e.g., Artelt et al., 2007; Guthrie et al., 1996; Miyamoto et al., 2018; Schiefele et al., 2012). However, separating the two aspects of intrinsic reading motivation, previous results suggest—in contrast to the expected higher effects for reading for enjoyment from a cross-sectional perspective—stronger effects of reading for interest compared to reading for enjoyment (Retelsdorf et al., 2011) in predicting reading literacy growth during secondary school.

Third, we examine moderation effects of reading for enjoyment and reading for interest with respect to the relation between strategical reading activities and reading literacy in the following research questions (RQ): 3.1 Do either of the two motivational aspects moderate the effects of strategic reading activities, in particular the use of reading strategies or declarative metacognition, with respect to reading literacy at Grade 7?; 3.2 Do either of the two motivational aspects moderate the effects of strategic reading activities at Grade 7 on changes in reading literacy until Grade 9? From a cross-sectional perspective (RQ3.1), we expect that readers must be motivated to a certain extent in order to make purposeful use of declarative metacognition to enhance their text comprehension processes (Artelt & Schneider, 2015). Furthermore, both aspects of reading motivation are expected to moderate effects of strategy use on text comprehension (Miyamoto et al., 2019; Schiefele et al., 2012). Additionally, in light of previous theoretical assumptions, it is conceivable that both aspects of intrinsic reading motivation moderate the effects of strategic reading activities over time (RQ3.2), and hence support long-term improvement in reading literacy (Miyamoto et al., 2019; Schiefele et al., 2012). In contrast, Retelsdorf and colleagues' (2011) findings suggest more beneficial longitudinal effects only for reading for interest, which might stimulate the use of reading strategies, and thus foster improvement in reading literacy.

Method

Sample and procedure

Participants in this study were part of the longitudinal multicohort *National Educational Panel Study* (NEPS Network, 2021; Blossfeld et al., 2019) in Germany, which follows representative samples of children, students, and adults across their life course. The present study focuses on a cohort of students in secondary schools that were initially sampled in Grade 5 in 2010 and subsequently received follow-up assessments with different measures each year. Most students were tested in small groups at their respective schools by trained test administrators. Students who left their original school during the longitudinal study were tracked and tested individually at their private homes. For the present analyses, we used measures of reading literacy obtained at two measurement points in Grade 7 and Grade 9, yielding a mean retest interval of 2.45 years ($SD = 0.08$, $Min = 2.25$, $Max = 2.92$). The sample included 1,958 girls and 2,079 boys (total $N = 4{,}037$), who were about $M = 12.91$ years ($SD = 0.50$, $Min = 10.43$, $Max = 15.60$) old in Grade 7. The students attended 191 different schools across the entire country, including lower-track ("Hauptschule", 9%), middle-track school ("Realschule", 26%), and upper-track secondary schools ("Gymnasium", 53%). The highest parental *International Socio-Economic Index* (HISEI; Ganzeboom, 2010) fell between 14 and 89 ($M = 57.53$, $SD = 19.84$) and, thus, spanned low as well as high levels of socioeconomic status.

Instruments

Reading literacy was assessed in Grades 7 and 9 by means of standardized tests that were constructed for the NEPS. Referring to a broad body of literature, such as Kintsch's (1998) conceptualization and the literacy conceptualization in PISA (OECD, 2009), the assessment addresses text comprehension processes at various hierarchical levels which place different cognitive requirements on readers, in particular a) finding information, b) drawing text-related conclusions, and c) reflecting and assessing (e.g., Gehrer et al., 2013). Accordingly, reading literacy is measured by means of items referring to five types of texts (i.e., informational, commentary or argumentation, literary, instructional, and advertising texts), with tasks in three closed-response formats that place specific cognitive requirements on participants. The paper-and-pencil tests ultimately included 27 or 29 of these items in Grade 7 and 30 or 32 items in Grade 9 and were administrated with a time limit of 28 min. Responses were scored as dichotomous or polytomous variables and scaled using unidimensional, one-parametric item response models (Masters, 1982). Detailed psychometric analyses for the two tests including item fit statistics and tests for differential item functioning are reported in previous publications (for more details see Online-Supplement). The reliabilities at the two measurement occasions were 0.78 and 0.79, respectively.

The use of the three *reading strategies*—elaboration, monitoring, and regulation—was measured in Grade 7 using a short standardized self-report instrument adapted from McElvany and Richter (2009) (see appendix Table 5). The scales included 3 to 4 items, with responses recorded on five-point response scales capturing frequencies (1: *never*, 5: *always*). A three-factorial, two-parametric item response model (Birnbaum, 1968) yielded good model fit (for more details see Online-Supplement). The three learning strategies were substantially correlated (r's between 0.70 and

Table 1 Means, Standard Deviations, and Correlations between Study Variables

	n	MV	*M*	*SD*	1	2	3	4	5	6	7
Reading literacy											
1. Reading literacy in Grade 7	4037	0%	0.58	0.84							
2. Reading literacy in Grade 9	3008	25%	0.81	0.68	.51*						
Reading strategies											
3. Elaboration	3827	5%	0.00	1.10	.18*	.15*					
4. Monitoring	3791	6%	0.01	1.11	.07*	.05*	.80*				
5. Regulation	3796	6%	0.01	1.07	.17*	.11*	.70*	.77*			
Reading motivation											
6. Reading for enjoyment	3914	3%	0.01	1.16	.47*	.36*	.52*	.37*	.40*		
7. Reading for interest	3900	3%	0.03	1.12	.31*	.25*	.59*	.48*	.49*	.88*	
Metacognition											
8. Declarative metacognition	3889	4%	0.06	1.15	.62*	.44*	.13*	.03	.11*	.34*	.21*

n = Number of observed responses. MV = Percentage of missing values. Based on 30 plausible values

* $p < .05$

0.80; see Table 1). The reliabilities for the scales were 0.83, 0.84, and 0.79, respectively.

Declarative metacognition was assessed using a scenario-based test that included eight scenarios describing various school and leisure time activities (Lockl, 2013; Händel et al., 2013). Due to time restrictions in the survey program, declarative metacognition was measured already in Grade 6. The scenarios and proposed strategies referred to memory and learning in general because the NEPS sought to assess declarative metacognition in a domain-general way detached from particular content domains. In Grade 6, the test was composed in such a way that three of the eight scenarios were related to reading activities. Nevertheless, in line with Händel et al. (2013), in the NEPS study, declarative metacognition is considered as a unidimensional construct. For each scenario, respondents had to rate the usefulness of six strategies on four-point response scales (1: *not at all useful*, 4: *very useful*). According to expert judgments from a previous pilot study (Lockl, 2013), the presented strategies were deemed to have different levels of efficacy for the described learning or reading situations. To score the test, pair comparisons (option X is more or less useful than option Y) were judged with reference to the experts' ratings of the relative usefulness of the presented strategies (Händel et al., 2013). These pair comparisons were scored as dichotomous variables, with 1 indicating a correct response (in line with the expert ratings) and 0 indicating an incorrect response (contrary to the expert ratings, or the two strategies making up the pair were considered equal). A unidimensional, two-parametric item response model (Birnbaum, 1968) resulted in a good model fit (for more details see Online-Supplement). The reliability of the measure was 0.71.

The two aspects of habitual *intrinsic reading motivation*—reading for enjoyment and reading for interest—were measured in Grade 7 using two self-report scales (see appendix Table 6) adapted from the questionnaire by Möller and Bonerad (2007). This instrument is a German adaption of the Motivations for Reading Questionnaire (Wigfield & Guthrie, 1997) and was piloted with good quality criteria and used in previous studies (Schiefele et al., 2012). The scales included 3 items each, accompanied by four-point response scales (1: *strongly disagree*, 4: *strongly agree*). For our data, a two-factorial, two-parametric item response model (Birnbaum, 1968) resulted in a good model fit (for more details see Online-Supplement). In line with a validation study by Möller and Bonerad (2007), both aspects of intrinsic reading motivation were substantially correlated ($r = 0.88$). The reliabilities for the scales were 0.87 and 0.83, respectively.

Statistical analyses

The research questions were examined by means of linear regression analyses with reading literacy in Grade 7 (RQ1) or Grade 9 (RQ2) as the dependent variable. In order to study changes in reading literacy, the latter analyses included Grade 7 scores as additional predictors in the regression model. The two questions were addressed in a single analysis by specifying both regression models simultaneously in a structural equation modeling (SEM) framework to increase the precision of the estimated effects. The effects of each set of predictors were evaluated by including either use of reading strategies, reading motivation, or declarative metacognition as independent variables. Their unique effects were further studied by including all predictor variables at the same time in an overall model. Finally, moderating effects of reading motivation (RQ3) were evaluated by adding interactions between both motivational aspects and use of reading strategies as well as declarative metacognition to the model. Multicollinearity was examined using the variance inflation

factor (VIF), for which values up to 10 are considered negligible (e.g., O'Brien, 2007). All analyses adopted a two-tailed significance level of $p = 0.05$. According to common effect size interpretations in educational research (for more details see Online-Supplement), in the present study, we interpret correlations and standardized regression weights of single variables below 0.10 as negligible and effects around 0.20 as medium effects.

Similar to other large-scale assessments such as PISA, measurement error was accounted for in the analyses by drawing 30 plausible values based on the item response models for each administered instrument. This allowed us to analyze latent relationships (similar to latent variables in structural equation models). To improve the accuracy of the estimated plausible values, several variables such as gender or school type were included in the background model for the plausible value model (for more details see Online-Supplement). The regression analyses addressing our research questions were repeated for each plausible value and subsequently combined using Rubin's (1987) rules. Because a substantial amount of heterogeneity in reading literacy resulted from students' clustering in different schools (intraclass correlation ICC = 0.27), dependencies were acknowledged by estimating cluster-robust standard errors (Cameron & Miller, 2015; cluster effects were negligible for reported uses of reading strategies: $ICC_{elaboration} = 0.02$, $ICC_{monitoring} = 0.01$, $ICC_{regulation} = 0.03$). Differences in correlations were examined following Meng et al. (1992).

Some respondents did not participate in the second reading literacy assessment, resulting in a nonresponse rate of about 25%. Missing values on the remaining variables were less prevalent and fell between 3 and 6% (see Table 1). Unit nonresponse is a pervasive problem in large-scale longitudinal studies. Therefore, it is important to account for nonparticipating sampling units to avoid distorted parameter estimates and biased conclusions. Assuming a missing at random mechanism, these missing values were imputed based on the background model during plausible value estimation. In turn, missing values on these background variables were imputed 30 times using classification and regression trees (for more details see Online Resource Online-Supplement).

Results

As depicted in Table 1, across the two measurement occasions, reading literacy exhibited moderate stability ($r = 0.51$, $p < 0.001$), indicating substantial rank-order changes from Grade 7 to Grade 9. As expected, declarative metacognition at Grade 6 was substantially correlated with reading literacy at both measurement occasions. Similar, both aspects of reading motivation at Grade 7 were related to reading literacy, reading strategy use and declarative metacognition. Interestingly, the correlation with reading literacy was significantly larger for reading for enjoyment as compared to reading for interest in Grade 7; the respective inference test for the difference test between correlations were $t(1088.46) = 6.11$, $p < 0.001$, and Grade 9, $t(320.96) = 6.64$, $p < 0.001$, respectively. However, use of the different reading strategies showed only negligible to modest associations with reading literacy and declarative metacognition.

Because use of reading strategies, the reading motivation aspects and declarative metacognition were not independent (see Table 1), we examined their unique effects on reading literacy. A regression of reading literacy in Grade 7 on these

Table 2 Regression Analyses for Predictors of Reading Literacy in Grade 7

	Model 1			Model 2			Model 3			Model 4			
	B	(*SE*)	β	*B*	(*SE*)	β	*B*	(*SE*)	β	*B*	(*SE*)	β	VIF
Intercept	0.58*	(0.04)		0.58*	(0.04)		0.58*	(0.04)		0.58*	(0.04)		
Reading strategies													
1. Elaboration	0.23*	(0.02)	.30							-0.01	(0.02)	-.01	3.5
2. Monitoring	-0.27*	(0.03)	-.35							-0.07*	(0.03)	-.09	3.9
3. Regulation	0.18*	(0.02)	.23							0.08*	(0.02)	.10	2.7
Reading motivation													
4. Reading for enjoyment				0.60*	(0.03)	.83				0.36*	(0.03)	.49	5.1
5. Reading for interest				-0.32*	(0.03)	-.41				-0.17*	(0.03)	-.22	5.3
Metacognition													
6. Declarative metacognition							0.47*	(0.02)	.62	0.37*	(0.02)	.50	1.2
Explained variance	.07			.26			.39			.48			

$N = 4{,}037$. Linear regression of reading literacy in Grade 7 based on 30 plausible values. *B* = unstandardized regression weight; *SE* = standard error of *B*; β = standardized regression weight; VIF = Variance inflation factor

* $p < .05$

variables (see Table 2; RQ1) showed that use of reading strategies (elaboration, monitoring, and regulation) explained about 7% of reading literacy, whereas the two dimensions of reading motivation (reading for enjoyment and reading for interest) and declarative metacognition explained 26% and 39%, respectively. The joint model including all variables as predictors of reading literacy (Model 4 in Table 2) highlighted that reading for enjoyment (β = 0.49, $p < 0.001$) and declarative metacognition (β = 0.50, $p < 0.001$) had the largest effects on reading literacy. In contrast, reading for interest exhibited a small negative effect (β = -0.22, $p < 0.001$). The effects of use of the three reading strategies were negligible (β's between -0.09 and 0.10; for more details on effect size interpretation see Online-Supplement).

To address the research question regarding to what degree changes in reading literacy might be explained by these variables (RQ2), reading literacy in Grade 9 was regressed on the same variables while controlling for students' initial reading literacy (see Table 3). These analyses replicated the cross-sectional pattern, albeit with substantially smaller effect sizes. Together, the use of reading strategies, reading motivation aspects and declarative metacognition explained about 4% of the variance in changes in reading literacy. Again, the effects of the use of all reading strategies and reading for interest were negligible (β's between -0.09 and 0.07; see Model 4 in Table 3). In contrast, reading for enjoyment (β = 0.21, $p < 0.001$) and declarative metacognition (β = 0.19, $p < 0.001$) had similarly sized unique effects on changes in reading literacy.

Furthermore, we hypothesized that both aspects of reading motivation would moderate the effects of use of reading strategies (elaboration, monitoring and regulation) and declarative metacognition on reading literacy at Grade 7 (RQ3.1) and changes in it until Grade 9 (RQ3.2). To this end, we extended the previous regression analyses by including the respective interaction effects (see Table 4). However, these analyses revealed no significant moderation effects (all p's > 0.05), accounting neither for differences in reading literacy at Grade 7 nor for changes in it until Grade 9.

Discussion

When predicting reading literacy at Grade 7 (RQ1), we found the strongest positive effects of declarative metacognition, followed by reading for enjoyment, whereas use of the three reading strategies exhibited low or negligible effects and reading for interest had a surprising negative effect. The positive effect of declarative metacognition—even exceeding the effects of use of reading strategies—was in line with previous outcomes (Artelt et al., 2010; Artelt & Schneider, 2015; Artelt & Neuenhaus, 2010) and underpinned our hypothesis that this characteristic supports text comprehension processes and thus enhances reading literacy.

Furthermore, consistent with our hypotheses, the outcomes indicated a strong positive effect of reading for enjoyment on reading literacy, which was of comparable size and exceeded the effect of reading for interest reported in previous studies (Artelt et al., 2010; Möller & Bonerad, 2008; Retelsdorf et al., 2011). By contrast, contrary to our assumptions, reading for interest exhibited an unexpected negative effect on reading literacy. Both results do not confirm the hypothesis that intrinsic reading motivation in general promotes the amount and quality of reading activities, practice opportunities for text comprehension

Table 3 Regression Analyses for Predictors of Change in Reading Literacy in Grade 9

	Model 0			Model 1			Model 2			Model 3			Model 4			
	B	(*SE*)	β	*B*	(*SE*)	β	*B*	(*SE*)	β	*B*	(*SE*)	β	*B*	(*SE*)	β	VIF
Intercept	0.57*	(0.02)		0.58*	(0.02)		0.61*	(0.02)		0.63*	(0.02)		0.67*	(0.02)		
1. Reading literacy in Grade 7	0.40*	(0.01)	.51	0.39*	(0.01)	.49	0.34*	(0.02)	.42	0.30*	(0.02)	.38	0.25*	(0.02)	.31	1.9
Reading strategies																
2. Elaboration				0.09*	(0.02)	.15							0.05*	(0.02)	.07	3.5
3. Monitoring				-0.07*	(0.02)	-.11							-0.04*	(0.02)	-.07	4.0
4. Regulation				0.00	(0.01)	.01							0.00	(0.02)	-.01	2.7
Reading motivation																
5. Reading for enjoyment							0.15*	(0.02)	.26				0.12*	(0.02)	.21	5.6
6. Reading for interest							-0.07*	(0.02)	-.12				-0.05*	(0.02)	-.09	5.5
Metacognition																
7. Declarative metacognition										0.13	(0.01)	.21	0.11*	(0.01)	.19	1.7
Explained variance	.26			.27			.28			.28			.30			

$N = 4{,}037$. Linear regression of reading literacy in Grade 9 based on 30 plausible values. *B* = unstandardized regression weight; *SE* = standard error of *B*; β = standardized regression weight; VIF = Variance inflation factor

* $p < .05$

Table 4 Moderation Analyses of Reading Motivations on Reading Literacy

		Model 1			Model 2		
		B	(*SE*)	β	*B*	(*SE*)	β
	Intercept	0.61*	(0.04)		0.61*	(0.02)	
1.	Reading literacy in Grade 7				0.24*	(0.02)	.31
	Reading strategies						
2.	Elaboration	-0.01	(0.02)	-.01	0.04*	(0.02)	.07
3.	Monitoring	-0.07*	(0.03)	-.09	-0.04*	(0.02)	-.07
4.	Regulation	0.08*	(0.02)	.10	0.00	(0.02)	.00
	Reading motivation						
5.	Reading for enjoyment	0.36*	(0.03)	.49	0.12*	(0.02)	.21
6.	Reading for interest	-0.17*	(0.03)	-.22	-0.05*	(0.02)	-.08
	Metacognition						
7.	Declarative metacognition	0.37*	(0.02)	.49	0.11*	(0.01)	.19
	Moderation effects of reading motivation						
8.	Reading for enjoyment x elaboration	0.01	(0.04)	.01	0.00	(0.03)	.01
9.	Reading for enjoyment x monitoring	0.01	(0.05)	.02	0.00	(0.03)	.00
10.	Reading for enjoyment x regulation	-0.03	(0.04)	-.05	-0.01	(0.03)	-.02
11.	Reading for enjoyment x metacognition	-0.04	(0.04)	-.06	0.00	(0.02)	.00
12.	Reading for interest x elaboration	-0.02	(0.04)	.04	0.02	(0.03)	.04
13.	Reading for interest x monitoring	-0.01	(0.05)	-.03	-0.01	(0.03)	-.03
14.	Reading for interest x regulation	0.02	(0.04)	.04	-0.01	(0.03)	-.01
15.	Reading for interest x metacognition	0.05	(0.03)	.07	0.02	(0.02)	.04
	Explained variance	.48			.31		

$N = 4{,}037$. Linear regression of reading literacy in Grade 7 (Model 1) or Grade 9 (Model 2) based on 30 plausible values. *B* = unstandardized regression weight; *SE* = standard error of *B*; β = standardized regression weight

* $p < .05$

processes, and thus improves reading literacy. While this assumption may hold for reading for enjoyment, it cannot explain the result for reading for interest. Moreover, this result supports the explanation based on Möller and Bonerad (2008) that reading for interest does not require or foster higher-order text comprehension processes and therefore does not enhance reading literacy. Concerning the cognitive requirements of the reading literacy test used, it can be assumed that at least the ability to find information in a text should be influenced by students` general tendency to read for interest. Nevertheless, it also can be expected that engaging in finding information does not foster the ability to draw text-related conclusions, reflect on and assess text content, as further cognitive requirements for text comprehension. Therefore, the data suggest that individuals who read mainly for interest skim through texts and skip over details, and hence do not read in a way that might promote their reading literacy. However, this explanation for the differential effects of aspects of intrinsic reading motivation on text comprehension processes cannot be investigated with the present data, but should be examined in further analyses.

Regarding the use of reading strategies, the outcomes did not confirm our hypotheses on moderate beneficial effects on reading literacy at Grade 7: While the small, but positive effect of regulation strategies was in concordance with results of Leopold and Leutner (2015), the negative effect (even though of negligible size) of monitoring contradicted the positive effects found in previous studies (Artelt et al., 2001; Artelt & Schneider, 2015; Artelt & Neuenhaus, 2010; Leopold & Leutner, 2015; Samuelstuen & Bråten, 2005). Nevertheless, consistent with our hypotheses and previous results (e.g., Artelt et al., 2001; Artelt & Schneider, 2015; Artelt & Neuenhaus, 2010), effects of regulation and monitoring strategies were higher than the effect of elaboration, which was of negligible size. Finally, these results did not confirm our assumptions that the use of all reading strategies investigated enhances text comprehension and thus reading literacy. Only more frequent use of regulation strategies appeared to support text comprehension processes and accordingly influenced performance on the reading literacy tests. One reason for the unexpected findings for elaboration and monitoring strategies might be that neither strategy was important for text comprehension in the test used, as previously discussed by Andreassen and Bråten (2010). Furthermore, the unexpected outcomes for monitoring might result from differences in assessment methods, with previous assessments conducted via observation or working protocols (e.g., Andreassen & Bråten, 2010; Leopold & Leutner, 2015; Samuelstuen &

Bråten, 2005). This is not the case for elaboration, which was assessed via similar self-reports in previous research (Artelt et al., 2001). Therefore, characteristics of some of the scales used must be considered as possible reasons for some of the unexpected results, as discussed below.

In our longitudinal analyses (RQ2), we found the strongest effects for initial reading literacy, effects of moderate and identical size for declarative metacognition and reading for enjoyment, and negligible effects for use of reading strategies and reading for interest with respect to changes in reading literacy until Grade 9. In particular, the results for initial level of reading literacy at Grade 7 (Becker et al., 2010) and declarative metacognition (Artelt & Schneider, 2015; Schneider et al., 2017) were consistent with our hypotheses as well as with previous results and underpinned our assumptions regarding their importance for the development of reading literacy.

In contrast, we found no positive effects for either aspect of intrinsic reading motivation, as expected. These results do not suggest that intrinsic reading motivation in general fosters the amount and quality of reading activities, and thus ultimately reading literacy over time in the same way, as assumed in current basic conceptions (e.g., Artelt et al., 2007, 2010; Guthrie et al, 1996; Miyamoto et al., 2018; Schiefele et al., 2012). While these conceptions might explain the beneficial effect of reading for enjoyment, they do not explain the negative effect of reading for interest. As described above, from a theoretical point of view, it is conceivable that reading for interest is strongly associated with finding information in texts and differs in quality from reading for enjoyment. Furthermore, reading activities for interest might be of lower duration than reading activities for enjoyment, which are typically associated with sustained reading and not noticing time go by. Finally, we assume that the reading activities associated with the two aspects of intrinsic reading motivation might differ in time and quality. This would suggest lower effects of reading for interest on reading literacy, which contradicts the results by Retelsdorf and colleagues (2011), but is in line with arguments of McElvany and colleagues (2008). According to the latter, adolescents' interests become increasingly differentiated over time, and the effects of intrinsic reading motivation—including reading for interest—on reading literacy are low and decline over time.

Concerning the use of reading strategies, the results did not indicate longitudinal beneficial effects on reading literacy, as expected based on previous research (e.g., Andreassen & Bråten, 2010; Oakhill & Cain, 2007). Therefore, our findings did not confirm our assumptions regarding the effects of elaboration, monitoring and regulation strategies on habitual text comprehension processes and thus reading literacy. One reason for these unexpected results could be that the use of reading strategies supports text comprehension in current tasks with specific goals, but does not necessarily enhance performance in the reading literacy tests used, as Andreassen and Bråten (2010) have shown for multiple-choice tests with available texts. However, again, one further reason for these results could be characteristics of the scales used, as discussed below.

With respect to the third question (RQ3.1), the results did not support our general assumptions based on previous results (Artelt & Schneider, 2015; Miyamoto et al., 2019; Schiefele et al., 2012) that readers who are intrinsically motivated use their declarative metacognition and reading strategies purposefully and thus exhibit higher reading literacy at Grade 7. Thus, neither reading for interest nor reading for enjoyment fostered the use of reading strategies or the activation of declarative metacognition, resulting in higher reading literacy. One reason for these unexpected results might be that our hypotheses apply to motivational states in current reading situations, which are not fully captured by the scales of habitual intrinsic reading motivation used. Accordingly, one would assume that highly intrinsically motivated readers in a given reading situation would choose a specific strategy to achieve their current goal.

Finally, we examined these hypotheses from a longitudinal perspective (RQ3.2), expecting moderation effects by the two aspects of intrinsic reading motivation on the relation between strategic reading activities and reading literacy. Again, we found no support for our hypotheses, which were based on previous theoretical assumptions (e.g., Miyamoto et al., 2019; Schiefele et al., 2012): Neither reading for interest—as expected based on findings by Retelsdorf and colleagues (2011)—nor reading for enjoyment influenced the relation between early strategic reading activities at Grade 7 and reading literacy at Grade 9. One reason no effects were found could be that the ninth grade reading test did not represent a reading situation in which previously practiced strategies or declarative metacognition could be used by motivated individuals and have an effect on performance. Accordingly, it is conceivable that strategic reading activities in Grade 7, triggered by a corresponding reading motivation, exert effects on reading literacy in the respective situation as well as in later reading situations. However, such effects on subsequent reading situations might have remained undetected if the test used did not adequately reflect the specific reading situation in question (e.g., Andreassen & Bråten, 2010). Finally, again, characteristics of the self-report scales for reading strategies might have impaired the detection of expected effects, as mentioned above and discussed in more detail below.

Strength, limitations, and outlook

Accordingly, as a first critical point of this study, it must be mentioned that general measures of habitual intrinsic reading motivation were used to investigate interactions in current

reading situations (see RQ3.1, RQ3.2). Even though previous assumptions suggest that habitual intrinsic reading motivation is well-suited for capturing motivational states (e.g., Schiefele et al., 2012), motivational states can vary to a considerable amount. Therefore, in future research, online measures of intrinsic reading motivation would be promising in order to investigate moderating effects of aspects of reading motivation on the relations between strategic reading activities and reading literacy. Furthermore, incorporating scales of extrinsic reading motivation is suggested in order to avoid suppression effects (Schiefele et al., 2012). Since this was not possible in this study due to a lack of data on these aspects of motivation, the results for reading motivation must be interpreted with caution.

Concerning the self-report assessment of use of reading strategies there is a need to critically mention certain characteristics of the scales used. These scales were selected on the basis of previous studies that had shown great practicability in large samples (OECD, 2010) as well as convincing quality criteria for comparable self-report scales (for subjects of similar ages; e.g., Pereira-Laird & Deane, 1997) and also revealed findings of strong associations between reading strategy use and reading proficiency (OECD, 2010). Nevertheless, our results could not replicate or corroborate these outcomes. In particular, the lack of correlation between the measures of use of monitoring or regulation strategies, on the one hand, and reading literacy and declarative metacognition, on the other hand, which was expected based on theoretical considerations and previous results (e.g., Pereira-Laird & Deane, 1997), suggests a low validity of the used scales. One reason for this could be the brevity of the used scales, which do not contain information on the reading goal. Accordingly, self-reports of learning and reading strategy use—in particular with respect to self-regulated learning—have come under criticism recently (e.g., Veenman, 2005), primarily because they do not provide information about the usefulness of strategies in terms of learning or reading goals or the quality with which they are deployed. Against this background, we suggest that future assessments of the use of reading strategies apply scales that also contain information on reading goals and quality of strategy use, such as scenario-based reading strategy questionnaires. Observational analyses, working protocols or highlighting indices are further promising instruments for the assessment of use of reading strategies.

Moreover, with regard to the cross-sectional analyses, it must be noted that for practical reasons, declarative metacognition was assessed one year before the other measures. Therefore, the correlation between declarative metacognition and reading literacy may have been underestimated. As declarative metacognition measures have only moderate stability in secondary school (Artelt et al., 2012), higher correlations might have emerged if both measures had been assessed at the same time.

Despite these critical points, the present study provided insights into important predictors of (changes in) reading literacy during secondary school from a cross-sectional and a longitudinal perspective. Based on previous research and the view of reading literacy as self-directed learning from texts, it revealed answers to the question of the importance, concurrent effects, and interplay of various characteristics of students to explain differences in reading literacy (development). Particularly, the study showed that effects of different strategic reading activities, that is, use of reading strategies and declarative metacognition, on reading literacy are not moderated by motivational aspects. It also revealed that the two aspects of intrinsic reading motivation as well as different strategic reading activities explain reading literacy to varying degrees. Thus, on the one hand, the assumed importance of declarative metacognition—which far exceeds the influence of the use of reading strategies—was confirmed. On the other hand, the strong importance of reading for enjoyment was corroborated, particularly compared to the relevance of reading for interest.

Hence, the results of this study emphasized both characteristics as strong predictors of reading literacy and thus as promising starting points for support programs. Therefore, encouraging and providing appropriate opportunities for students to read for fun and enjoyment should be a top priority to develop their reading literacy. In addition, a further focus in reading instruction should be to inform students about the uses, goals, and benefits of reading strategies to enhance their declarative metacognition.

Furthermore, the strong differences in effects found for the two aspects of intrinsic reading motivation highlighted the importance of distinguishing between these two concepts in future analyses, as previously recommended by Schiefele and colleagues (2012). Accordingly, as our results and the underlying view of self-regulated reading suggest, it seems promising to separately investigate the effects of reading for enjoyment and reading for interest, both of which belong to the outermost layer of the model, on reading processes, text processing, and reading literacy, all three of which are located in the inner layers. In addition, emotional characteristics of readers, concerning the outer layer, as well as reading amount and involvement, concerning the middle layer, should be considered as further possible moderating or mediating variables in the interplay between the cognitive, metacognitive, and motivational characteristics studied here, and thus as determinants of reading literacy. Moreover, further questions arise when considering the broader concept of reading literacy that underlies the recent PISA studies and includes reading situations with texts in multiple sources and media that are increasingly available in digital offerings. Finally, further insights into the interplay between such differentiated features of reading situations, the characteristics and processes of readers, and their reading literacy promise to identify additional entry points for the future promotion of secondary students´ reading literacy.

Appendix

Table 5 Reading strategies scales (adapted from McElvany & Richter, 2009)

Scale		Item
Elaboration		When I read a text …
	1.	I try to relate my own experiences to the subject matter of the text
	2.	I try to understand how the most important parts of the text are interrelated
	3.	I try to relate what I've read with things that I've read before
	4.	I try to gain a deeper understanding of what I've read by considering how what I've read is related to what I already know
Monitoring		When I read a text …
	1.	I make sure that I remember the most important aspects
	2.	I consider how best to proceed while reading
	3.	while reading, I try to find out what I haven't really understood yet
	4.	I check repeatedly whether I understand the context properly
Regulation	1.	If the text contains a lot of difficult passages, I consider which parts are the most important and try to understand these first
	2.	If I notice that I don't understand the text, I try to find out which passages of the text I haven't understood
	3.	If I don't understand something while reading, I try to understand it by looking for additional information in other parts of the text

Response scale: 1 "never", 2 "rarely", 3 "sometimes", 4 "often", 5 "always". All items are mono-directed

Table 6 Habitual intrinsic reading motivation scales (adapted from Möller & Bonerad, 2007)

Scale		Item
Reading for enjoyment		What do you think about reading?
	1.	I enjoy reading books
	2.	I find reading interesting
	3.	If I had enough time, I would read even more
Reading for interest		What do you think about reading?
	1.	I like to read about new things
	2.	I am convinced that I can learn a lot through reading
	3.	Reading is important for understanding things correctly

Response scale: 1 "strongly disagree", 2 "disagree", 3 "agree", 4 "strongly agree". All items are mono-directed

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s12144-022-04184-7.

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Data availability Data used are available to the scientific community as scientific use files (see https://doi.org/10.5157/NEPS:SC3:10.0.0).

Code availability The analyses were conducted in *R* version 3.4.0 (R Core Team, 2021) with the *TAM* package version 3.7–16 (Robitzsch et al., 2021), *lavaan* package version 0.6–9 (Rosseel, 2012), and *lavaan.survey* version 1.1.3.1 (Oberski, 2014). The analysis syntax are provided at the repository OSF https://osf.io/fueyk/?view_only=6c819ace85c14f77b857974874e4d33a.

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Declarations

Conflicts of interest The authors declare that this research was conducted in the absence of any personal, commercial or financial relationships that could be construed as potential conflicts of interest.

Research involving human participants with informed consent All analyses were conducted using data from starting cohort 3 of the National Educational Panel Study (NEPS; https://doi.org/10.5157/NEPS:SC3:10.0.0; Blossfeld et al., 2019). All participants of this study or their parents gave informed consent to participate in the study.

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