Reading competence development of poor readers in a German elementary school sample: an empirical examination of the Matthew effect model

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Abstract: According to the Matthew effect model, interindividual differences in reading competence between poor and normal readers should become wider as students grow older. The second part of the model assumes that these differential pathways are mainly attributable to differential reading activities. The purpose of this study is to examine whether both assumptions can be verified in a sample of German elementary school students. Data from 1,124 students, participating in the BiKS longitudinal study with assessment starting in Grade 3 and two further points of measurement in Grade 4, were available for our analyses. Latent growth curve models showed a significant lower linear and quadratic trend on reading competence development for students with severe reading deficits in comparison with their better classmates. Further analysis indicates that differential reading behaviour seems to be a prominent factor in explaining these differential pathways whereas the students' general cognitive abilities seem to be of less importance.

Keywords: reading competence development, poor readers, Matthew-effect, elementary school, latent growth curve model

As widely accepted, reading is one of the core competences that students acquire during their elementary school years. Nevertheless, the ability to read and to understand what currently has been read (reading competence) is often not very well developed when students leave elementary school. When looking at the respective results from large-scale assessments for Germany, the findings are the following: as has been shown in Progress in International Reading Literacy Study (PIRLS) 2006, at the end of the elementary school years, 2.6% of students still have severe problems in decoding words and phrases and another 10.6% have severe problems in identifying explicitly denoted items of information in texts, so in total 13.2% of German elementary school students can be classified as having severe reading deficits (Bos et al., 2007). At the age of 15, about 20% of the German students are still below or only reach the lowest reading competence level in Programme for International Student Assessment (PISA) 2006 (Drechsel & Artelt, 2007). The number of students with severe reading deficits at the age of 15 in Germany hardly differs from the average quota from all OECD countries participating in PISA 2006. Nevertheless, students with severe reading deficits are a true challenge for society. In the long run, students with severe reading deficits will remain more often without completed vocational training and will be more often affected by unemployment (Esser, Wyschkon & Schmidt, 2002; Klicpera & Gasteiger-Klicpera, 1995). Therefore, analysing conditions and consequences of more or less successful reading competence development is an important task for current research.

Reading competence and causes of individual differences

Text comprehension comprises more than the simple recoding of letters, their aggregation to words and the subsequent formation of phrases. In the current literature, text comprehension is viewed as a dynamic and interactive process, in which several distinct skills of the reader need to interact jointly in order to understand a written text (Cain, 2009; Lenhard & Artelt, 2009). For building up a coherent representation of a text, the reader needs to engage in different text-based and knowledge-based processes: he or she has to generate text-based inferences and additionally has to use and apply different knowledge components, like vocabulary, syntactic knowledge, content prior knowledge as well as meta-cognitive strategies (Graesser, Millis & Zwaan, 1997; Kintsch, 1998). Whereas some of these processes are highly automatic, others require cognitive load and meta-cognitive planning, monitoring and regulation. When talking about a successful text comprehension process, the reader should have constructed a coherent and integrated mental representation of the text that is analogous in structure to the events, situations or layouts described by the text. This kind of text representation is often referred to in the literature as mental model or situational model (Graesser & Zwaan, 1995; Johnson-Laird, 1983; McNamara, Miller & Bransford, 1996).

As multiple components are needed for successful reading, reading difficulties can be determined by factors at different levels that contribute to or reflect deficits in

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reading competence (Baker & Carter Beall, 2009; Daneman, 1996; Klicpera & Gasteiger- Klicpera, 1995). At the word level, good and poor readers seem to differ in their vocabulary knowledge as well as in their decoding skills. At the sentence level, poor readers seem to have lower syntactic knowledge and have more problems in creating a locally coherent representation of related sentences. And finally, at the text level, poor readers seem to have more problems in generating elaborated text-based inferences and to integrate propositions from the text with their own prior knowledge while building a situational model (Cain, 2009). Because of this demanding integration process, reduced working memory capacity might also impair text comprehension (Just & Carpenter, 1992). Cognitive theories of text comprehension almost neglect the importance of motivational processes for the development of reading competence and thus also for reading difficulties. Correlations between reading competence and reading motivation are well investigated (Guthrie, Wigfield, Metsala & Cox, 1999; Guthrie, Wigfield & Perencevich, 2004; Wigfield & Guthrie, 1997). The connection between both variables is most apparent for intrinsic motivation (Baker & Wigfield, 1999; Wang & Guthrie, 2004). A high level of intrinsic reading motivation increases the probability of reading, for example in leisure time out of school. Consequently, the amount of reading is a good indicator for intrinsic reading motivation (Cox & Guthrie, 2001). Numerous longitudinal studies affirmed that reading behaviour, often operationalised as the amount of time spent reading, influences reading comprehension (Anderson, Wilson & Fielding, 1988; Cipielewski & Stanovich, 1992) and contributes to the explanation of differential development of readers.

Matthew effect in reading

As has been shown by several longitudinal studies, the best predictor of future performance is past performance (e.g. Boland, 1993). Nevertheless, beyond focusing on rank order stability between students with good and poor school performance, it seems appropriate to ask whether differences in competence level between students with good and poor school achievement increase or decrease as students grow older. In theory, increasing differences in reading competence between good and poor readers are expected with age and mostly referred to as fan-spread effect or Matthew effect (Stanovich, 1986, 2000; Walberg & Tsai, 1983). Furthermore, in the Matthew effect model, Stanovich suggests that progressing interindividual differences in reading competence are caused by reciprocal mechanisms of differential reading activities and reading skills. Therefore, this self-reinforcing causal process leads to a cumulative advantage for good readers in contrast to their less-skilled classmates: students who are reading well will read more and hence (better) improve their reading competence which in turn leads to more reading behaviour and vice versa. Consequently, as stressed in this model, the amount of reading experience is the critical mediating variable leading to individual differences in the development of reading skills.

The empirical support for this assumed widening gap between good and poor readers in reading comprehension, however, is weak. Bast and Reitsma (1998), using data from a sample of Dutch elementary schools, could find evidence for a Matthew effect in word recognition but not for reading comprehension. Aarnoutse, van Leeuwe, Voeten and Oud (2001), based on a Dutch elementary school sample, report a catch-up effect for poor readers during the elementary school years on several reading competence measures, inter alia reading competence. Shaywitz et al. (1995), based on a data set from the United States, report a Matthew effect for intelligence but not for a composite reading score. Juel (1988) on the other hand, also based on a US elementary school sample, did not test for a widening gap in reading competence, but reports an increasing difference in reading time from Grades 1 to 4 between poor and normal readers. And finally, based on an Austrian school sample, Klicpera, Schabmann and Gasteiger-Klicpera (1993) report a widening gap between poor and normal readers in reading speed and a narrowing gap for reading accuracy. Taken together at least fragmentary evidence exists for a widening gap of basic reading skills between poor and normal readers during the elementary school years. Nevertheless, for hierarchy high levels of reading skills, like on measures of text comprehension, support for the assumption of a widening gap seems to be rare.

Better empirical support, however, is found for the second part of Stanovich's Matthew effect model, which assumes that the widening gap in reading competence between good and poor readers should be attributable to a self-reinforcing causal process between reading behaviour and reading comprehension. As has been shown by Anderson et al. (1988), there is substantial divergence in the amount of out-of-school reading for different reading ability groups. For example, the average child at the 80th percentile spends 10 times more time reading per day than a child at the 20th percentile. Furthermore, there is good evidence from longitudinal educational studies that differences in the amount of reading leads to differences on measures of reading competence (Anderson et al., 1988; Cipielewski & Stanovich, 1992; Watkins & Edwards, 1992). However, empirical support from experimental and quasi-experimental studies concerning the positive effects of reading on reading competence is less convincing (National Institute of Child Health and Human Development, 2000). Currently, a growing number of studies demonstrate reciprocal effects of reading competence and reading behaviour by using structural equation models, indicating that better reading comprehension leads to more reading behaviour which in turn leads to a further improvement of reading comprehension (McElvany, Kortenbruck & Becker, 2008; Pfost, Dörfler & Artelt, 2010) and consequently support at least the second part of the Matthew effect model, suggesting that reading deficits of poor readers cumulate because of a lack of reading behaviour.

In the present study, we are interested in the development of students who have severe reading competence deficits in comparison with normal readers. Therefore we ask whether poor readers can catch up to the normal readers or fall even more behind in measures of reading competence during the last year of elementary school. Although most studies so far failed to prove increasing differences in measures of reading competence, we adhere to the theoretically described Matthew effect model and therefore expect that poor readers that have reading deficits on high as well as low processing levels cannot compensate for their deficits and have a lower reading competence growth than their better classmates (Hypothesis 1). We assume that the application of latent growth models with a common metric over time is a powerful tool to detect interindividual differences in competence development. Then we ask whether these differences in the growth of reading competence between poor and normal readers can be attributed to their extracurricular reading behaviour operationalised as the amount of daily extracurricular reading for pleasure. We expect that reading behaviour is a potent variable in explaining differences in the reading competence development (Hypothesis 2a), even when controlling for general cognitive abilities (Hypothesis 2b).

Methods

Design and participants

Data collection took place within the framework of the BiKS research group (Bildungsprozesse, Kompetenzentwicklung und Formation von Selektionsentscheidungen im Vor- und Grundschulalter [educational processes, competence development and selection decisions in pre- and elementary school age]), in which two longitudinal studies are conducted in the southern and middle part of Germany. In these regions, elementary school comprises 4 years of education and starts when children are about 6 years old. Every school year is divided into two terms. In our analyses, we used data from the first wave of measurement in the second term of Grade 3 (Time 1), the second wave of measurement in the first term of Grade 4 (Time 2) and the third wave of measurement in the second term of Grade 4 (Time 3). In Grade 3, a total of 1,124 students from 77 classes in 41 elementary schools in Bavaria and Hesse participated. Students were nested in classes with an average 14.6 students per class (*SD* = 4.3; with a range between 5 and 24) and classes were nested within schools with on average 1.9 (*SD* = 0.5; with a range between 1 and 3) classes per school. In Grade 4, 89.9% (Time 2) and 85.1% (Time 3), respectively, of the students were reassessed. The average age of the students at Time 1 was 9.3 years (*SD* = 0.5) and 10.4 years (*SD* = 0.5) at Time 3. In our sample, 9.6% of the students lived in households with a migration background meaning that other languages than German were mainly spoken at home. The gender of the students was almost equally distributed: 52.2% of the students were male and 47.8% were female.

Measures

The students and the parents were tested every half-year on a wide range of measures. The following measures were used in the current analysis.

Reading competence. In the first and the second wave of measurement, reading competence was measured by a sample of 13 short texts with altogether 20 multiple-choice items from the subscale text comprehension of the *Ein Leseverständnistest für Erst- bis Sechstklässlter* (ELFE 1–6; Lenhard & Schneider, 2005). In the third wave of measurement, the ELFE text comprehension subscale was prolonged by adding three new texts with six multiple-choice items, developed by the authors. That prolongation of the test was necessary in order to avoid ceiling effects. Within the reading competence test, the students had to read a given text, search relevant information and generate more or less high inferences from the text to answer the given items. Test time was limited to 7 minutes for the whole reading competence test. The internal consistencies (Cronbach's a) of the measures were satisfying for all waves of measurement (α_{Time} 1 = .88, α_{Time} 2 = .87 and α_{Time} 3 = .89).

Reading behaviour. Students' habitual extracurricular reading behaviour was assessed by a single item ('Does [the name of the child] read for pleasure?') in the parental telephone interview at the third wave of measurement. Parents rated the frequency of their children's reading behaviour on a 4-point Likert-type scale with the response options 1 = *almost never or never*, 2 = *rarely*, 3 = *yes, several times a week* and 4 = *yes, everyday*.

Reading speed. Reading speed was assessed at Time 1 by using the *Salzburger Lesescreening für die Klassen 1–4* (SLS 1–4; Mayringer & Wimmer, 2005). The intended purpose of the SLS 1–4 reading test is to measure interindividual differences in low-level reading processes characterised as the ability to read and understand sentences fluently and without mistakes. Therefore, the students got a list of 70 simple phrases with a correct or incorrect statement and the students had to evaluate the plausibility of each phrase. The students' performance was assessed by summing up the number of the correct answers within a 3-minute time limit. According to the test manual, the psychometric properties of the test are satisfactory (parallel-test reliability *r* = .89).

General cognitive abilities. Students' general cognitive abilities were assessed with a set of 15 items from the matrices subtest of the *culture fair intelligence test* (German version: Weiß, 2006). This test measures the ability to recognise and solve problems of figural relations and of formal figural reasoning with different levels of complexity within a 3-minute time limit. The tasks contain a 2 x 2 matrix whereas one cell is left blank. The student has to fill in the correct answer by choosing one out of five provided alternatives. According to the test manual, the psychometric properties of the test are acceptable (correlation of the matrices subtest with the total test score *r* = .82).

Analysis strategy

At first, we classified students as normal readers or as poor readers. To belong to the poor reading group, the students had to fulfil the following criteria: according to the age- related population norm provided by the test manuals, poor readers had to score at least one standard deviation below the population mean in reading speed (SLS 1–4) as well as one standard deviation below the population mean in reading competence (ELFE 1–6).

In case of missing data, we used the expectation–maximisation algorithm (EM-algorithm) at this step, integrated in the SPSS software package, to obtain the best individual estimate for the classification procedure. In total, 132 of the 1,124 (11.7%) students in our sample were classified as poor readers with a slight overrepresentation of boys (n = 77). Consequently, 992 students were assigned to the group of normal readers. The consideration of low-level as well as high-level reading processes in the selection of poor readers will guarantee a high reliability and validity of the classification process and thus should help to avoid effects of the regression to the mean.

In a next step, for all items of the reading competence test, the item difficulty parameters were estimated within an item response theory framework. We assumed a 1-parameter Rasch model with a Gaussian population distribution. Item difficulty parameters varied between - 4.4 and 4.5 and covered the students' estimated ability distribution. Subsequently, every item difficulty parameter was fixed to guarantee a common metric of the individual reading competence estimator for all three points of measurement. In order to obtain two parallel test forms, we generated two item parcels by separation of all test items (see Little, Cunningham, Shahar & Keith, 2002). Therefore, the items were ranked according to their difficulty and then the first, fourth, fifth, eighth and so forth, item was selected for parcel 1 and the second, third, sixth, seventh and so forth, item was selected for parcel 2, respectively. This procedure was necessary to allow in the subsequent analysis the formation of a measurement model for reading competence. The individual student's ability was estimated by weighted likelihood estimates (WLEs) by using the ConQuest software package (Wu, Adams, Wilson & Haldane, 2007). WLE scores were subsequently T standardised (Mean = 50, SD = 10) based on parcel 1 of the first wave of measurement.

In a third step, we used Mplus 4.02 (Muthén & Muthén, 1998–2007) as a tool for latent growth curve analysis of the reading competence measures. The three measurement points were coded as - 1, 0, 1 for the linear trend and 1, 0, 1 for the quadratic trend (see Biesanz, Deeb-Sossa, Papadakis, Bollen & Curran, 2004). The dummy-coded grouping variable was used to predict differences in the intercept (the mean level for the estimation of reading competence) and slope (the linear and quadratic trends for the estimation of reading competence) between poor and normal readers. Then, we incorporated the indicator of the students' reading behaviour as mediator between the reading level classification variable and the prediction of the linear and quadratic trend. Finally, the measure of students' general cognitive abilities was further incorporated in the mediator model. All models were evaluated by common fit parameters (Hu & Bentler, 1998, 1999). To control for the nesting of students within classes, the *type = complex* option in Mplus was used. Missing data were handled by using the full information maximum likelihood (FIML) estimation option, which allows the inclusion of participants with partially missing data and the use of all available information in the analyses (Lüdtke, Robitzsch, Trautwein & Köller, 2007; Muthén & Muthén, 1998–2007).

Results

Descriptive statistics

Table 1 presents the inter-correlations for all relevant measures for the whole sample and Table 2 presents the means and standard deviations for all relevant measures across the two groups of readers. First, results indicate that the rank order stability of students concerning their reading competence in the whole sample for a 1-year period is very high (r = .76, p < .01). Second, general cognitive abilities as well as reading behaviour are both significant correlated with the used measures of reading speed and reading competence in a low to medium size (range from r = .24 to .40). Third, general cognitive abilities and reading behaviour are significantly positively related (r = .08, p < .05), although of a magnitude of almost no practical relevance. Finally, our results show significant differences for all measures between students classified as poor readers and students classified as normal readers. Students, classified on the basis of reading speed and reading competence as poor readers, consequently demonstrate a lower reading competence and read slower. Besides, poor readers have lower general cognitive abilities and read less than their better classmates in their spare time. Concerning the changes of the reading competence measures (T metric) across time, we furthermore see an increasing standard deviation as well as an increasing mean difference between poor and normal readers. As the standard deviation of the whole population increases faster with time as does the absolute mean difference between poor and normal readers, the quota between these two estimates, the effect size, slightly decreases.

Table 1: Inter-correlations between reading competence, reading behaviour, reading speed and general cognitive abilities.

		1	2	3	4	5	6
1	Reading competence (Time 1)	1					
2	Reading competence (Time 2)	.76**	1				
3	Reading competence (Time 3)	.76**	.80**	1			
4	Reading behaviour (Time 3)	.37**	.36**	.40**	1		
5	Reading speed (Time 1)	.68**	.67**	.68**	.34**	1	
6	General cognitive abilities (Time 1)	.33**	.30**	.29**	.08*	.24**	1

Note: Time 1 = first wave of measurement; Time 2 = second wave of measurement; Time 3 = third wave of measurement. *N* varies between 798 and 1,119 students.
***p* < .01; **p* < .05.

Table 2: Means and standard deviations of reading competence, reading behaviour, reading speed and general cognitive abilities by reading-level classification.

	Whole sample			Normal readers			Poor readers			t	M_N - M_P	$(M_N–M_P)/SD_{N+P}$
	N	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*			
Reading competence (Time 1)	1,115	50.9	9.5	988	52.5	8.7	127	38.0	4.5	29.85**	14.54	1.53
Reading competence (Time 2)	1,008	57.1	9.7	897	58.8	8.7	111	44.0	5.9	23.44**	14.80	1.53
Reading competence (Time 3)	948	62.9	11.8	853	64.5	11.1	95	48.0	6.9	20.49**	16.51	1.40
Reading behaviour (Time 3)	853	3.0	1.0	769	3.1	0.9	84	2.4	1.1	6.13**	0.75	0.77
Reading speed (Time 1)	1,119	37.8	9.0	988	39.7	7.6	131	23.7	5.7	29.11**	16.0	1.78
General cognitive abilities (Time 1)	1,122	8.1	2.5	991	8.3	2.4	131	6.9	2.6	5.81**	1.33	0.53

Note: M = mean; M_N - M_P = mean difference between normal readers and poor readers; $(M_N - M_P)/ SD_{N+P}$ = mean difference between normal readers and poor readers divided by the standard deviation of the whole sample; *N* = number of students; *SD* = standard deviation; for reading competence the mean of parcel 1 and parcel 2 is indicated; *t* = *t* value; Time 1 = first wave of measurement; Time 2 = second wave of measurement; Time 3 = third wave of measurement.
** *p* < .01.

The development of reading competence

In the following, the results for the latent growth curve models are presented. At first, we had to choose an appropriate growth function for the whole sample. Therefore, we evaluated a linear latent growth model ($E(Y_t) = \beta_0 + \beta_1 t$) as well as a linear–quadratic latent growth model ($E(Y_t) = \beta_0 + \beta_1 t + \beta_2 t^2$). For the linear latent growth model, a poor model fit was found (χ^2 = 323.86, *df* = 16, $p < .05$; CFI = .946; RMSEA = .131), whereas the linear–quadratic latent growth model showed an appropriate model fit (χ^2 = 51.85, *df* = 12, $p < .05$; CFI = .993; RMSEA = .054). Consequently for all further analysis, a linear–quadratic latent growth model for the development of reading competence was chosen. In a second step, the dummy variable, which reflects whether a student belongs to the group of normal readers (coded as 0) or the group of poor readers (coded as 1) was incorporated in the model in order to predict the intercept and slope components of the reading competence growth model (Figure 1). The overall fit of the model was acceptable (χ^2 = 71.154, *df* = 15, $p < .05$; CFI = .992; RMSEA = .058). The estimated results are presented in Table 3. At first, the results indicate that in general students' reading competence increases with time (slope – linear = 5.850, $p < .01$; slope – quadratic = - 0.156, *ns*). Then as indicated by our analysis, poor readers had a significant lower reading competence intercept (γ_0 = - 14.557, $p < .01$) as well as a significant lower linear slope (γ_1 = - 1.131, $p < .01$), indicating that poor readers gain less than their better classmates in this 1-year period. Concerning the quadratic slope, poor readers show a significant negative acceleration of their reading competence development whereas normal readers do not (γ_1 = - 1.132, $p < .05$). A graphical illustration of the development of reading competence for the poor and normal readers is depicted in Figure 2.

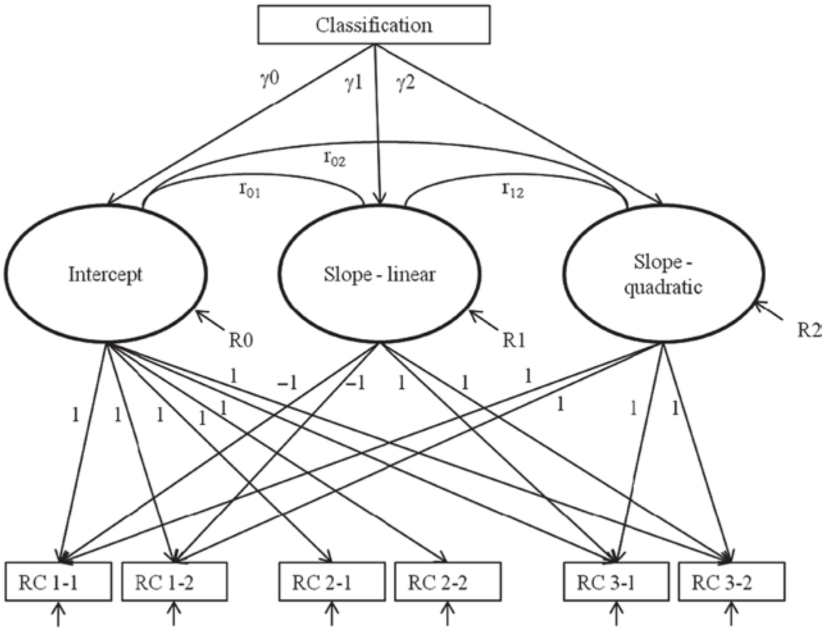

Figure 1: Latent growth curve model.

Note: Classification = dummy variable, indicating whether the student is classified as normal reader (0) or as poor reader (1); RC = reading competence; the first cipher indicates the measurement point, the second cipher indicates the parcel.

Table 3: Latent means, regression coefficients, covariances and (residual) variances for the estimated latent growth curve model of reading competence development.

	Estimated parameter	*SE*	Standardised solution	Est./*SE*
Mean structure				
Intercept	58.511	0.360	6.392	162.438**
Slope – linear	5.850	0.168	1.794	34.925**
Slope – quadratic	- 0.156	0.211	- 0.036	- 0.738
Regression				
γ_0	- 14.557	0.578	- 0.512	- 25.178**
γ_1	- 1.131	0.373	- 0.112	- 3.029**
γ_2	- 1.132	0.482	- 0.083	- 2.349*
Covariances				
r_{01}	9.619	1.076	0.332	8.941**
r_{02}	- 4.448	2.095	- 0.111	- 2.123*
r_{12}	1.173	0.902	0.082	1.300
Variances				
R_0	61.827	2.793	0.738	22.134**
R_1	10.507	0.873	0.988	12.039**
R_2	19.038	1.594	0.993	11.947**

Note: Est./*SE* = estimated parameter divided by its standard error; *SE* = standard error.

** $p < .01$; * $p < .05$.

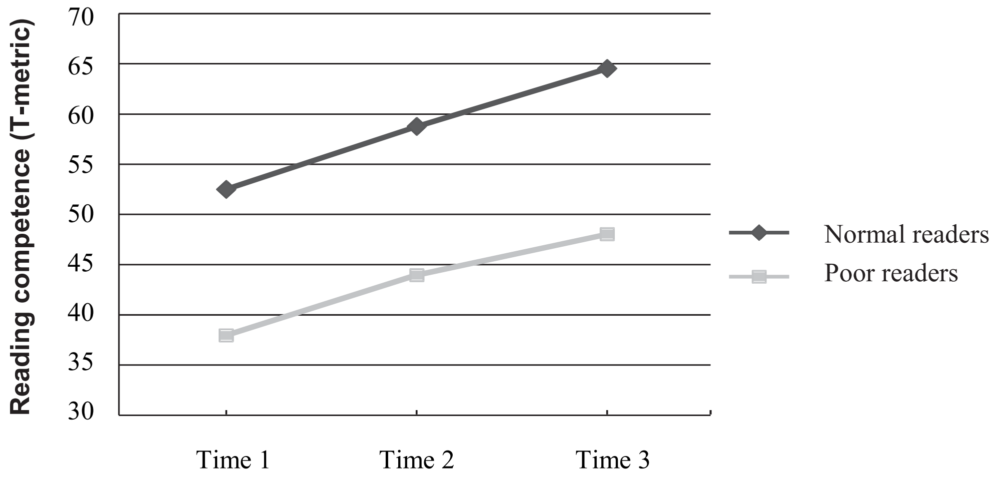

Figure 2: The development of reading competence for poor and normal readers, measured in the second term of Grade 3 (Time 1), the first term of Grade 4 (Time 2) and the second term of Grade 4 (Time 3).

Mediator models

We now turn to the second question: can the differences in the development of reading competence between poor and normal readers be attributed to interindividual differences in reading behaviour? And does this explanatory model remain significant when differences in general cognitive abilities are entered in this mediator model? In order to address these questions, we estimated two further latent growth curve models (Figure 3).

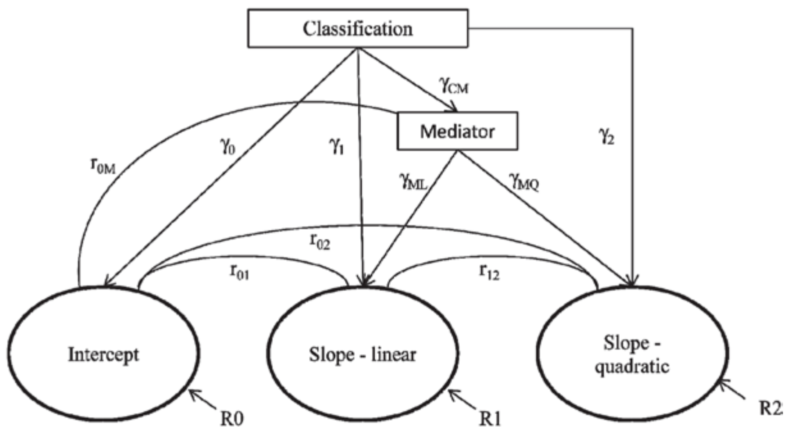

Figure 3: Latent growth curve model with mediator variable(s).

Note: Only the structural part of the model is depicted. Classification = dummy variable, indicating whether the student is classified as normal reader (0) or as poor reader (1).

In the first mediator model, only reading behaviour was included as a possible mediator. In the second model, reading behaviour and general cognitive abilities were included as mediator variables. The estimated results for both models are presented in Table 4. The overall fit statistics indicate satisfactory fit for both models (mediator model 1: $\chi^2 = 69.757$, $df = 18$, $p < .05$; CFI = .992; RMSEA = .051; mediator model 2: $\chi^2 = 72.218$, $df = 21$, $p < .05$; CFI = .992; RMSEA = .047). The first mediator model, which includes only the students' habitual extracurricular reading behaviour as mediator variable will be presented first. As expressed by the significant path coefficient from the reading-level classification variable to reading behaviour, poor readers read less often outside school than their better classmates ($\gamma_{CM(Reading)} = -0.759, p < .01$). Reading behaviour in turn is positively related to the linear component of the growth process of reading competence ($\gamma_{ML(Reading)} = 0.609$, $p < .01$) as well as to the quadratic component of the reading competence growth process ($\gamma_{MQ(Reading)} = 0.640, p < .01$). Whereas in the model without any mediator variables, the direct path coefficients between the classification variable and the linear and quadratic reading competence growth components were highly significant, these direct path coefficients become irrelevant after the inclusion of reading behaviour as mediator variable between the reading level classification variable and the slope components. Neither the direct path coefficient to the linear (γ_1 = - 0.692, *ns*) nor to the quadratic growth component (γ_2 = - 0.632, *ns*) reached significance anymore, indicating a full mediation of this former direct influence over the included reading behaviour variable. This is confirmed by the significant testing of the whole indirect effect of the reading-level classification variable on the linear (- 0.462, $p < .01$) and quadratic trend (- 0.486, $p < .01$) over the reading behaviour mediator variable.

The addition of general cognitive abilities as a mediator variable in the second mediator model does not significantly change the pattern for reading behaviour as mediator. The indirect effects over the reading behaviour mediating variable still remain significant both for the linear (- 0.462, $p < .01$) as well as for the quadratic (- 0.457, $p < .01$) trend. When regarding the general cognitive abilities, the reading level classification variable is significantly linked with the students' general cognitive abilities ($\gamma_{CM(GCA)}$ = - 0.537, $p < .01$), but there is no significant path coefficient to the linear trend of reading competence development ($\gamma_{ML(GCA)}$) = 0.125, *ns*). The path coefficient from general cognitive abilities to the quadratic reading competence growth trend, however, is positive and significant ($\gamma_{MQ(GCA)}$) = 0.411, $p < .05$). This is also reflected by the nonsignificant indirect effect of the reading-level classification variable on the linear trend of reading competence development over the general cognitive ability variable (- 0.067, *ns*) whereas there is a significant indirect effect of the reading-level classification variable on the quadratic trend of reading competence development over the general cognitive ability variable (- 0.221, $p < .05$).

Taken together, the results indicate a widening gap in a 1-year developmental period in reading competence between students with and without severe deficits in reading skills. As has been shown by our second analysis, poor readers spend less time in extracurricular reading, which in turn explains differences in reading competence development, even after controlling for interindividual differences in general cognitive abilities.

Table 4: Latent means and regression coefficients for the estimated mediator models.

	Mediator model 1			Mediator model 2		
	Est.	*SE*	Est./SE	Est.	*SE*	Est./SE
Mean structure						
Intercept	58.510	0.360	162.555**	58.506	0.359	162.756**
Slope – linear	5.828	0.163	35.675**	5.816	0.164	35.548**
Slope – quadratic	- 0.179	0.210	- 0.855	- 0.204	0.209	- 0.977
Regression						
γ_0	- 14.573	0.579	- 25.148**	- 14.623	0.579	- 25.248**
γ_1	- 0.692	0.398	- 1.739	- 0.637	0.381	- 1.670
γ_2	- 0.632	0.527	- 1.199	- 0.483	0.535	- 0.904
$\gamma_{CM(Reading)}$	- 0.759	0.127	- 5.984**	- 0.759	0.126	- 6.004**
$\gamma_{ML(Reading)}$	0.609	0.147	4.132**	0.609	0.149	4.074**
$\gamma_{MQ(Reading)}$	0.640	0.184	3.480**	0.603	0.182	3.315**
$\gamma_{CM(Reading)}$				- 0.537	0.105	- 5.132**
$\gamma_{CM(GCA)}$				0.125	0.132	0.942
$\gamma_{ML(GCA)}$				0.411	0.193	2.123*
$\gamma_{MQ(GCA)}$						
Specific effects of poor reader classification on reading competence development through reading behaviour as mediator variable						
Linear	- 0.462	0.152	- 3.046	- 0.462	0.152	- 3.035*
Quadratic	- 0.486	0.153	- 3.178**	- 0.457	0.149	- 3.063**
Specific effects of poor reader classification on reading competence development through general cognitive abilities as mediator variable						
Linear				- 0.067	0.070	- 0.953
Quadratic				- 0.221	0.107	- 2.058*

Note: Est. = estimated parameter; Est./*SE* = estimated parameter divided by its standard error; *SE* = standard error;
γ_{CM} = γClassification variable – Mediator variable, γ_{ML} = γMediator variable – Slope reading competence linear, γ_{MQ} = γMediator variable – Slope reading competence quadratic, in parentheses indicates whether the mediator variable refers to reading behaviour or general cognitive abilities.
**$p < .01$; *$p < .05$.

Discussion

The purpose of our study was to investigate how reading competence of students who have severe reading competence deficits in Grade 3 develops throughout the last year of German elementary school and whether differences in reading competence development can be attributed to differential reading behaviour. Consistent with our first hypothesis, results clearly show that the development of reading competence of poor readers is somewhat slower than for their better classmates, indicated by the lower linear growth trend for poor readers. Furthermore the significant difference in the quadratic growth component between poor and normal readers indicates a negative acceleration of the reading competence growth trend for poor readers but not for normal readers, making the gap even wider as students grow older (see Figure 2). Therefore our results strongly support the theoretical model proposed by Walberg and Tsai (1983) as well as Stanovich (1986, 2000). They propose that early differences in reading skills between students will become bigger as students grow older if no special intervention takes place. This interpretation is further supported by the increasing variance of the reading competence measures with time. The fact that we find evidence for a Matthew effect while other empirical studies do not may – in part – be attributable to differences in the analysis strategies applied: at first, we believe that latent growth curve modelling is an appropriate technique for analysing reading competence development, as this technique allows in comparison with traditional methods the incorporation of more than two waves of measurement and a separation of linear from non-linear trends. Furthermore, the use of structure equation models allows a consideration of measurement error and the use of latent variables. Thirdly, latent growth curve models focus on the students' competence development in an absolute metric whereas traditional methods mostly refer to the relative position of the student within its distribution of other students. Nevertheless, other techniques that take an increasing variance into account like the auto-regressive models used by Bast and Reitsma (1998) may also be appropriate for studying Matthew effects. Another reason might be that the second part of the elementary school years may be a sensitive phase for differential developmental processes in reading as growth rates in reading competence are high and therefore allow for differential developmental processes. And finally, the classification of students in readers with severe reading deficits versus readers without these deficits, based on more than one diagnostic measure and by using population-based age norms, should alleviate the finding of differential pathways as regression to the mean is to some extent controlled.

Concerning the second hypothesis, that the differences in the development of reading competence between poor and normal readers may be attributable to differential reading behaviour, the results of our analysis confirm our expectations. Students' habitual extracurricular reading behaviour is less pronounced for students classified as poor readers and students' reading behaviour strongly predicts interindividual differences in reading competence development. It thus seems highly plausible that reading behaviour is one important factor in explaining the cause of a widening gap in reading competence development between poor and normal readers. This conclusion is further supported by the result that the direct path coefficient from the reading-level classification variable to the linear growth factor loses its significance when reading behaviour is introduced as a mediator variable. Moreover, the inclusion of general cognitive abilities as a concurrent mediating variable does not diminish the significance of the first mediator variable, reading behaviour, which further underpins our hypothesis: reading behaviour is one critical variable in explaining differential pathways in reading competence development. However, this result will not negate the importance of other factors in the explanation of Matthew effects.

Nevertheless, certain limitations of this study should be kept in mind. At first, for testing real cause–effect relations other research designs are needed. In addition, another partly superficial limitation stems from the fact that the extracurricular reading behavior was measured at the third wave of measurement by asking the parents for habitual behaviour of their child of the foregoing period. We believe that this indicator reflects rather well reading behaviour for the time period under investigation as it is a question asking for a retrospective estimation of students' reading habits. Therefore, for the critical time period of our investigation, this indicator asked at the third wave of measurement seems to reflect this time period better than when asked at the first wave of measurement, which would probably be a good indicator of reading behaviour in Grade 2. Unfortunately for the second wave of measurement, this information was not available. Furthermore, the strict assumptions that the predictor variable should precede the dependent variable as assumed by cause–effect conception do not hold true for our analysis.

An important finding of our study is the fact that students' general cognitive abilities exert almost no effect on the differential development of reading competence. Students classified as poor readers also perform worse on measures of general cognitive abilities, but general cognitive abilities exert no significant effect on the linear trend of reading competence development. On the quadratic component of reading competence development, a positive influence of general cognitive abilities was found, indicating a positive acceleration of the reading competence development as general cognitive abilities increase; however, it was of very moderate size. Therefore our data also support the view that the distinction between students having severe reading deficits with and without an impairment of general cognitive abilities, as often made in clinical psychology, seems to be of less practical importance for the further reading competence development in comparison with, for example, behavioural or social factors (see Lyon, Shaywitz & Shaywitz, 2003; Vellutino, Fletcher, Snowling & Scanlon, 2004).

Conclusions and implications for further research

When regarding our results from a broader perspective of the development of students with severe reading deficits, we can report at least one positive finding. All students, even those with severe deficits on basic reading skills as well as on comprehension measures show substantial growth in reading competence in a 1-year period. However, the growth in reading competence of poor readers is substantially lower than for normal readers. There seems not to be an automatic catch-up effect in reading competence. When regarding the level of reading competence, even at the end of Grade 4 the poor readers in our study do not reach the mean competence level that their better classmates reached at the end of Grade 3. This seems to lead to detrimental effects for the students' future cognitive development as well as for their academic careers (Cain & Oakhill, 2006; Klicpera & Gasteiger-Klicpera, 1995). Consequently, if we acknowledge that severe reading deficits do not diminish over time, the incorporation of effective strategies in the prevention of reading difficulties in the regular school and preschool system seems to be of high relevance. The application of prevention strategies also seems to be of interest for making further progress in the field of research in reading comprehension development. Especially the experimental manipulation of variables, like the student's reading behaviour, might offer further insights in cause–effect relations of reading and reading competence development. Furthermore, future research should take into account interindividual differences in strategic text processing and meta-cognition in order to disentangle motivational and meta-cognitive effects as well as to gain a better understanding of effective interventions.

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