Title: Skill or will? The relative contribution of behavioral and motivational characteristics to secondary school students' reading comprehension

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Abstract

The central aim of this study was to investigate the (in)direct relationships between 9th-grade students' behavioral (i.e. reading strategy use, reading strategy use, and reading frequency) and motivational (i.e. reading motivation and reading self-concept) characteristics and their reading comprehension. A total of 2485 students completed a standardized reading comprehension test and an online questionnaire to operationalize the behavioral and motivational reading variables. Data were analyzed using multiple group structural equation modeling, to study potential differential relationships across educational tracks (i.e. academic, technical, and vocational track). As to behavioral characteristics, global and problem-solving reading strategy use and reading engagement were positively related to reading comprehension. Supportive reading strategy use was, however, negatively related. Concerning reading frequency, a positive relationship was found for academic students, while a negative relationship was found for students in the technical and vocational track. As to motivational characteristics, it appeared that reading self-concept and autonomous reading motivation contributed positively, while controlled reading motivation contributed negatively to students' reading comprehension. Additionally, motivational characteristics were related to behavioral characteristics. Consequently, motivational characteristics are both directly and indirectly related to reading comprehension. As to the differences in the relationships between educational tracks, not all of the abovementioned relations were corroborated for each track. Generally, the results emphasize the importance of considering the "bigger picture", taking into account the relative contribution of both behavioral and motivational characteristics to secondary school students' reading comprehension, and concurrently considering differences between educational tracks.

Keywords: reading comprehension, reading motivation, reading behavior, structural equation modeling, secondary education, educational tracks

1. Introduction

In the context of 21st century skills and lifelong learning (European Commission, 2006), reading comprehension is a key competence contributing to both students' academic success and success beyond school (Taboada, Tonks, Wigfield, & Guthrie, 2009). In this respect, schools are entrusted with the crucial task to develop students' skills in reading comprehension. In view of realizing this, schools and teachers should be aware of student characteristics associated with reading comprehension. Prior research already investigated this extensively, confirming that behavioral as well as motivational characteristics are important correlates of reading comprehension (e.g. Guthrie, Wigfield, Metsala, & Cox, 1999; Taboada et al., 2009; Wang & Guthrie, 2004). However, some issues remain open.

First, secondary school students are increasingly expected to obtain knowledge from text (Boardman, Klingner, Buckley, Annamma, & Lasser, 2015). Proficient reading comprehension skills are therefore essential. However, a growing number of adolescents does not possess age-appropriate reading skills (e.g. Paul & Clarke, 2016; OECD, 2010). Consequently, several researchers call for more reading comprehension research in secondary schools (Retelsdorf, Köller, & Möller, 2011; Wolters, Denton, York, & Francis, 2014) in contrast with the prior dominant focus on primary education. Second, few studies investigated the contribution of behavioral and motivational characteristics to secondary school students' reading comprehension from a comprehensive point of view. Most studies focused on either behavioral or motivational characteristics, without considering indirect pathways in which these characteristics might relate to reading comprehension (e.g. Denton et al., 2015; Katzir, Lesaux, & Kim, 2009). In this respect, Schiefele and colleagues (2012) state that the mediating role of reading behavior between reading motivation and achievement remains to be clarified. Third, in secondary education, students are divided into separate educational tracks. Recently there has been growing interest in studies on differences between these tracked groups (Dockx, De Fraine, & Vandecandelaere, 2019). However, research considering educational tracks in relation to the (relative) contribution of behavioral and motivational characteristics to reading comprehension remains very scarce.

The present study addresses these gaps in the literature in three ways. First, the focus is on secondary school students. Second, the relative contribution of behavioral and motivational characteristics to reading comprehension is included in the study design. More specifically, reading behavior is assumed to mediate the relationship between motivation and comprehension. Third,

educational tracks are taken into account in analyzing these relationships. Underneath, the hypothesized model is displayed in Figure 1 and reflects the outline of the text.

Reading comprehension

Reading comprehension refers to the ability to gain meaning from what is read. This demonstrates a complex (meta-)cognitive process encompassing both low-level (word-level) and high-level (text-level) text-processing activities (McNamara & Magliano, 2009). Especially in the context of secondary education, high-level processes receive prominent focus. This focus on high-level text-processing is indubitably related to the concept of knowledge in our knowledge-based society. Knowledge needs not only to be remembered. It is crucial to understand, criticize, and reflect on knowledge as well (Fredricks, Blumenfeld, & Paris, 2004; Jarvis, 2001). Moreover, in the context of lifelong learning, individuals should be able to expand their knowledge, skills, and strategies in various contexts (European Commission, 2006). Third, in secondary education students are expected not only to be able to read texts, but also to learn form text (Wharton-McDonald & Swiger, 2009). This requires high-level text comprehension (Rogiers, Merchie, & Van Keer, 2019). Correspondingly, the focus in the present study will be on high-level text comprehension processes of secondary school students.

Motivational characteristics

The motivational characteristics embedded in the present study are reading motivation and reading self-concept. *Reading self-concept* refers to students' perception of their own reading competence (Martin, Mullis, & Kennedy, 2007). Given that students' self-concept appears to be an important predictor of behavioral, emotional, and cognitive outcomes (Marsh & Martin, 2011), it is included in the study. As self-concept is highly domain-specific, the present study particularly focuses on students' reading self-concept, which appears to be positively associated with reading comprehension (e.g. Katzir, Lesaux, & Kim, 2009; Taboada et al., 2009). However, evidence for secondary school remains scarce (Retelsdorf, Köller, & Möller, 2014). Hypothesis 1 in the present study states that students' reading self-concept is positively related to their reading comprehension (hypothesis 1).

As to *reading motivation*, a positive relationship with secondary school students' comprehension has been confirmed (e.g. Anmarkrud & Bråten, 2009; Wolters et al., 2014). However, different conceptualizations of reading motivation have been adopted. For example, Wang and Guthrie (2004) distinguish intrinsic and extrinsic motivation in eight components (i.e. curiosity, involvement, challenge, recognition, reading for grades, social motivation, competition, compliance).

However, this factor structure and the underlying theory has been critizised (De Naeghel, Van Keer, Vansteenkiste, & Rosseel, 2012; Watkins & Coffey, 2004). In the present study, self-determination theory (SDT) (Deci, Ryan, Vallerand, & Pelletier, 1991), which is promising in terms of assessing qualitatively different types of motivation (De Naeghel et al., 2012), is adopted as the underlying theoretical framework. More particularly, SDT distinguishes autonomous and controlled reading motivation. Autonomous reading motivation refers to reading because of the enjoyment of reading itself (i.e. intrinsic regulation) or the relevance readers attach to reading (i.e. identified regulation). Controlled reading motivation refers to reading because of external demands, rewards or expectations (i.e. external regulation) or because of internal demands, reflected in feelings of guilt, pride, fear or shame (i.e. introjected regulation). Autonomous reading motivation is expected to be positively related to reading comprehension (hypothesis 2), whereas reading for controlled reasons is expected to be negatively related (hypothesis 3) (De Naeghel et al., 2012; Vansteenkiste, Zhou, Lens, & Soenens, 2005; Reeve, 2002).

Behavioral characteristics

The behavioral characteristics included in this study are reading strategy use, reading engagement, and reading frequency. Reading strategy use and engagement can be considered to reflect the quality of the reading behavior, while reading frequency rather represents the quantity of reading behavior (De Naeghel et al., 2012). *Reading strategies* are defined as "deliberate, goal-directed attempts to control and modify the reader's efforts to decode text, understand words, and construct meanings of text" (Afflerbach, Pearson, & Paris, 2008, p. 368). Good readers tend to flexibly use a repertoire of reading strategies before, during, and after reading (Pressley & Harris, 2006; Rogiers, De Smedt, De Backer, & Van Keer, 2019). Therefore, reading strategy use is considered an important predictor of reading comprehension (Artelt & Schneider, 2015; Cai & Zhu, 2017; Cox & Guthrie, 2001; Denton et al., 2015; Lau, 2006). Following the highly cited research of Mokhtari and Reichard (2002), the present study distinguishes global, support, and problem-solving reading strategy use. Global reading strategy use assists in the global understanding of texts. Support reading strategies make use of external aids or materials. Problem-solving reading strategies are used when confronted with comprehension difficulties. Previous studies particularly confirm the positive association of global and problem-solving reading strategy use and reading comprehension. A negative or non-significant relationship is found for support reading strategy use (Cantrell & Carter, 2009; Cromley & Azevedo, 2006). Based on findings in previous studies, problem solving (hypothesis 4a) and global reading strategies (hypothesis 4b) are expected to be postively reated to students' reading comprehension performance (Mokhtari & Reichard, 2002), while no or even a negative relationship is supposed for support reading strategy use (hypothesis 4c).

Reading engagement refers to the quality of students' involvement during reading and is considered a multi-dimensional construct encompassing both a behavioral (e.g., attention, effort) and emotional component (e.g., positive emotion) (Fredricks, Blumenfeld, & Paris, 2004). Consequently, hypothesis 5 states that reading engagement will be positively related to reading comprehension (hypothesis 5). Further, it is generally assumed that students who read frequently are more successful readers. Moreover especially poor readers benefit from independent reading time (De Naeghel et al., 2012; Mol & Bus, 2011). In the present study, *reading frequency* in the recreational context (i.e. reading online texts and printed materials such as books, comics, or magazines) is taken into account, since this appears to be more strongly related to comprehension than reading frequency in the academic context (Schiefele et al., 2012). Hypothesis 6 states thus that reading frequency is positively related to reading comprehension.

Relative contribution of behavioral and motivational characteristics to reading comprehension

Behavioral and motivational characteristics are not only directly related to reading comprehension. This relationship is supposed to be mediated by reading behavior (De Naeghel et al., 2012; Schiefele et al., 2012). As to *mediation through reading engagement*, it is well established that students who are more intrinsically motivated and more confident about their reading skills show higher levels of engagement during reading (Klauda & Guthrie, 2014; Skinner, Wellborn, & Connell, 1990). Although these prior studies do not originate from the theoretical SDT framework applied in the present study, a positive relation is parallely excpected for autonomous reading motivation (hypothesis 8d), embracing both intrinsic motivation and identified regulation. Additionally, students' reading self-concept is hypothesized to be positively related to reading engagement (hypothesis 7d). De Naeghel and colleagues (2012) furthermore demonstrated that for upper primary school students reading engagement indeed acts as a mediator between reading self-concept and autonomous reading motivation on the one hand and comprehension on the other hand. To the best of our knowledge, the association between controlled reading motivation and engagement has only been studied by De Naeghel and colleagues (2012), finding no significant relationship. Therefore, this hypothesis remains explorative (hypothesis 9d).

As to *mediation through reading strategy use*, no prior research was conducted operationalizing the distinction between autonomous and controlled motivation. Prior studies rather departed from the concepts intrinsic and extrinsic reading motivation (e.g. Taboada et al., 2009; Völlinger, Spörer, Lubbe, & Brunstein, 2017). In this respect, the review of Schiefele and colleagues (2012) indicates that intrinsic reading motivation, defined as "the willingness to read because that

activity is satisfying or rewarding in its own right" (p. 429) is positively associated with reading strategy use, whereas a negative or nonsignificant relation is found for extrinsic motivation. Furthermore, differential relationships between intrinsic and extrinsic reading motivation and specific types of reading strategy use are suggested (Schiefele et al., 2012). Nonethless, more research is still needed to confirm the abovementioned relationships between reading motivation and reading strategy use, especially from the SDT literature distinguishing between autonomous (hypothesis 8a – 8b – 8c) and controlled (hypothesis 9a – 9b – 9c) reading motivation. Concerning reading self-concept, the theoretical work of Paris, Lipson and Wixson (1983) indicates that students' reading self-concept influences their decision making about how to invest time and effort to achieve a goal, affecting strategy use during reading. This positive relationship between reading self-concept and students' strategy use is indeed confirmed in prior research pointing to a significant correlation with metacognitive strategy use (Roeschl-Heils, Schneider, & Van Kraayenoord, 2003). Therefore, a positive relationship is expected in hypothesis 7a, 7b and 7c.

As to *mediation through reading frequency*, the relationship between reading motivation and reading frequency has been studied exhaustively (Mol & Bus, 2011). However, this was similarly primarily done departing from the distinction between intrinsic and extrinsic reading motivation. More particularly, intrinsic motivation is found to be positively related to reading amount, while the results for extrinsic reading motivation are less clear. Contrary to studies on the direct relation between reading motivation and reading frequency, the mediating role of reading frequency was not extensively supported by the large amount of empirical research (Schiefele et al., 2012). Considering autonomous and controlled reading motivation in particular, children who are more motivated to read (both for autonomous or controlled reasons) are found to read more frequentely during leisure time (De Naeghel et al., 2012). However this was only studied for upper primary school students. Translating these results to secondary school students, their autonomous (hypothesis 8e) and controlled (hypothesis 9e) reading motivation are expected to be positively related to reading comprehension. As to reading self-concept a positive relationship with reading frequency was detected (De Naeghel et al., 2012; Durik et al., 2006) and is consequently expected in this study (hypothesis 7e).

An overview of the hypothesized relationships is presented Figure 1. Based on the above, it is hypothesized that the motivational characteristics self-concept and autonomous reading motivation and the behavioral characteristics reading engagement, global and problem solving reading strategy use, and reading frequency are positively related to reading comprehension, while a negative relation with controlled reading motivation is hypothesized. Concerning support reading strategy use, prior results are inconclusive. Further, the relationship between motivational characteristics and reading comprehension is assumed to be mediated by the quality (i.e. reading strategy use and engagement)

and the quantity (i.e. reading frequency) of students' reading behavior (De Naeghel et al., 2012; Schiefele et al., 2012).

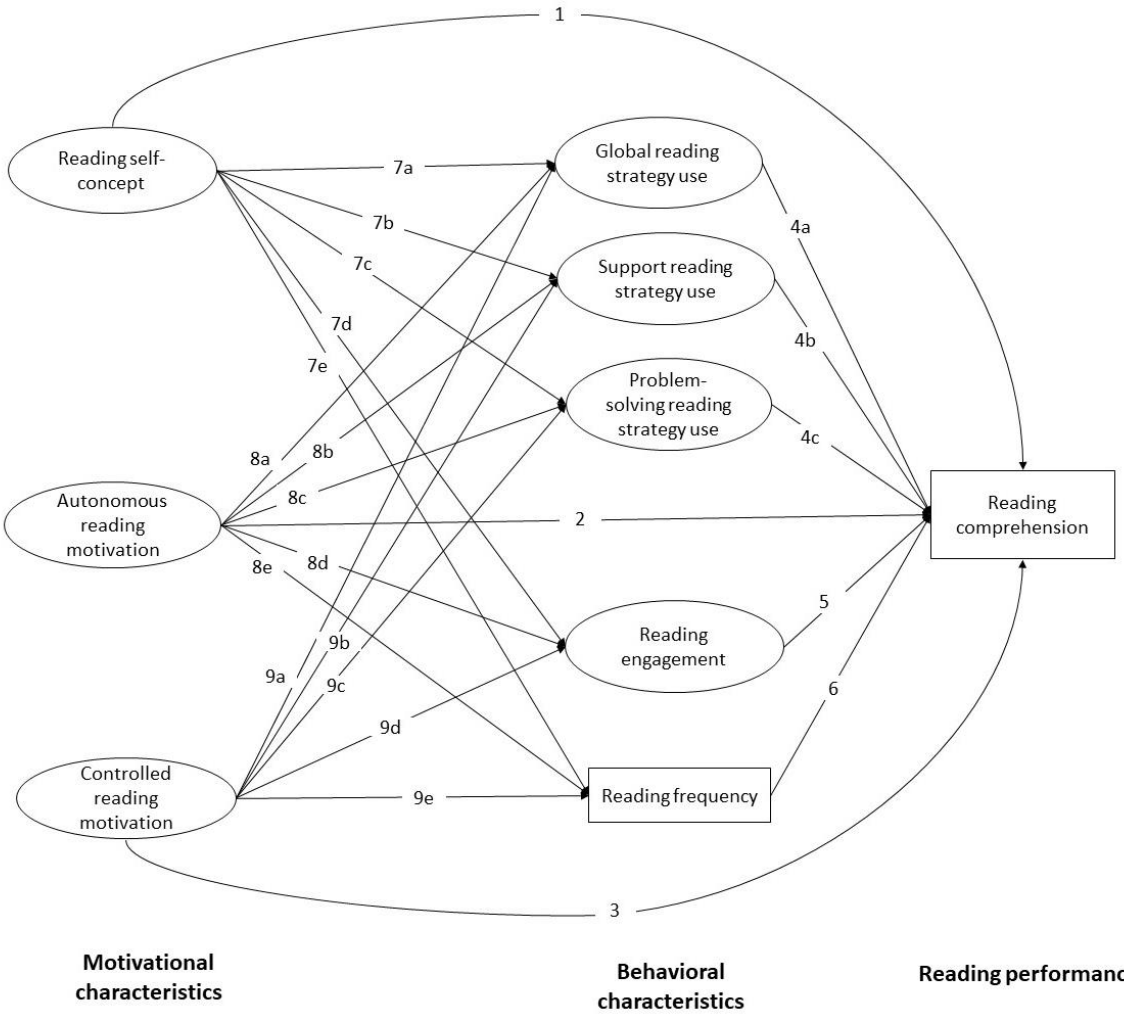

Fig 1: Hypothesized model relating motivational and behavioral characteristics to reading comprehension

Differences between educational tracks

In secondary education students are accomodated into different educational tracks. Reading comprehension, reading self-concept, reading interest, reading enjoyment, recreational reading frequency, and reading strategy knowledge are demonstrated to be lower for students in the technical and especially in the vocational track (De Maeyer, Rymenans, Daems, Van Petegem, & Van Den Bergh, 2003; Departement Onderwijs & Vorming, 2009; Dockx et al., 2019; Kozminsky & Kozminsky, 2001; Mol & Jolles, 2014; Retelsdorf, Becker, Olaf, & Möller, 2012; Retelsdorf et al., 2011; Roeschl-Heils et al., 2003). These differences could result in differential relationships between students' behavioral and motivational characteristics on the one hand and their reading comprehension on the other hand. With the exception of Kozminsky and Kozminsky (2001), Retelsdorf and colleagues (2011), and Schaffner, Philipp and Schiefele (2016), this only received limited attention in the literature. Moreover, the results

of these studies are inconclusive. According to Schaffner and colleagues (2016) the relation between intrinsic motivation and reading competence is only significant for academic students, while Retelsdorf and colleagues (2011) found no differential relationships. Kozminsky and Kozminsky (2001) concluded that reading strategy knowledge contributed to a greater extent to reading comprehension for academic students.

2. Method

Sample and procedure

A total of 2485 9th-grade students (1151 boys, 1334 girls) from 194 classes in Flanders (i.e., the Dutch speaking part of Belgium) participated. Students' age ranged from 12 to 18 years (*M*=15.06, *SD*=0.61). Regarding their educational track, respectively 52% (*N*=1294), 32% (*N*=782), and 16% (*N*=409) attended the academic, technical, and vocational track. The sample is representative for the Flemish community as to students' gender, track, and mothers' country of birth. Data were gathered in authentic classroom settings, during two 50-minute periods. The first period students completed part 1 of the paper pencil reading comprehension test. The second period students completed part 2 of the comprehension test (25 minutes) and an online questionnaire (25 minutes). To enhance standardization, the reading comprehension test and online questionnaire were administered in attendance of the main researcher or trained research assistants.

Educational context

In Flemish secondary education, students attend one of four educational tracks (academic, technical, art, or vocational) from 9th grade on. Students in the art track are not included in the present study because in comparison with the other tracks only a very small proportion of students attends this art track. The academic track involves academical training and primarily prepares for higher education studies. The technical track encompasses both academical and practical training and prepares for both further studies in higher education or outflow to the labour market. The vocational track involves practical training and primarily has a labour market orientation.

Instruments

Reading comprehension. Reading comprehension performance was assessed using a modified version of a standardized reading comprehension test composed by the Dutch centre of educational measurement CITO (CITO, 2013). The test consisted of seven expository texts, with 46 binary scored multiple-choice items (0=incorrect; 1=incorrect). Validity and reliability analyses of the test were conducted based upon classical test and item response theory. Additionally, all items were screened

for differential item functioning for educational tracks. The empirical reliability was found to be good (.79).

Behavioral and motivational variables. Reading self-concept was measured using five items based on the PIRLS 2006 reading self-concept subscale (Martin, Mullis, & Kennedy, 2007). Reading motivation was measured using the SRQ-reading motivation questionnaire (De Naeghel et al., 2012). Students rated their reading engagement through five items tapping into their attention, effort, verbal participation, persistence, and positive emotion in reading activities (Reeve, Jang, Carrell, Jeon, & Barch 2004). Reading frequency was measured using a single item, based on the PIRLS 2006 student questionnaire (Martin et al., 2007), referring to both online and offline recreational reading. Based on the MARSI-R, the use of 14 reading strategies were tapped into (Mokhtari, Dimitrov, & Reichard, 2018), sorted into three categories. An overview of the format, answer options, number of items and an example item is presented in Table 1.

Table 1: Overview of measures: format, answer options, number of items, example item

Measure	Format	Answer options	Number of items	Example item
Reading self-concept	4-point Likert type scale	I do not agree – I agree	5	Reading is harder for me than for many of my classmates
Reading motivation:	5-point Likert scale	I do not agree at all – I definitely agree		I read because…
Autonomous			8	I enjoy reading
Controlled			9	I feel guilty when I do not read
Reading engagement	Bipolar format	/	4	My attention is dispersed during reading – my attention is focused during reading
Reading strategy use:	5-point Likert scale	I do not agree at all – I definitely agree		
Global			5	I have a purpose in mind when I read
Support			5	I take notes while reading to help me understand what I read
Problem-solving			4	I try to guess the meaning of unknown words or phrases
Reading frequency	4-point Likert type scale	Never – every day or almost every day	1	How often do you read in your free time?

Information about the confirmatory factor analysis, measurement invariance related to educational track, and internal consistency is presented in Table 2. The CFA model for reading

engagement showed excellent fit-measures (CFI = .96, RMSEA = .09, SRMR = .03). However, strong measurement invariance across educational tracks was not corroborated. Therefore we excluded one item to ensure strong measurement invariance (effort). Based on these four items, CFA still showed excellent fit-measures.

Table 2: Overview of measures: confirmatory factor analysis - measurement invariance – internal consistency

Measure	**Confirmatory factor analysis[1]**			**Measurement invariance[2]**	**Internal consistency[3]**
	CFI	**RMSEA**	**SRMR**	**Δ CFI**	**Bentler's rho**
Reading self-concept	1.00	.00	.04	.010	.74
Reading motivation	.94	.08	.06	.003	Autonomous .95 Controlled .79
Reading strategy use	.94	.06	.04	.010	Global .67 Support .69 Problem-solving .69
Reading engagement	.99	.06	.02	.008	.71
Reading frequency	.94	.06	.04	.010	.72

Data analysis

Multigroup structural equation modeling analysis (MG-SEM) was used to analyze relationships between behavioral and motivational characteristics and students' reading comprehension, taking into account potentially differential relationships across educational tracks. All analyses were performed using the R-packages lavaan (Rosseel, 2010) , lavaan.survey (Oberski, 2014) and semTools (Jorgensen, 2018) and the program MLwiN (Rasbash, Steele, Browne, & Goldstein, 2009). To allow for not completely normal distributed data, robust maximum-likelihood estimation method was used with a

[1] Several fit indexes are used to evaluate the fit of confirmatory factor models and structural equation models. First, the CFI. According to Browne and Cudeck (1992), a CFI-value above .90 indicates an adequate fit. Second, the RMSEA. This value should be close to .06 for an acceptable fit (Hu & Bentler, 1999) and below .08 for a reasonable fit (Schreiber, Stage, King, Nora, & Barlow, 2006). Finally, the SRMR should be below .08 to indicate a reasonable fit (Hu & Bentler, 1999).

[2] A difference in CFI between a model with no constraints and a model with two constraints (equal loadings and intercepts) smaller than .01 indicates strong measurement invariance (Chueng & Rensvold, 2002).

[3] An internal consistency between .60-.75 is regarded moderate, .75-.85 good and larger than .85 excellent (Bentler, 2009).

Satorra-Bentler-scaled chi-square statistic. Additionally, the standard errors and fit statistics were adjusted according to the clustered data (i.e. students into classes) (Oberski, 2014).

3. Results

Descriptive statistics

Descriptive statistics of all variables are presented in Figure 2. The presented means take into account the nested data structure of students nested into classes. Differences between educational tracks were encountered among all scales, with the execption of support reading strategy use. More specifically, students enrolled in the academic track generally obtained higher scores in comparison with students enrolled in the technical and especially in the vocational track. Furthermore, students in the technical track generally obtained higher scores than students in the vocational track.

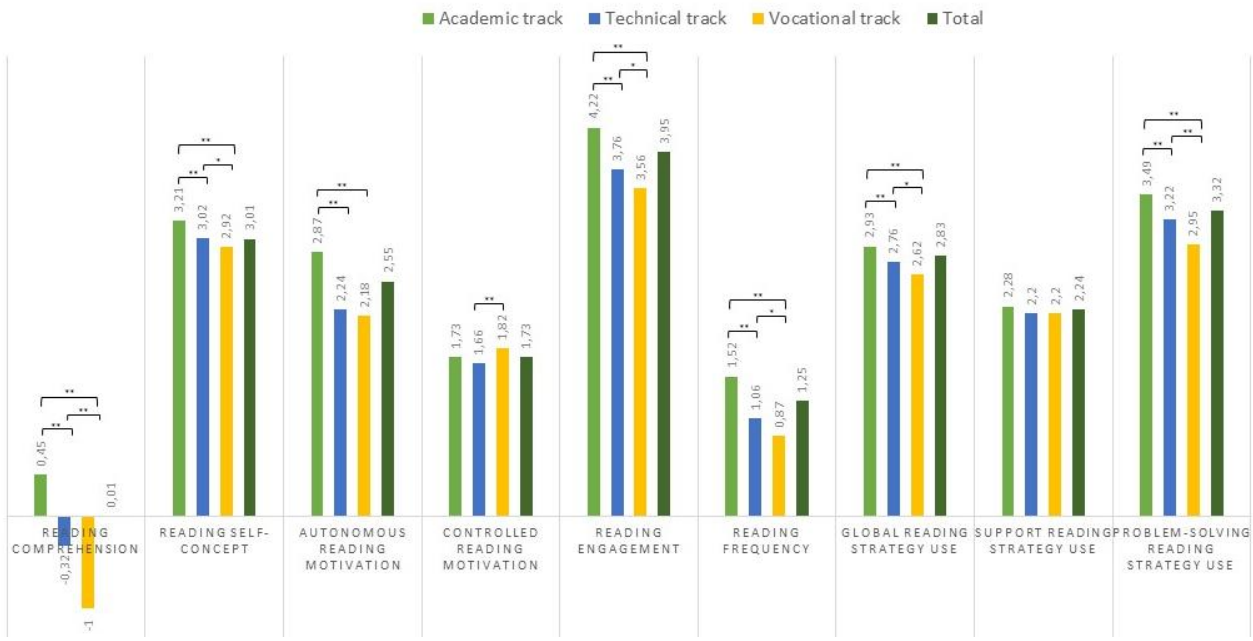

Fig 2: Descriptive statistics for the variables included in the study

*p<.05, **p<.01, two-tailed

Correlations between variables are presented in Table 3. Correlations per educational track are presented in Appendix A. Almost all correlations were positive and significant. They range from .03 to .59, indicating that the assumption of no perfect multicollinearity when including the variables in the MG-SEM was not violated.

Table 3: Correlations among the variables included in the study

	1	2	3	4	5	6	7	8	9

1. Reading comprehension	-								
2. Reading self-concept	.34**	-							
3. Autonomous reading motivation	.37**	.26**	-						
4. Controlled reading motivation	-.12**	-.12**	.21**	-					
5. Reading engagement	.28**	.28**	.53**	.11**	-				
6. Reading frequency	.33**	.24**	.59**	.03	.40**	-			
7. Global reading strategies	.12**	.08**	.31**	.21**	.29**	.20**	-		
8. Support reading strategies	-.08**	-.13**	.19**	.29**	.16**	.07**	.45**	-	
9. Problem-solving reading strategies	.25**	.10**	.40**	.18**	.37**	.27**	.49**	.43**	-

Note: n = 2485
*p < .05 **p < .01, two-tailed

MG-SEM

To analyze the relative contribution of behavioral and motivational characteristics to reading comprehension across educational tracks, two MG-SEM models were compared. In model 1 factor loadings and intercepts were forced to be equal across groups. In model 2 factor loadings, intercepts, and regression coefficients were forced to be equal across groups. The results revealed significant differences between model 1 and 2. More particularly, a significant different log likelihood value ($\Delta \chi^2 = 600.61$ (46), $p < .001$) was found, indicating better model fit for model 1. This implies that a model with differential relationships across educational tracks (model 1) fits the data better compared to the model without differential relationships across educational tracks (model 2). In view of further analyzing the differences in the relationships across tracks, model 2 was adjusted by means of allowing each regression coefficient separately to vary across groups. The log likelihood values of these adjusted models 2 were compared with the log likelihood value of the original model 2. The difference between both log likelihood values has a chi-square distribution with two degrees of freedom, adjusted based on the scaling correction factor for the Sattora-Bentler correction (Satorra & Bentler, 2001). A significant difference between these models indicates a significant difference across educational tracks for the specific regression coefficient that was allowed to vary. Using this procedure, it was possible to test each regression for significant differences across educational tracks. Results are displayed in Table 4.

Table 4: MG-SEM: Comparison of difference across educational tracks

Model	SB χ^2	*df*	Reference model	Δ χ^2	Δ *df*	p
1[a]	7335.76	2500				
2[b]	7936.36	2546	Model 1	600.61	46	.00**
Adjustments to Model 2: allowing each regression coefficient separately to vary across educational tracks						
"Variable X → variable Y": specific regression that is allowed to vary across educational tracks						
Motivational variables → reading comprehension						
Reading self-concept → reading comprehension	7755.38	2544	vs model 2	180.98	2	.00**
Autonomous reading motivation → reading comprehension	7836.75	2544	vs model 2	99.62	2	.00**
Controlled reading motivation → reading comprehension	7924.70	2544	vs model 2	11.66	2	.00**
Behavioral variables → reading comprehension						
Reading engagement → reading comprehension	7842.23	2544	vs model 2	94.13	2	.00**
Global reading strategy use → reading comprehension	7855.62	2544	vs model 2	80.74	2	.00**
Support reading strategy use → reading comprehension	7935.08	2544	vs model 2	1.29	2	.53
Problem-solving reading strategy use → reading comprehension	7751.21	2544	vs model 2	185.16	2	.00**
Reading frequency → reading comprehension	7547.27	2544	vs model 2	389.09	2	.00**
Reading self-concept → behavioral variables						
Reading self-concept → reading engagement	7934.62	2544	vs model 2	1.75	2	.42
Reading self-concept → global reading strategy use	7935.94	2544	vs model 2	0.43	2	.81
Reading self-concept → support reading strategy-use	7934.77	2544	vs model 2	1.59	2	.45
Reading self-concept → problem-solving reading strategy-use	7935.28	2544	vs model 2	1.09	2	.58
Reading self-concept → reading frequency	7930.54	2544	vs model 2	5.82	2	.05
Autonomous reading motivation → behavioral variables						
Autonomous reading motivation → reading engagement	7935.91	2544	vs model 2	0.45	2	.76
Autonomous reading motivation → global reading strategy use	7933.09	2544	vs model 2	3.28	2	.19

Table 4 (continued)

Autonomous reading motivation → support reading strategy use	7937.07	2544	vs model 2	0.71	2	.70
Autonomous reading motivation → problem-solving reading strategy use	7933.04	2544	vs model 2	3.32	2	.19
Autonomous reading motivation → reading frequency	7933.46	2544	vs model 2	2.90	2	.23
Controlled reading motivation → behavioral variables						
Controlled reading motivation → global reading strategy use	7929.41	2544	vs model 2	6.95	2	.03*
Controlled reading motivation → support reading strategy use	7936.47	2544	vs model 2	0.10	2	.94
Controlled reading motivation → problem-solving reading strategy use	7931.16	2544	vs model 2	5.21	2	.07
Controlled reading motivation → reading engagement	7933.46	2544	vs model 2	2.90	2	.23
Controlled reading motivation → reading frequency	7934.55	2544	vs model 2	1.81	2	.40

[a] equal factor loadings and equal intercepts across educational tracks
[b] equal factor loadings, equal intercepts, and equal regression coefficients across educational tracks
*p < .05, **p < .01, two-tailed

Results of the MG-SEM are visually presented in Figure 3. Significant differences in the relationships between variables across educational tracks are presented by separate regression coefficients and dotted lines. Non-significant regressions were not included in the final model. Regression coefficients presented in this figure are standardized. The coefficient of determination R^2, which equals the proportion of explained variance (Kline, 2016), is separately included for all educational tracks ($R^2_{academic}$ / $R^2_{technical}$ / $R^2_{vocational}$). The final model fit was acceptable (CFI = .88, RMSEA = .05, SRMR = .08).

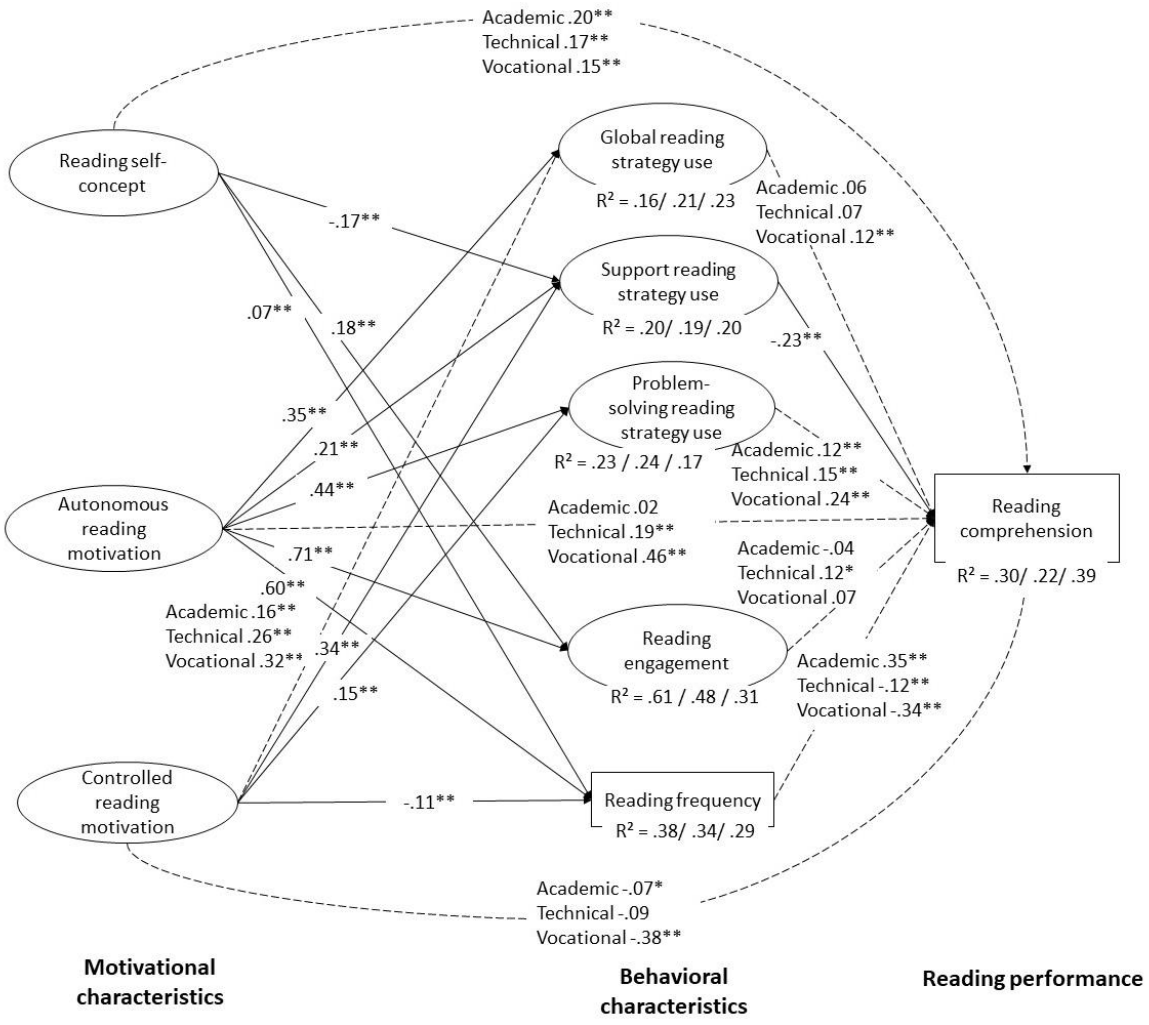

Fig 3: Significant parameter estimates of the structural model across educational tracks
*p < .05 **p < .01, two-tailed

Concerning hypothesis 1, reading self-concept was positively associated with comprehension in all tracks ($\beta_{academic}$ = .20, $\beta_{technical}$ = .17, $\beta_{vocational}$ = .15). Regarding hypothesis 2, autonomous reading motivation was positively related to comprehension in the technical and vocational track ($\beta_{technical}$ = .19, $\beta_{vocational}$ = .46). As to hypothesis 3, controlled reading motivation was negatively related to comprehension for academic and vocational students ($\beta_{academic}$ = -.07, $\beta_{vocational}$ = -.38). As to hypothesis 4 (a-b-c), differences between self-reported global, support, and problem-solving strategy use were revealed. Global reading strategy use was significantly related to comprehension only in the vocational track (β =.12). Problem-solving reading strategy use was positively related in all tracks ($\beta_{academic}$ = .12, $\beta_{technical}$ = .15, $\beta_{vocational}$ =.24). In contrast, support reading strategy use was negatively related in all tracks (β = -.23). Considering hypotheses 5, the positive contribution of reading engagement was only confirmed for the technical track ($\beta_{technical}$ = .12). Finally, regarding hypothesis 6, reading frequency was positively related in the academic track ($\beta_{academic}$ = .35) and negatively in the technical and vocational track ($\beta_{technical}$ = -.12, $\beta_{vocational}$ = -.34).

The indirect effects of motivational characteristics to reading comprehension, mediated by behavioral characteristics were investigated based on the Sobel test (Sobel, 1986). The results are displayed in Table 5. Indirect effects that involve non-significant paths (see Figure 3) were not included in this analysis because both direct paths need to be significant to generate mediation (Kline, 2016). Total effects are displayed in Appendix B.

Table 5: Standardized parameter estimates relating motivational variables to reading comprehension mediated by behavioral variables

Indirect path	**Standardized indirect relationship**			
Motivational variable → behavioral variable → reading comprehension	**Academic track**	**Technical track**	**Vocational track**	**Total sample**
Reading self-concept				
Reading self-concept → reading engagement	-.01	.02*	.01	.01
Reading self-concept → support reading strategy use	.02*	.08**	.04*	.04**
Reading self-concept → reading frequency	.02*	-.00	-.06	.01*
Autonomous reading motivation				
Autonomous reading motivation → reading engagement	-.03	.08*	.04	.03
Autonomous reading motivation → global reading strategy use	.02	.02	.04**	.03**
Autonomous reading motivation → support reading strategy use	-.03**	-.06*	-.06**	-.05**
Autonomous reading motivation → problem-solving reading strategy use	.05**	.07**	.09**	.07**
Autonomous reading motivation → reading frequency	.21**	-.07**	-.21**	.05**
Controlled reading motivation				
Controlled reading motivation → global reading strategy use	.01	.02	.04**	.02*
Controlled reading motivation → support reading strategy use	-.04**	-.16**	-.09**	-.07**
Controlled reading motivation → problem-solving reading strategy use	.01*	.03**	.06**	.02**
Controlled reading motivation → reading frequency	-.03**	.01	.08**	-.01**

*p < .05, **p < .01, two-tailed

First, results concerning the indirect relationships involving reading self-concept are reported (hypothesis 7a-7e). Generally, the standardized regression coefficients were small. Only the indirect effect of reading self-concept mediated by support reading strategy use was significant and positive for each educational track ($\beta_{academic}$ =.02, $\beta_{technical}$ = .08, $\beta_{vocational}$ =.04). Students with a higher reading

self-concept tended to use less support reading strategies. Smaller effects were encountered for reading frequency as a mediator for academic students ($\beta_{academic}$ = .02) and reading engagement as a mediator for technical students ($\beta_{technical}$ = .02).

Second, results concerning the indirect paths involving autonomous reading motivation are presented (hypotheses 8a-8e). As abovementioned, autonomous reading motivation in the academic track was not directly related to comprehension. However, higher autonomous reading motivation corresponded to more problem-solving strategy use and a higher reading frequency, which in turn corresponded to higher reading comprehension scores ($\beta_{problem\text{-}solving}$ = .05, $\beta_{reading\ frequency}$ = .21). Contrary to the relations in the academic track, in the technical and vocational track autonomous reading motivation was directly and positively related to comprehension. However, the indirect path of autonomous reading motivation via reading frequency was negative in these tracks ($\beta_{technical}$ = -.07, $\beta_{vocational}$ = -.21). Similarly, the indirect path mediated by support reading strategy use was negative ($\beta_{technical}$ = -.06, $\beta_{vocational}$ = -.06).

As to the indirect paths involving controlled reading motivation (hypotheses 9a-9e), it appears that the relation between controlled motivation and comprehension was mediated by support reading strategy use in all tracks (β = -.07). For students enrolled in academic and vocational tracks, the direct contribution of controlled reading motivation to reading comprehension was negative ($\beta_{academic}$ = -.07, $\beta_{vocational}$ = -.38). However, mediated by problem-solving reading strategy use, the contribution of controlled reading motivation to reading comprehension was found to be positive ($\beta_{academic}$ = .01, $\beta_{vocational}$ = .06). The same pattern emerged for global reading strategy use, however, only for vocational students ($\beta_{vocational}$ = .04).

4. Discussion

As presented in the hypothesized model (see Figure 1) both behavioral and motivational characteristics are related to 9th-grade students' reading comprehension. Futhermore, behavioral characteristics are found to mediate the relationship between motivational characteristics and reading comprehension. However, the complete picture is more complex than hypothesized and not all relationships were corroborated across all tracks. The discussion of the differential relationships across educational tracks is included in the discussion and conclusion, as well as the limitations of this study, suggestions for future research, and implications for theory and practice.

First, regarding hypothesis 1, students' reading self-concept was hypothesized to be positively related to their reading comprehension, both directly and indirectly mediated via reading engagement, reading frequency, and (global and problem-solving) reading strategy use. The present results indeed

generally confirm this direct positive relation. Students who regard themselves as competent readers obtain higher reading comprehension scores. This strengthens the empirical support for this relationship, which was previously primarily obtained for primary school students (Retelsdorf et al., 2014). Concerning the indirect relationships, the most pronounced is the mediation via support reading strategy use (hypothesis 1c). Students who report feeling more competent as readers report using less support reading strategies. This reported use of support reading strategies is negatively related to reading comprehension (hypothesis 4b), which corroborates the findings of Cantrell and Carter (2009). To clarify this finding, they stated that struggling readers might feel they need these strategies, involving the aid of external resources, more than proficient readers. Our data support this statement, since analysis of variance indicate that struggling readers (i.e., the group of students with the 25% lowest reading comprehension scores) report using significantly more support reading strategies in comparison with their more proficient peers (i.e., the group of 25% highest reading comprehension scores) ($F = 6{,}788$ (2); $p < .01$). Thus struggling readers report using these strategies more frequently, although these might not be the most beneficial to actually foster their comprehension. On the other hand also teachers might be more inclined to include these strategies in their instruction for and approach of struggling readers, since these are observable strategies that are more easily thaught to students (Cantrell & Carter, 2009). Considering global and especially problem-solving reading strategy use, a positive relationship with reading comprehension was found (hypothesis 4a, 4c). This is in line with prior research stating for example that monitoring comprehension and using strategies to fix comprehension when this breaks down is regarded as critical behavior of proficient comprehenders (McNamara, Danielle S., Ozuru, Best, & O'Reilly, 2012). Returning to the use of support reading strategies as a mediator in the relationship between reading self-concept and reading comprehension (hypothesis 1c + 4b), students who report feeling more competent in reading might not feel the need to use support strategies, since these positive feelings of competence prevent them from the need of using external aids. Therefore, they could report using them less, which is related to higher reading comprehension. Regarding measuring reading strategy use, a limitation of the present study should be mentioned since only students' self-reported reading strategy use was measured. Studies show that this self-reports are not necessarily a good reflection of students' actual strategy use, as measured using on-line instruments (Cromley & Azevedo, 2006). The use of on-line measures (e.g. think-aloud measures, traces) could result in a more in-depth view of students' reading strategy use and further guide the explanation of these findings (Merchie & Van Keer, 2014). The application of on-line measures could therefore be an important consideration for future research. However, self-report measures are regularly adopted because of their easy administration in large-scale testing and practical usefulness (Schellings & Van Hout-Wolters, 2011).

Due to the limited feasibility of think-aloud measures or traces with this extensive sample of 2485 students, the use of self-reports was opted for in the present study, despite its limitations.

As to hypothesis 2, it was expected that autonomous reading motivation is directly and positively related to comprehension. This is indeed confirmed in the present study for the technical and particularly the vocational track, indicating that reading for pleasure and attaching personal value to reading are positively related to reading comprehension. In the academic track, however, autonomous reading motivation is only indirectly related to comprehension, most notably via reading frequency (hypothesis 2f). More autonomously motivated students are found to engage more frequently in recreational reading, which is positively related to reading comprehension for this group. As to the technical and vocational track, autonomous reading motivation is equivalently related to a higher reading frequency. However, the latter is negatively related to reading comprehension. The reasoning of Guthrie and colleagues (1999) might give some insight into this finding. Students in technical and vocational tracks might not read as much challenging expository texts (similar to the texts in the reading comprehension test), since they feel less competent to do so (see Figure 2). However, this does not necessarily explain the negative relationship. As to hypothesis 2e, reading engagement is found to positively mediate the relationship between autonomous reading motivation and comprehension. However, this was only confirmed for the technical track. In this respect, for these students the quality of the reading activities seems to be more important than the quantity, which corroborates the findings of De Naeghel and colleagues (2012). To conclude, autonomous reading motivation is positively related to reading comprehension for students in all tracks. However, for students in the academic track this relationship is dominantly mediated by reading frequency, while for students in the technical and vocational track this is mainly a direct effect.

Contrary to autonomous reading motivation, controlled reading motivation is negatively related to comprehension in the academic and especially in the vocational track (hypothesis 3). In other words, students who feel more internally or externally pressured to read generally are worse comprehenders. In addition, controlled reading motivation is negatively related to students reading frequency (hypothesis 3f), implying that reading more for controlled reasons elicits less recreational reading. This is in contrast with the results of De Naeghel and colleagues (2012) who found controlled reading motivation to be positively related to upper primary school students' reading frequency. This highlights the need to differentiate between age groups and to consider how feelings of external and internal pressure to read might play a different role in children versus youngsters and in primary versus secondary school contexts. Schiefele and colleagues (2012) on the other hand, found results similar to the present results in their review. They more particulary indicated that when studying intrinsic and extrinsic motivational constructs in the same statistical model, extrinsic motivation is negatively

related to reading frequency. In their discussion they suggested that this might be due to a reciprocal surpression based on the high correlation between intrinsic and extrinsic motivation. In the present study, however, the correlation between autonomous and controlled motivation is only moderate (r=.21). Notwithstanding the fact that Schiefele and colleagues (2012) departed from another theoretical conceptualization of reading motivation, the parallel with the present study can be drawn. Studying the (cor)relation between autonomous and controlled reading motivation more in depth could therefore be an interesting venue for future research, for example by considering studens' motivational profiles (Vansteenkiste, Sierens, Soenens, Luyckx, & Lens, 2009).

5. Conclusion

Reading comprehension is a crucial skill for secondary school students. It enables them to participate successfully in society and achieve success in and beyond school. This study contributes to the research, policy, and practice related to reading comprehension in several ways. As to the scientific research on reading comprehension, this research reinforces the current trend to focus on secondary school students and explains the specific pathways in which behavioral as well as motivational characteristics are related to their reading comprehension. The results clearly underline the importance of considering the "bigger picture". Students' reading self-concept, motivation, strategy use, engagement, and frequency are all separately related to reading comprehension. However, they also interact whith one another. Additionaly, several differences in the relationship between these characteristics across educational tracks are encountered. Therefore, taking into account differences across educational tracks is a promising guideline for future studies. In this respect, for example, the differential relationship between reading frequency and comprehension could be focused onmore in-depth. This because of the positive relationship for academic students and contrastingly negative relationship for technical and vocational students. Scholars could for instance focus on the quality of texts they read during their free time, which might be a mediator in this relationship. Considering the value of this study in light of policy and practice, the results might guide schools, teachers, and teacher educators in decisions regarding reading promotion and comprehension instruction in two ways. First, the design of instruction and learning environments should be based on behavioral as well as motivational characteristics. Given the relations found, it appears important to strengthen students' autonomous reading motivation and their reading self-concept, but also to teach the use of a flexible repertoire of reading strategies, especially global and problem-solving strategies, and to foster reading engagement. Additionaly, it appears that differentiated instruction depending on students' educational track might be beneficial. This is especially the case for vocational students, a group of readers who not only struggle with reading comprehension, but are less autonomously motivated to read, have a lower reading self-concept, read less during their free time, and are less engaged during

reading. Their instruction should ideally focus on teaching problem-solving strategies in a learning environment simultaneously promoting autonomous reading motivation and reading engagement. Finally, although our results are based on a large representative sample, intervention and/or longitudinal research will be essential to confirm these possible implications since no causal relationships can be inferred using cross-sectional data as was applied in this study.

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Appendix A

Correlations among the variables included in this study

Academic track	1	2	3	4	5	6	7	8	9
1. Reading comprehension	-								
2. Reading self-concept	.34**	-							
3. Autonomous reading motivation	.32**	.25**	-						
4. Controlled reading motivation	-.18**	-.12**	.11**	-					
5. Reading engagement	.23**	.30**	.52**	.06*	-				
6. Reading frequency	.31**	.24**	.60**	-.03	.40**	-			
7. Global reading strategies	.06*	.07*	.27**	.13**	.27**	.17**	-		
8. Support reading strategies	-.12**	-.15**	.15**	.23**	.17**	.05	.42**	-	
9. Problem-solving reading strategies	.15**	.06*	.33**	.12**	.33**	.23**	.44**	.39**	-

*p < .05, **p < .01, two-tailed

Technical track	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Reading comprehension	-								
2. Reading self-concept	.26**	-							
3. Autonomous reading motivation	.21**	.20**	-						
4. Controlled reading motivation	-.08*	-.14**	.27**	-					
5. Reading engagement	.17**	.21**	.51**	.15**	-				
6. Reading frequency	.19**	.16**	.54**	.09*	.35**	-			
7. Global reading strategies	.02	.05	.25**	.26**	.29**	.15**	-		
8. Support reading strategies	-.15**	-.13**	.21**	.31**	.18**	.12**	.46**	-	
9. Problem-solving reading strategies	.09*	.06	.41**	.24**	.40**	.26**	.48**	.46**	-

*p < .05, **p < .01, two-tailed

Vocational track	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Reading comprehension	-								
2. Reading self-concept	.21**	-							
3. Autonomous reading motivation	.12**	.16**	-						
4. Controlled reading motivation	-.15**	-.09	.46**	-					
5. Reading engagement	.08	.21**	.40**	.16**	-				
6. Reading frequency	.17**	.20**	.48**	.09	.31**	-			
7. Global reading strategies	-.02	.06	.39**	.33**	.22**	.20**	-		
8. Support reading strategies	-.29**	-.17**	.21**	.39**	.08	-.02	.53**	-	
9. Problem-solving reading strategies	.07	.04	.40**	.29**	.25**	.18**	.52**	.47**	-

*p < .05, **p < .01, two-tailed

Appendix B

Standardized parameter estimates relating motivational variables to reading comprehension mediated by behavioral variables (total effects)

Indirect path	**Standardized total effect**			
Motivational variable → behavioral variable → *reading comprehension*	**Academic track**	**Technical track**	**Vocational track**	**Total sample**
Reading self-concept → reading engagement	.19**	.19**	.17**	.17**
Reading self-concept → support reading strategy use	.24**	.20**	.21**	.20**
Reading self-concept → reading frequency	.22**	.16**	.12*	.16**
Autonomous recreational reading motivation → reading engagement	-.06	.27 **	.49 **	.15**
Autonomous recreational reading motivation → global reading strategy use	.04	.21**	.49**	.20**
Autonomous recreational reading motivation → support reading strategy use	-.01	.13*	.37**	.13**
Autonomous recreational reading motivation → problem-solving reading strategy use	.07	.26**	.55**	.24**
Autonomous recreational reading motivation → reading frequency	.23**	.12*	.26**	-.10
Controlled recreational reading motivation → global reading strategy use	-.06	-.07	-.34**	-.10**
Controlled recreational reading motivation → support reading strategy use	-.13**	-.16**	-.48**	-.18**
Controlled recreational reading motivation → problem-solving reading strategy use	-.05	-.06	-.33**	-.10**
Controlled recreational reading motivation → reading frequency	-.10**	-.08	-.31**	-.17**

*p < .05, **p < .01, two-tailed