Self-regulated learning and reading comprehension: The effects of gender, motivation and metacognition

Katsantonis, I.

SELF-REGULATED LEARNING AND READING COMPREHENSION: THE EFFECTS OF GENDER, MOTIVATION AND METACOGNITION

Ioannis G. Katsantonis

University of Patras, Greece

Abstract: The study aimed at determining the effects of aspects of self-regulated learning (SRL) such as metacognition and motivation on reading comprehension. A nationwide, representative sample ($N = 6,403$) of 15-year-old Greek adolescents was drawn from the PISA 2018 database. The participants' data on metacognitive knowledge of reading strategies, reading task-specific metacognitive experiences, intrinsic motivation, and reading comprehension were selected for subsequent analyses. Multiple-group confirmatory factor analyses were conducted to test gender differences in metacognitive functioning via measurement invariance. Structural equation modeling was also utilized to assess predictive and mediating effects between motivation, metacognition and reading comprehension achievement. Results indicated gender-related individual differences in metacognitive functioning. Further, structural equation modeling showed that metacognitive experiences, metacognitive knowledge and intrinsic task motivation predicted reading comprehension achievement; however, metacognition mediated the association of intrinsic motivation with reading comprehension achievement. Potential cognitive and educational implications are briefly discussed.

Key words: Metacognitive experiences, Metacognitive knowledge, PISA, Reading, Self-Regulated Learning, Text comprehension

---

Address: Ioannis Katsantonis, Eleftherias 14, Agios Vasileios, Patras 26504, Greece. E-mail: ioanniskatsantonis@upnet.gr

INTRODUCTION

Metacognition is conceptualized as "cognition about cognition", that is, awareness monitoring, and control of cognitive processing (Efklides, 2008, 2011). Metacognition is a multidimensional construct that includes metacognitive knowledge (i.e., declarative knowledge about cognition, persons, tasks, and strategies), metacognitive experiences (i.e., feelings and judgments about cognitive processing) and metacognitive skills (i.e., procedural knowledge of strategies) (cf., Efklides, 2006, 2008; Veenman, Van Hout-Wolters, & Afflerbach, 2006). Self-regulated learning (henceforth SRL) is a theoretical construct that encompasses self-directed learning, that is, goal setting, planning and strategy use for the monitoring, control and evaluation of cognitive processing and its outcomes (Zimmerman & Moylan, 2009). However, goal setting and the effort to be invested on a task is affected by motivational and other person characteristics (Efklides, 2011). That is, SRL involves metacognitive, motivational, and affective processes (Efklides, 2011; Gidalevich & Kramarsk, 2017; Lau & Ho, 2015). In the present study, the term "self-regulated learning" is used to denote the superordinate factor that encompasses motivation and metacognition in the reading comprehension process. Motivation involves the reasons why one would work on a reading comprehension task. Metacognition involves monitoring and control of reading behavior, monitoring of reading comprehension processing in the form of metacognitive experiences and metacognitive knowledge, and control through the use of reading strategies.

Reading comprehension is conceptualized as building knowledge and drawing inferences from written corpora (Guthrie, Wigfield, Metsala, & Cox, 1999). Reading comprehension is a higher-order cognitive process that builds on the decoding of written texts to grasp their meaning (Πόρποδας, 2002). It is a demanding process that requires use of reading strategies for the successful processing of continuous, written linguistic input (e.g., Dermitzaki, Andreou, & Paraskeva, 2008; Kolić-Vehovec, Bajšanski, & Zubković, 2010; Mokhtari & Reichard, 2002; Thiede & de Bruin, 2017). There is evidence that Greek-speaking adolescents score lower than the OECD grand mean in reading comprehension in the Program of International Student Assessment (PISA- see Σοφιανοπούλου, Εμβαλωτής, Καρακολίδης, & Πίτσια, 2019). This calls for investigation of the extent to which Greek secondary education students self-regulate their reading comprehension in situations such as PISA testing.

A second objective of the present study was the investigation of possible gender differences in reading comprehension and its regulation in the PISA data of Greek

adolescents, as there are inconclusive findings (e.g., Ciascai & Haiduc, 2011; Sperling, Howard, Miller, & Murphy, 2002) regarding gender effects on metacognitive aspects of SRL in reading comprehension.

Self-regulated learning and reading comprehension: Predictive and mediating relations

Studies drawing upon data of international student surveys such as PISA have underscored the role of awareness of metacognitive strategies in reading tasks (e.g., Callan, Marchant, Finch, & German, 2016). Another interesting study is that by Lau and Ho (2015). These authors used a sample of 4837 Hong Kong adolescents to investigate the effects of SRL on reading comprehension. Their results indicated that all aspects of SRL (e.g., reading strategies awareness, metacognitive processing, reading motivation and engagement, etc.) had an impact on reading comprehension. Dermitzaki et al. (2008) also found with Greek students (M_{age} = 9.7 years) that awareness of reading strategies was strongly correlated with reading comprehension. However, it is not clear how the various components of SRL interacted between them and if their effect on reading comprehension was direct or indirect.

With respect to motivation effects on reading comprehension, Pintrich (1990, 1999) suggested that intrinsic motivation would have a positive association with the self-regulation of learning processes. Pintrich (1990) found that there was positive relationship between lower secondary school students' intrinsic motivation, in the form of perception of intrinsic value of the learning task, with cognitive strategy use. Metallidou and Vlachou (2010) confirmed this association with Greek primary school students' intrinsic motivation and performance in language tasks.

However, van Kraayenoord and Schneider (1999) in a German sample of elementary school children found that motivational beliefs exerted only an indirect effect on reading comprehension via metacognition. In that study, metacognition was conceptualized as metacognitive knowledge of reading strategies and declarative metacognitive knowledge of (a) general metamemory (relating to the task, person or strategies), (b) task processing metamemory, (c) semantic categorization metamemory. However, their analysis did not include metacognitive experiences in reading. Metallidou and Vlachou (2007), in a sample of Greek 5th and 6th-graders, also found a significant mediating effect of cognitive strategy use in the association between motivational variables and language achievement. Unlike the previous studies, Völlinger, Spörer, Lubbe, and Brunstein (2018), in a sample of German students (M_{age} = 11.34 years), were unable to detect an indirect effect of intrinsic reading motivation on reading comprehension via cognitive strategy use such as

summarizing, questioning, and predicting. Therefore, extant research on the effects of motivation on reading comprehension is not conclusive and suggests that at least in younger students such a relationship is mediated by cognitive strategy use or metacognition.

Gender effects on metacognition

Research on gender differences in metacognition has yielded inconclusive results. For example, Sperling et al. (2002) with a sample of 416 primary and lower secondary school children found that there were no gender differences in metacognition. On the other hand, research in Greece by Mastrothanais, Kalianou, and Katsifi (2018) with a sample of 245 students (M_{age} = 13.35 years) showed that there was statistically significant effect of gender on metacognitive knowledge and cognitive regulation; that is, typically developing females scored higher than males in metacognitive awareness of reading strategies. Similar were the findings of Ciascai and Haiduc (2011). These researchers drawing from a sample of 90 Romanian middle-school children (M_{age} = 14.62 years) concluded that there were gender differences in metacognition. Metallidou and Vlachou (2007), however, did not find gender effects in Greek 5th and 6th-grade students in cognitive and regulatory strategy use, nor in self-efficacy or in task motivation.

Contradictory evidence has also been found in studies with university students. Veloo, Rani, and Hariharan (2015) found that female college students were applying more metacognitive strategies in reading than male students. However, Zhang (2018), with a sample of Chinese college students, found that male college students perceived specific metacognitive strategies (e.g., evaluation; cognitive monitoring) as more important than female students did. Yet, other aspects of metacognitive strategy use (e.g., planning, inference drawing) did not differ between genders. Finally, gender differences were found in the case of educators' metacognitive and teaching strategy use (Chatzistamatiou & Dermitzaki, 2013).

It should be underscored that another dimension of SRL, that of metacognitive experiences, has in the past become the object of attention from the perspective of individual differences psychology. For example, Efklides, Papadaki, Papantoniou, and Kiosseoglou (1998) examined gender differences in metacognitive experiences, and specifically in feelings of difficulty. They found no gender effects. However, it is important to underline that the study by Efklides et al. (1998) focused only on mathematics-related feelings of difficulty and did not consider language-related metacognitive experiences.

To sum up, it seems that there is contradictory evidence regarding gender

differences in various domains of metacognitive functioning. Therefore, further and in-depth study of gender-dependent variation in metacognitive domains is, at least from our point of view, of utmost importance.

The present study

As already mentioned, there is inconclusive evidence regarding gender differences in metacognitive awareness of reading strategies. Some studies suggest that metacognitive strategies in reading are predominantly endorsed by female rather than male students (e.g., Veloo, Rani, & Hariharan, 2015), while other studies suggest that male and female students score about the same in metacognitive awareness measures (e.g., Metallidou & Vlachou, 2007; Zhang, 2018). Although studies have examined potential gender differences in Greece (Mastrothanais et al., 2018; Metallidou & Vlachou, 2007), the present study draws upon a nationwide, representative sample from a different target population (i.e., adolescents) from the PISA 2018 (December 2019) program (OECD, 2019a), which allows for more generalizable findings. An additional contribution of this study is the examination of potential gender differences in metacognitive experiences in reading. Although individual differences in metacognitive experiences in mathematics tasks have been extensively studied (e.g., Efklides et al., 1998), there are no empirical findings, to the best of our knowledge, that have previously examined individual differences in metacognitive experiences in reading. Additionally, few studies with Greek-speaking adolescents have, to our knowledge, comprehensively examined the predictive and mediating effects of SRL dimensions, such as motivation, on reading comprehension performance. Prior research findings have indicated that intrinsic motivation has a direct effect on reading comprehension (Callan et al., 2016; Lau & Ho, 2015; Pintrich, 1990). However, intrinsic motivation (e.g., value beliefs such as perception of the task as useful or interesting/ difficult) has been found to directly affect SRL strategy use (Pintrich, 1990, 1999), and SRL, in its turn, directly affects reading comprehension achievement (e.g., Dermitzaki et al., 2008; Lau & Ho, 2015). This suggests an indirect effect of motivation on reading comprehension. Based on prior empirical studies (e.g., van Kraayenoord & Schneider, 1999; Metallidou & Vlachou, 2007; Völlinger et al., 2018), that have either found, or not, a significant mediating effect of metacognition (as a component of SRL), one may assume that metacognitive dimensions of SRL act as mediating variables in the association between task-related intrinsic motivation and reading comprehension achievement. Subsequently, the following research questions and hypotheses were formulated:

RQ1: Are there gender differences in Greek-speaking adolescents' metacognitive functioning in reading? The hypothesis was that there will be no gender differences

in metacognitive functioning in reading comprehension tasks as tested in PISA, because adolescents of both genders have extensive experience with reading tasks, and gender effects seem to be mainly in younger students (Hypothesis 1).

RQ2: What aspects of SRL, namely motivation and metacognition, affect the reading comprehension performance of Greek adolescents? Do metacognitive knowledge and metacognitive experiences in reading act as mediating variables in the association between reading-related motivational beliefs and reading comprehension? The hypothesis was that intrinsic motivation will have a direct effect on reading comprehension (Hypothesis 2a). Further, metacognitive knowledge of reading strategies will also have a direct effect on reading comprehension (Hypothesis 2b). The same prediction was made for metacognitive experiences (Hypothesis 2c). Finally, it was predicted that metacognitive knowledge and metacognitive experiences will mediate the relationship between intrinsic motivation and reading comprehension achievement (Hypothesis 3).

METHOD

Dataset and Participants

The data utilized in the present study are part of the seventh cycle of PISA administered by the Organization for Economic Cooperation and Development (OECD, 2019a, 2019c). Data were collected in 2018. Overall, about 710,000 adolescent students from 79 countries participated in the international survey. The present study focused solely on the Greek-speaking sample. The nationwide sample ($N = 6,403$) comprised 15-year-old ($M = 15.70$, $SD = .29$, range 15.25 to 16.17) Greek-speaking students. Participants were about equally distributed across gender groups: $N = 3,178$ (49.6%) females and $N = 3,225$ (50.4%) males.

Measures

All measures used in the present study were developed and administered by OECD (2019d). The scales included in this study were selected based on their relevance to the aims and hypotheses stated previously.

Intrinsic motivation scale

Five items were selected from a larger pool of items to constitute the Intrinsic

Motivation for Reading scale. Responses on all items were on a 4-point Likert-type scale ranging from 1: Strongly Disagree to 4: Strongly Agree. The items depict participants' interest in, or enjoyment of, reading activities. Enjoyment or interest in specific activities have long been suggested as indicators of intrinsic motivation (see Isen & Reeve, 2005). Three negatively worded items were reverse scored so that higher scores indicate greater intrinsic motivation for reading. The internal consistency reliability was Cronbach's $\alpha = .77; \omega_T = .82$. Confirmatory factor analysis was conducted to confirm the single-factor structure of the scale. Due to possible cross-language differential effects, measurement errors for Items 2 and 3, as well as Items 4 and 5 (based on modification indices) were correlated to achieve an acceptable fit. The analysis indicated excellent fit of the model tested: $\chi^2(df = 3, N = 6,403) = 52.200$, $p > .05$, TLI = .976, CFI = .991, RMSEA = .056 90% CI [.043; .070], SRMR = .016. Items and factor loadings are presented in Table 1.

Table 1: Confirmatory factor analysis of the Intrinsic Motivation for Reading Scale

How much do you agree or disagree with these statements about reading?	Loadings (λ)
1. I read only if I have to (-)	.682 (.014)
2. Reading is one of my favorite hobbies	.558 (.016)
3. I like talking about books with other people	.500 (.016)
4. For me, reading is a waste of time (-)	.597 (.014)
5. I read only to get information that I need (-)	.668 (.013)
Error Covariances	Estimate (ε)
Item 2 – Item 3	.441 (.017)
Item 4 – Item 5	.185 (.022)

Note: (-) Items were reverse-scored. Standard errors are in parentheses. All loadings and covariances are significant at least at $p < .05$

Metacognition scales

In line with the theoretical developments in self-regulated learning (Efklides, 2011; Gidalevich & Kramarski, 2017; Lau & Ho, 2015), an overall Metacognition scale was hypothesized to subsume the scales of "Metacognitive experiences in reading", "Metacognitive knowledge of text comprehension and memorization strategies", and "Metacognitive knowledge of text summarizing strategies". Hence, an intercorrelated three-factor model was specified and tested in a confirmatory factor analysis. Overall, the model's fit was satisfactory: $\chi^2(df = 48, N = 6,256) = 791.365$, $p < .001$, CFI =0.955, TLI = .938, RMSEA = .052 90%CI [.049 - .056], SRMR = .036. The factor loadings of this model are presented in Table 2. Analytically, the model was as follows:

Table 2: Confirmatory Factor Analysis of the Metacognition scale

Items	Factor loadings (λ)		
	I	II	III
How do you feel about these tasks?			
1. There were many words I could not understand	.741 (.011)		
2. Many texts were too difficult for me	.854 (.011)		
3. I was lost when I had to navigate between different pages	.652 (.011)		
How do you rate the usefulness of the following strategies for text comprehension and memorizing?			
4. I concentrate on the parts of the text that are easy to understand		.347 (.014)	
5. After reading the text, I discuss its content with other people		.460 (.011)	
6. I underline important parts of the text		.704 (.012)	
7. I summarize the text in my own words		.640 (.012)	
8. I read the text aloud to another person		.333 (.014)	
How do you rate the usefulness of the following strategies for writing a summary of this two-page text?			
9. I write a summary. Then I check that each paragraph is covered in the summary, because the content of each paragraph should be included			.496 (.012)
10. Before writing the summary, I read the text as many times as possible			.635 (.011)
11. I carefully check whether the most important facts in the text are represented in the summary			.793 (.010)
12. I read through the text, underlining the most important sentences. Then I write them in my own words as a summary.			.668 (.011)

Interfactor Covariances (φ)	
I-II: -0.100 (0.019); I-III: -0.199(0.018); II-III: 0.763 (0.015)	

Item- Error Covariances (ε)	Estimates (ε)
5-8	.214 (.014)
9-10	.091 (.017)
6-12	.256 (.019)

Note: Standard errors are in parentheses. All loadings and covariances are significant at least at $p < .05$; I: Metacognitive experiences - feelings of difficulty; II: Metacognitive knowledge of memorization and understanding; III: Metacognitive knowledge of text summarizing

Metacognitive Experiences in Reading

Three items of the PISA pool constituted the Metacognitive Experiences in Reading scale. The items tap participants' retrospective reports of feelings of difficulty regarding the reading task. A sample item is "Many texts were too difficult for me" (for the full scale see Table 2). Responses to all items were on a 4-point Likert-type

scale ranging from 1: Strongly Disagree to 4: Strongly Agree. Higher scores on this scale reflect greater levels of feelings of difficulty. The scale was sufficiently reliable, $\alpha = .78;$ $\omega_T = .80$.

Metacognitive Knowledge of Reading Comprehension and Memorization Strategies

Six items of the PISA pool constituted the Metacognitive Knowledge of Reading Comprehension and Memorization Strategies scale. The items tap participants' awareness of reading strategies. A sample item is "After reading the text, I discuss its content with other people" (see also Table 2). Responses on all items were on a 6-point Likert-type scale ranging from 1: Not useful at all to 6: Very useful. The scale was sufficiently reliable, $\alpha = .63;$ $\omega_T = .72$. In the CFA performed, to establish an acceptable fit to the sample covariance matrix, and due to potential cross-language differential effects, measurement errors for items 3 and 6 were correlated based on modification indices. One item was excluded from analyses because of low loading (i.e., less than .30).

Metacognitive Knowledge of Text Summarizing Strategies

Five items of the PISA pool constituted the Metacognitive Knowledge of Text Summarizing Strategies scale. Items tap participants' awareness of text summarizing strategies. For example, "Before writing the summary, I read the text as many times as possible" (see also Table 2). Responses on all items were on a 6-point Likert-type scale ranging from 1: Not useful at all to 6: Very useful. The scale was sufficiently reliable, $\alpha = .70;$ $\omega_T = .80$. In the CFA, to establish an acceptable fit to the sample covariance matrix and due to potential cross-language differential effects, measurement errors for Items 1 and 3 were correlated based on modification indices. One item was excluded from analyses because of low loading (i.e., less than .30).

Additionally, the measurement errors of Item 4 of the Metacognitive Knowledge of Text Comprehension and Memorization Strategies scale and Item 5 of the Metacognitive Knowledge of Text Summarizing Strategies scale were correlated. It is reasonable to do so because both scales describe dimensions of metacognitive knowledge of strategies that pertain to text processing.

Reading comprehension

PISA (OECD, 2019b) tests reading comprehension with computer- administered assessment. In other words, all reading tasks were electronically presented. Overall,

in the international student assessment, 245 items were administered to Greek adolescent students. Some items were scored using a mixed response format, that is, binary format (0: incorrect; 1: correct) or a "partial" scoring system (0: incorrect; 1: partially correct; 2: correct). The one-parameter logistic Rasch model (Rasch, 1980), which takes into consideration both subjects' ability estimates (θ_i) and the items' difficulty (δ_i), was utilized by OECD to extract latent trait scores for binary items; the partial credit model (Wright & Masters, 1982), which is the extension of the Rasch model for polytomous items, was employed for partially scored items. Because the items were coded by the PISA officials for all countries, the coding reliability (i.e., interrater reliability) for Greece was $\varrho = 98$ for the new reading items and for the old reading items the reliability was $\varrho = 98.6$ (OECD, 2018). Further, PISA officials (OECD, 2019c) extracted multiple reading comprehension ability estimates by utilizing Item Response Theory modeling. According to the UNESCO Institute of Statistics (Brown & Micklewright, 2004) the average of these ability estimates represents the individual subject's ability score (i.e., factor score). A composite, reading comprehension score with interval scale properties ($M = 460.40$, $SD = 93.2$; range 552.3; Skewness = -0.13; Kurtosis = -0.38) was calculated for Greece. This composite score was utilized for all subsequent analyses.

Statistical analyses

All statistical analyses in this study were conducted with the statistical language and environment R (R Core Team, 2018). PISA (OECD, 2019c) has opted for an Item Response Theory latent variable modeling approach for measurement validation. However, in this study, a Classical Test Theory approach was adopted via the Common Factor Model (see McDonald, 2011). Examination of the psychometric properties of the instruments, via confirmatory factor analyses (CFA), was carried out with the Robust Maximum Likelihood (MLR) estimator, which corrects the non-normality of the measured indicators (see Rhemtulla, Brosseau-Liard, & Savalei, 2012). Regarding the estimation of structural models, the MLR estimator was selected because contemporary simulation studies have found that MLR performs considerably well in estimating structural relations with 2, 3, 4 or more data categories (cf., Bandalos, 2014; Li, 2016; Rhemtulla et al., 2012).

Reliability coefficients, including McDonald's (2011) coefficient omega total, which shows the total reliability of the instrument by considering the factorial structure of the items as well, were calculated with the Psych package (Revelle, 2018). Confirmatory factor analyses (CFA) and structural equation modeling (SEM) were carried out with the Lavaan package (Rosseel, 2012).

RESULTS

A latent correlation matrix, that describes the interrelationships among the theoretical constructs under study, is presented in Table 3. It is to be noted that the reading comprehension (composite) ability estimate was correlated with the latent variables of the CFA model. The goodness-of-fit indices displayed the following values: $\chi^2(N = 6{,}403, df = 121) = 1673.312, p < .001$, CFI = .943, TLI = .928, RMSEA = .047 90% CI [.045; .049], SRMR = .040.

Table 3: Latent correlation matrix

Factor	1	2	3	4	5
1. Metacognitive Knowledge of Understanding and Memorization	1	.758***	-.102***	.313***	.237***
2. Metacognitive Knowledge of Text Summarizing		1	-.204***	.385***	.381***
3. Metacognitive Experiences			1	-.341***	-.432***
4. Intrinsic Task Motivation				1	.403***
5. Reading Comprehension (composite)					1

Note: Standardized solution; *** significant at $p < .001$

Gender differences in metacognition

To examine potential gender-related individual differences in metacognitive functioning, several multiple-group confirmatory factor analyses (MGCFA) with one-factor specification were examined, because this procedure takes into consideration measurement error as well as the latent nature (Breitsohl, 2019; Brown, 2015) of the dimensions of metacognition. Measurement invariance was tested across three levels of progressively more constrained models, that is, configural, metric, and scalar models were tested across groups (Putnick & Bornstein, 2016). The factor structures were specified exactly as presented in the *Measures* section of this article. To avoid the possibility of undetected non-invariant parameters, and following Brown's (2015) recommendation, instead of the reference indicator approach, the factors were scaled by standardizing the factor variance to unity.

According to Cheung and Rensvold (2002), changes in |ΔCFI|< .01 are indicative of model invariance. Chen's (2007) recommendations were also adopted, i.e., metric and scalar invariance is established, if |ΔCFI| ≤ .01 and |ΔRMSEA| ≤ .015. In case the assumption of measurement invariance had not been supported, a partially invariant (Byrne, Shavelson, & Muthen, 1989) model was examined following a tear-

down approach (Brown, 2015). In other words, all items' intercepts and/ or loadings were constrained to equal and then Univariate Lagrange Multiplier (LM) tests were run to determine which constraints with the largest chi-square should be relaxed, by comparing the less constrained model with the fully constrained one (Bollen, 1989). The degree of the non-invariant parameters' cross-group variance was also considered. To take into consideration the inflated Type I error rate, the alpha level of .05 was adjusted by dividing with the number of the constrained parameters in each instance. The only assumption for this kind of procedure is that at least two item intercepts and their associated loadings should be invariant across groups to enable unbiased testing of cross-group latent differences (Brown, 2015). Research has shown that only two invariant indicators are sufficient to proceed with latent mean comparisons (cf., De Beuckaeler, 2005; Steenkamp & Baumgartner, 1998; Steinmetz, 2013). Further, Steinmetz (2013) underscores the fact that even a measurement model with two invariant indicators out of a scale comprising four items is still a sufficient partially invariant model and, thus, latent differences are still meaningful. Additionally, as Kline (2016) points out, the proportion of non-invariance should be no more than 50% of the scales' items. Non-invariant parameters, in this instance, may indicate that the items were differentially functioning (DIF); that is, they were differentially, cognitively construed across groups. It is reasonable to assume that some indicators would differentially function across gender groups because the relevant literature has identified the existence of gender-related individual differences in reading comprehension (e.g., Veloo et al., 2015; Zhang, 2018). Thus, relaxing some constrained parameters would be considered as the norm in this case.

At the beginning of the analyses, a Metacognitive Knowledge of Text Comprehension and Memorization Strategies factor was specified. The measurement model was tested across groups with gender as the grouping variable. According to the approximate goodness-of-fit indices, configural and metric invariance were established. When the item intercepts were constrained to equal, the model fit substantially declined with $|\Delta CFI| > .01$, even though the $|\Delta RMSEA|$ was within the acceptable range. Therefore, a partially invariant, scalar solution was examined. Adjustment of the alpha level was deemed necessary to account for the inflated Type I error rate due to multiple comparisons. Thus, with 10 constrained parameters, the alpha level was adjusted at $.05/10 = .005$. Univariate Lagrange Multiplier (LM) tests indicated that the intercepts of two items (i.e., items 4 and 5) were non-invariant across gender groups, $LM\chi^2_4 (1) = 60.252$, $p < .001$; $LM\chi^2_5 (1) = 42.142$, $p < .001$. Subsequently, the equality constraints of the intercepts of these items were relaxed to establish a partially invariant, scalar model. Because the MLR estimator was employed, Satorra- Bentler delta- chi-square scaling corrected tests (Satorra &

Bentler, 2001) were used to determine whether the nested models were significantly different. The Satorra-Bentler $\Delta\chi^2(2) = 4.664$, $p > .05$, indicated that the model with the relaxed constraints was not significantly different from the metric invariant model. The initial scalar model, without the relaxed constraints, and the partially invariant scalar model were significantly different, Satorra- Bentler $\Delta\chi^2(2) = 64.2$, $p < .001$.

When latent means of the partially scalar model were constrained to equal, the model was rejected which means that the latent/ factor means differed across gender groups. The Satorra- Bentler corrected $\Delta\chi^2(1) = 83.676$, $p < .001$, confirmed the model fit degradation. Female participants endorsed more the usefulness of the metacognitive strategies of understanding and memorization of text, $M_{\text{diff}} = .415$, $z = 8.771$, $p < .001$. The effect size of this difference was calculated by utilizing Hancock's (2001) extension of Cohen's d (Cohen, 1988) for factor means, which is called *Latent d*. The gender-related individual differences were of medium effect size with *Latent d* = .465. Goodness-of-fit indices are presented for progressively more constrained models in Table 4.

Table 4: Measurement invariance across gender groups for the Metacognitive Knowledge of Understanding and Memorization of Text factor

Level of Invariance	CFI	|ΔCFI|	RMSEA	|ΔRMSEA|	$\chi^2(df)$	Satorra-Bentler $\Delta\chi^2$ (df)
Configural	.982		.053		66.090*** (8)	
Metric	.973	.009	.052	.001	103.580*** (12)	38.127*** (4)
Scalar	.955	.018	.058	.006	171.066*** (16)	68.666*** (4)
Partially Scalar	.972	.001†	.049	.003†	108.705*** (14)	4.810† (2)
Factor Intercepts	.948	.024††	.064	.015††	190.953*** (15)	83.676*** (1) ††

Note: *** Significant χ^2 and/ $\Delta\chi^2$ at $p < .001$; $N = 5,885$; Fit indices, χ^2, $\Delta\chi^2$ † between metric and partially scalar models; †$\dagger^2$ between factor intercepts and partially scalar model

Next, a Metacognitive Knowledge of Text Summarizing Strategies factor was specified, and the analytical procedure was followed as abovementioned. Configural, metric, and scalar invariance was established without the need for partial invariance. When latent means were constrained to equal, the model was rejected, which means that the factor intercepts differed across gender groups. The Satorra- Bentler corrected $\Delta\chi^2(1) = 305.62$, $p < .001$, confirmed the model fit degradation. Female participants endorsed more the usefulness of the metacognitive strategies of text summarizing, $M_{\text{diff}} = .479$, $z = 17.866$, $p < .001$. The effect size of this difference was calculated by utilizing Hancock's (2001) extension. The gender-related individual differences were of medium effect size with *Latent d* = .557. Fit indices across progressively more constrained models are presented in Table 5.

Table 5: Measurement invariance across gender groups for the Metacognitive Knowledge of Text Summarizing factor

Level of Invariance	CFI	|ΔCFI|	RMSEA	|ΔRMSEA|	$\chi^2(df)$	Satorra-Bentler $\Delta\chi^2$ (df)
Configural	.999		.033		7.003** (2)	
Metric	.996	.003	.038	.005	52.120*** (8)	42.812*** (4)
Scalar	.987	.009	.052	.014	68.833*** (8)	45.309*** (3)
Factor Intercepts	.927	.060	.117	.065	357.168*** (9)	305.62*** (1)

Note: *** significant at $p < .001$; ** significant at $p < .05$; $N = 5,888$

Finally, a Metacognitive Experiences factor was specified, and measurement invariance was tested. Configural, metric, and scalar invariance was established without any need for partial measurement invariance. The delta chi-squared difference was not computable between the configural and the metric model, because the first one was fully saturated (i.e., just-identified). However, by imposing additional constraints on item intercepts, scalar invariance was established. The Satorra- Bentler scaled $\Delta\chi^2$ (2) = 1.272, $p > .05$, indicated that the scalar model was statistically identical to the metric one. Female participants endorsed more the retrospective feelings of difficulty, i.e., $M_{\text{diff}} = .172$, $z = 6.288$, $p < .001$. The effect size was equal to *Latent d* = .184, which is a minimal effect size.

Table 6: Measurement invariance across gender groups for the Metacognitive Experiences in Reading factor

Level of Invariance	CFI	|ΔCFI|	RMSEA	|ΔRMSEA|	$\chi^2(df)$	Satorra-Bentler $\Delta\chi^2$ (df)
Configural	1.00		.000		-	
Metric	1.00	.000	.002	.002	2.009 (2)	-
Scalar	1.00	.000	.000	.012	3.448 (4)	1.272 (2)

Note: χ^2 or $\Delta\chi^2$; * significant at $p < .05$; $N = 6,132$

Mediation analyses

To test a possible indirect effect of intrinsic task-related motivation on reading comprehension via metacognition, a fully latent, multiple mediation model was specified and tested within the SEM framework. Prior to commencing structural equation modeling, the variance inflection factor (VIF) and the tolerance indices for each indicator were examined to identify any multicollinearity issues. The VIFs were all less than 2 and the tolerance values were greater than 0.1, which is indicative of no

multicollinearity problems (Kline, 2016). The multiple mediation structural model was specified as shown in Figure 1. Model identification was achieved by standardizing the factors' variance to unity. Due to the high latent correlation, $\varphi = .758$, $p < .001$, between the Metacognitive Knowledge of Reading Comprehension and Memorization Strategies factor (abbreviation: Fkw_1) and Metacognitive Knowledge of Text Summarizing Strategies factor (abbreviation: Fkw_2), a higher-order factor, that exerts a direct effect on these two factors, would be a more appropriate modeling approach (Beaujean, 2014; Rindskopf & Tedd, 1988). Therefore, the two factors, that pertained to metacognitive knowledge of text processing, were modeled as subcomponents of a second-order factor, namely Metacognitive Knowledge (abbreviation: Fk). This specification is justified because both factors are different facets of the superordinate concept of metacognitive knowledge. Both the second-order metacognitive knowledge factor (Fk) and the Metacognitive Experiences (abbreviation: Fm_exp) factor were then specified as correlated mediators. The Intrinsic Motivation (abbreviation: Fmotiv) factor was specified as the exogenous variable. The mediators were then regressed on the exogenous intrinsic motivation factor. Finally, the Reading Comprehension composite variable was specified as the endogenous variable that was regressed on the mediators and the Intrinsic Motivation factor. The Full Information Maximum Likelihood (FIML) method was utilized to
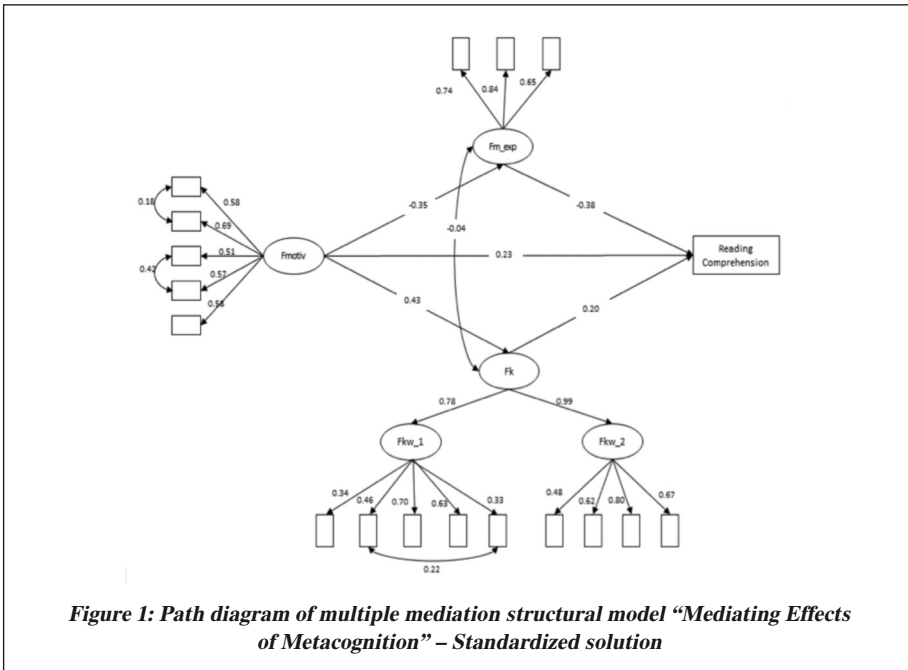

Figure 1: Path diagram of multiple mediation structural model "Mediating Effects of Metacognition" – Standardized solution

handle missing values (see Enders & Bandalos, 2001). Following Hu and Bentler's (1999) recommendations for cutoff criteria for goodness-of-fit indices, a model is deemed acceptable when CFI and TLI reach values equal to/ greater than .90, and when RMSEA and SRMR reach values less than .06.

Statistical testing of the model indicated that all latent variables had a statistically significant effect on reading comprehension (see Table 7). Further, goodness-of-fit indices indicated a good fit, $\chi^2(N = 6,403, df = 22) = 1541.038, p < .001$, CFI = .947, TLI = .934, RMSEA = .045 90% CI [.043; .047], SRMR = .039. The structural model explained 31% of the variance of reading comprehension, $R^2 = .317$. All indirect effects were statistically significant. The full mediation analysis is shown in Table 7.

Table 7: Multiple mediation - Structural model parameter estimates:
Mediating effects of metacognition

Path	B Coefficient (Standard Error)	β Coefficient	*p*-Value*
1. Motivation (Fmotiv) → Reading comprehension (composite)	21.994 (1.688)	.236	< .001
2. Motivation (Fmotiv) → Metacognitive Knowledge (Fk)	.476 (.022)	.430	< .001
3. Metacognitive Knowledge (Fk) → Reading comprehension (composite)	17.620 (1.388)	.209	< .001
4. Motivation (Fmotiv) → Metacognitive Experiences (Fm_exp)	-.380 (.021)	-.355	< .001
5. Metacognitive Experiences (Fm_exp) → Reading Comprehension (composite)	-26.829 (1.284)	-.308	< .001
Indirect Effects:			
1. Indirect Effect 1: Motivation → Metacognitive Knowledge (Fk) → Reading Comprehension (composite)	8.392 (.683)	.090	< .001
2. Indirect Effect 3: Motivation → Metacognitive Experiences (Fm_exp) → Reading Comprehension (composite)	10.203 (.668)	.109	< .001
Total Effect:	40.589 (1.424)	.435	< .001

Note: Fk: Metacognitive knowledge second-order factor; Fkw_1: Metacognitive knowledge of memorization and understanding; Fkw_2: Metacognitive knowledge of text summarizing; Fm_exp: Metacognitive experiences; Fmotiv: Intrinsic task motivation; * *p*-Value based on the unstandardized solution.

DISCUSSION

The first part of the present study aimed to investigate possible gender differences in metacognitive functioning with emphasis on metacognitive knowledge of reading

strategies and metacognitive experiences in reading tasks. Results of the analyses indicated that female participants reported higher feelings of difficulty and were more aware of (a) the usefulness of reading strategies for comprehension and memorizing of texts; (b) the usefulness of strategies for text summarizing. This finding is consistent with the conclusions of Ciascai and Haiduc (2011) and Mastrothanais et al. (2018). However, our findings are in contrast with those of Metallidou and Vlachou (2007), who did not find evidence of gender differences, although they are in line with the findings of other studies (e.g., Mastrothanais et al., 2018; Zhang, 2018), who found gender differences in metacognitive knowledge. Regarding individual differences in metacognitive experiences, it should be noted that, despite some statistically significant cross-group variation, the effect size of that difference was minimal. This finding corroborates that of Efklides et al. (1998). Thus, Hypothesis 1 is rejected. We underscore the fact that, because this approach draws upon a nationwide, representative sample, these results are more generalizable as compared to other studies with Greek participants. Further, our procedure is differentiated from prior work in the Greek context, because it has examined latent, instead of manifest, differences in factor intercepts, which means that measurement error is explicitly modeled (Breitsohl, 2019; Brown, 2015). Finally, it should be noted that relaxing constraints on empirical grounds turns these analyses more to the exploratory side, but these procedures are long thought of as a standard approach (Bollen, 1989).

Moreover, the present study examined the effects of SRL components such as motivation and metacognition on Greek adolescents' reading comprehension performance. Structural equation modeling (SEM) showed that both components of SRL had a statistically significant direct effect on reading comprehension. Thus, Hypotheses 2a, 2b and 2c were confirmed. However, the significant direct effect of intrinsic motivation on reading comprehension is a finding that contradicts that of van Kraayenoord and Schneider (1999), whose analysis did not identify a significant direct effect. Nevertheless, the direct effects of metacognition confirm other cross-national findings such as those by Callan et al. (2016), as well as the findings of research in Greece such as those by Dermitzaki et al. (2008) and Metallidou and Vlachou (2010). It is to be noted that this study may be among the first ones to also take into consideration metacognitive experiences and specifically feelings of difficulty as predictors of reading comprehension achievement. Further, in this study, it was found, as expected, that metacognitive knowledge was exerting a positive and statistically significant effect on reading comprehension. That is, higher perceptions of the usefulness of text processing strategies predict greater levels of reading comprehension. On the other hand, metacognitive experiences, operationalized as retrospective feelings of difficulty in the task, were a negative predictor of reading

comprehension performance. In other words, higher levels of feelings of difficulty were associated with lower levels of performance.

Another significant finding of this study pertains to the mediating effects of metacognition in the association between intrinsic motivation and reading comprehension. Although correlations and mediating relations between intrinsic motivation and reading comprehension have been reported in the past (e.g., Metallidou & Vlachou, 2007, 2010; Pintrich, 1990), no study has, to our knowledge, investigated the mediating effect of metacognition in Greek adolescents. In the German and Greek primary school context, mediating effects have been identified by prior research (e.g., Metallidou & Vlachou, 2007; van Kraayenoord & Schneider, 1999). Regarding our study, though, intrinsic motivation exerted both a direct and an indirect effect on reading comprehension via: (a) metacognitive knowledge and (b) metacognitive experiences, that is, feelings of difficulty in reading. Thus, Hypothesis 3 was confirmed.

Educational implications

The findings of our study are significant because they come from a large representative sample of Greek adolescents and internationally established measures (i.e., PISA testing). There are two major findings: firstly, there are gender differences in metacognition. This means that gender may also have implications in the selection and use of reading comprehension strategies and, indirectly in reading comprehension performance, since metacognition was a powerful predictor of achievement in reading comprehension tasks. Moreover, girls reported higher feelings of difficulty in the processing of the tasks. This suggests that girls were more aware of task demands and utilized strategies in order to overcome the experienced difficulty and succeed in the tests. Whether reading comprehension is considered by Greek adolescent boys a "female" domain should be investigated in future research. Such an attitude could lower young boys' motivation towards reading comprehension tasks and lead to less investment of effort on related tasks.

Indeed, intrinsic motivation is important for the self-regulation of the reading comprehension process. Our findings suggest that it has both direct and indirect effects on reading comprehension performance. Considering that motivation has indirect effects on task performance, via metacognition, it is evident that cultivating student motivation can have major effects on the awareness of task difficulty and demands and, subsequent use of strategies for the regulation of the reading comprehension process. Therefore, it is a challenge for research and educators to come up with interventions that have the potential to differentially treat motivation

and metacognition as well as their interrelations in the classroom. Evidently, this is not easy, particularly if there are stereotypes about gender differences that impact student engagement with reading comprehension tasks. From this point of view, research on SRL in reading comprehension tasks in primary and secondary education students has a lot to offer.

REFERENCES

Bandalos, D. (2014). Relative performance of categorical diagonally weighted least squares and robust maximum likelihood estimation. *Structural Equation Modeling: A Multidisciplinary Journal, 21*(1), 102-116. doi: 10.1080/10705511.2014.859510

Beaujean, A. (2014). *Latent variable modeling using R*. New York, NY: Routledge.

Bollen, K. (1989). *Structural equations with latent variables.* New York, NY: Wiley.

Breitsohl, H. (2019). Beyond ANOVA: An introduction to structural equation models for experimental designs. *Organizational Research Methods, 22*(3), 1-29. doi: 10.1177/1094428118754988

Brown, A. T. (2015). *Confirmatory factor analysis for applied research* (2nd ed.). New York, NY: Guilford.

Brown, G., & Micklewright, J. (2004). *Using international surveys of achievement and literacy: A view from the outside.* Montreal, Canada: UNESCO Institute of Statistics. Retrieved from http://uis.unesco.org/sites/default/files/documents/using-international-surveys-of-achievement-and-literacy-a-view-from-the-outside-04-en_0.pdf

Byrne, B., Shavelson, R., & Muthen, B. (1989). Testing for the equivalence of factor covariance and mean structures: The issue of partial measurement invariance. *Psychological Bulletin, 105*(3), 456-466. doi: 10.1037/0033-2909.105.3.456

Callan, L. G., Marchant, J. G., Finch, W. H., & German, L. R. (2016). Metacognition, strategies, achievement, and demographics: Relationships across countries. *Educational Sciences: Theory & Practice, 16*(5), 1485-1502. doi: 10.12738/estp.2016.5.0137

Chatzistamatiou, M., & Dermitzaki, E. (2013). Teaching mathematics with self-regulation and for self-regulation: Teachers' reports. *Hellenic Journal of Psychology, 10*(3), 253-274.

Chen, F. F. (2007). Sensitivity of goodness of fit indexes to lack of measurement invariance. *Structural Equation Modeling, 14*(3), 464-504. doi: 10.1080/10705510701301834

Cheung, G. W., & Rensvold, R. B. (2002). Evaluating goodness-of-fit indexes for testing measurement invariance. Structural Equation Modeling, 9(2), 233-255. doi: 10.1207/S15328007SEM0902_5

Ciascai, L., & Haiduc, L. (2011). Gender differences in metacognitive skills. A study of the 8th grade pupils in Romania. *Procedia – Social and Behavioral Sciences, 29,* 396-401. doi: 10.1016/j.sbspro.2011.11.255

Cohen, J. (1988). *Statistical power analysis for the behavioural sciences (*2nd ed.). New York, NY: Erlbaum.

De Beuckaeler, A. (2005). *Measurement invariance issues in international management research.* [Unpublished doctoral thesis]. Limburgs Universitair Centrum, Limburg, Belgium.

Dermitzaki, E., Andreou, G., & Paraskeva, V. (2008). High and low reading comprehension achievers' strategic behaviors and their relation to performance in a reading comprehension situation. *Reading Psychology, 29*, 471-492. doi: 10.1080/02702710802168519

Efklides, A. (2006). Metacognition and affect: What can metacognitive experiences tell us about the learning process? *Educational Research Review, 1,* 3-14. doi: 10.1016/j.edurev.2005.11.001

Efklides, A. (2008). Metacognition: Defining its facets and level of functioning in relation to self-regulation and co-regulation. *Educational Psychologist, 13*(4), 277-287. doi: 10.1027/1016-9040.13.4.277

Efklides, A. (2011). Interactions of metacognition with motivation and affect in self-regulated learning: The MASRL model. *Educational Psychologist, 46*(1), 6-25. doi: 10.1080/00461520.2011.538645

Efklides, A., Papadaki, M., Papantoniou, G., & Kiosseoglou, G. (1998). Individual differences in feelings of difficulty: The case of school mathematics. *European Journal of Psychology of Education, 13*(2), 207-226. doi: 10.1007/BF03173090

Enders, K. C., & Bandalos, L. D. (2001). The relative performance of full information maximum likelihood estimation for missing data in structural equation models. *Structural Equation Modeling*, *8*(3), 430-457.

Gidalevich, S., & Kramarski, B. (2017). Guidance for metacognitive judgments: A thinking-aloud analysis in math problem solving. *Hellenic Journal of Psychology, 14*(2), 83-113.

Guthrie, T. J., Wigfield, A., Metsala, L. J., & Cox, E. K. (1999). Motivational and cognitive predictors of text comprehension and reading amount. *Scientific Studies of Reading, 3*(3), 231-256. doi: 10.1207/s1532799xssr0303_3

Hancock, R. G. (2001). Effect size, power, and sample size determination for structured means modeling and mimic approaches to between-groups hypothesis testing of means on a single latent construct. *Psychometrika, 66,* 373-388. doi: 10.1007/BF02294440

Hu, L., & Bentler, M. P. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal, 6*(1), 1-55. doi: 10.1080/10705519909540118

Isen, M. A., & Reeve, J. (2005). The influence of positive affect on intrinsic and extrinsic motivation: Facilitating enjoyment of play, responsible work behavior, and self-control. *Motivation and Emotion, 29*(4), 297-235. doi: 10.1007/s11031-006-9019-8

Kline, R. (2016). *Principles and practice of structural equation modeling.* New York, NY: Guilford.

Kolić-Vehovec, S., Bajšanski, I., & Zubković, B. (2010). Metacognition and reading comprehension: Age and gender differences. In A. Efklides & P. Misailidi (Eds.), *Trends and prospects in metacognition research* (pp. 327-344). New York, NY: Routledge. doi: 10.1007/978-1-4419-6546-2_16

Lau, K., & Ho, S. E. (2015). Reading performance and self-regulated learning of Hong Kong students: What we learnt from PISA 2009. *The Asia-Pacific Education Researcher, 25*(1), 159-171. doi: 10.1007/s40299-015-0246-1

Li, H.-C. (2016). The performance of ML, DWLS, and ULS estimation with robust corrections

in structural equation models with ordinal variables. *Psychological Methods, 21*(3), 369-387. doi: 10.1037/met0000093

Mastrothanais, K., Kalianou, M., & Katsifi, S. (2018). The use of metacognitive knowledge and regulation strategies of students with and without special learning difficulties. *International Journal of Special Education, 33*(1), 184-200.

McDonald, P. R. (2011). *Test theory: A unified treatment.* New York, NY: Routledge.

Metallidou, P., & Vlachou, A. (2007). Motivational beliefs, cognitive engagement, and achievement in language and mathematics in elementary school children. *International Journal of Psychology, 42*(1), 2-15. doi: 10.1080/00207590500411179

Metallidou, P., & Vlachou, A. (2010). Children's self-regulated learning profile in language and mathematics: The role of task value beliefs. *Psychology in Schools, 47*(8), 776-788. doi: 10.1002/pits.20503

Mokhtari, K., & Reichard, A. C. (2002). Assessing students' metacognitive awareness of reading strategies. *Journal of Educational Psychology, 94*(2), 249-259. doi: 10.1037//0022-0663.94.2.249

OECD. (2018). *PISA 2018 technical report.* Paris, France: OECD Publishing. Retrieved from http://www.oecd.org/pisa/data/pisa2018technicalreport/#d.en.423800

OECD. (2019a). *PISA 2018.* Paris, France: OECD Publishing. [Dataset]

OECD. (2019b). *PISA 2018 results: What students know and can do.* Paris, France: OECD Publishing.

OECD. (2019c). *PISA 2018 results: Where all students can succeed.* Paris, France: OECD Publishing. doi: 10.1787/b5fd1b8f-en

OECD. (2019d). *PISA 2018 assessment and analytical framework.* Paris, France: OECD Publishing. doi: 10.1787/b25efab8-en.

Pintrich, P. (1990). The role of motivation in promoting and sustaining self-regulated learning. *International Journal of Educational Research, 31*(6), 459-470. doi:10.1016/S0883-0355(99)00015-4

Pintrich, P. (1999). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology, 82*(1), 33-40.

Πόρποδας, K. (2002). *Ανάγνωση* [Reading]. Πάτρα: Αυτο-έκδοση.

Putnick, L. D., & Bornstein, H. M. (2016). Measurement invariance conventions and reporting: The state of the art and future directions for psychological research. *Developmental Review, 41*, 71-90. doi: 10.1016/j.dr.2016.06.004

R Core Team. (2018). *R: A language and environment for statistical computing.* Vienna, Austria: R Foundation for Statistical Computing.

Rasch, G. (1980). *Probabilistic models for some intelligence and attainment tests.* Chicago, USA: The University of Chicago Press.

Revelle, W. (2018). *Psych: Procedures for personality and psychological research.* Evanston, IL: Northwestern University-Evanston. Retrieved from https://CRAN.R-project.org/package=psych.

Rhemtulla, M., Brosseau-Liard, P. É., & Savalei, V. (2012). When can categorical variables be treated as continuous? A comparison of robust continuous and categorical SEM estimation

methods under suboptimal conditions. *Psychological Methods, 17,* 354-373. doi: 10.1037/a0029315

Rindskopf, M. D., & Tedd, R. (1988). Some theory and applications of confirmatory second-order factor analysis. *Multivariate Behavioral Research, 23,* 51-67. doi: 10.1207/s15327906mbr2301_3

Rosseel, Y. (2012). Lavaan: An R package for structural equation modeling. *Journal of Statistical Software, 48*(2), 1-36. doi: 10.18637/jss.v048.i02

Satorra, A., & Bentler, P. M. (2001). A scaled difference chi-square test statistic for moment structure analysis. *Psychometrika, 66*(4), 507-514. doi: 10.1007/BF02296192

Σοφιανοπούλου, Χ., Εμβαλωτής, Α., Καρακολίδης, Α., & Πίτσια, Β. (2019). *Μια ανάλυση των αποτελεσμάτων του PISA 2015: Οι επιδόσεις των Ελλήνων μαθητών και οι παράγοντες που τις επηρεάζουν* [An analysis of the results of PISA 2015: The performance of Greek students and the factors that affect them]. Αθήνα: Διανέοσις. Retrieved from https://www.dianeosis.org/wp-content/uploads/2019/11/final_pisa2015.pdf

Sperling, A. R., Howard, C. B., Miller, A. L., & Murphy, C. (2002). Measures of children's knowledge and regulation of cognition. *Contemporary Educational Psychology, 27,* 51-79. doi: 10.1006/ceps.2001.1091

Steenkamp, E. M. J-E., & Baumgartner, H. (1998). Assessing measurement invariance in cross-national consumer research. *Journal of Consumer Research, 25,* 78-90. doi: 10.1086/209528

Steinmetz, H. (2013). Analyzing observed composite differences across groups: Is partial measurement invariance enough? *Methodology, 9*(1), 1-12. doi: 10.1027/1614-2241/a000049

Thiede, W. K., & de Bruin, B. H. A. (2017). Self-regulated learning in reading. In D. Schunk & J. Greene (Eds.) *Handbook of self-regulation of learning and performance* (pp. 124-137). New York, NY: Routledge.

van Kraayenoord, E. C., & Schneider, E. W. (1999). Reading achievement, metacognition, reading self-concept and interest: A study of German students in Grades 3 and 4. *European Journal of Psychology of Education, 14,* 305-324. doi: 10.1007/BF03173117

Veenman, V. J. M., Van Hout-Wolters, B., & Afflerbach, P. (2006). Metacognition and learning: Conceptual and methodological considerations. *Metacognition and Learning, 1,* 3-14. doi: 10.1007/s11409-006-6893-0

Veloo, A., Rani, A. M., & Hariharan, K. (2015). The role of gender in the use of metacognitive awareness reading strategies among biology students. *Asian Social Science, 11*(1), 67-73. doi: 10.5539/ass.v11n1p67

Völlinger, A. V., Spörer, N., Lubbe, D., & Brunstein, C. J. (2018). A path analytic test of the reading strategies mediation model: Relating cognitive competences and motivational influences with individual differences in fifth-grade students' reading comprehension. *The Journal of Educational Research, 116*(6), 733-745. doi: 10.1080/00220671.2017.1412930

Wright, B., & Masters, G. (1982). *Rating scale analysis.* Chicago, IL: MESA Press.

Zhang, L. (2018). *Metacognitive and cognitive strategy use in reading comprehension.* Singapore: Springer.

Zimmerman, J. B., & Moylan, R. A. (2009). Self-regulation: Where metacognition and motivation intersect. In D. J. Hacker, J. Dunlosky, & A. C. Graesser (Eds.), *Handbook of metacognition in education* (pp. 299-315). New York, NY: Routledge.