

Comprehending and recalling from text: The role of motivational and cognitive factors

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The relative contribution of motivational and cognitive factors to reading comprehension might depend on how reading comprehension is measured. The participants in this study were 146 students attending grade 7. Students' reading comprehension of a history text was assessed through three measures, literal comprehension, inferential comprehension, and free recall. Students' prior knowledge, reading motivation, topic interest, inference-making skills, and metacognition were also assessed. According to the multivariate general linear model, the set of motivational and cognitive variables explained students' performance in inferential comprehension and free recall, but not in literal comprehension. Moreover, topic interest moderated the association between inference-making skills and free recall. Results underlined the importance of the interplay between motivational and cognitive factors in contributing to students' deep processing of the text, but also emphasised that reading measures might not tap the same array of processes. While literal comprehension happens without the direct involvement of the cognitive-motivational variables measured in this study, believing in one own's ability in reading was associated to deep processing of the text, and free recall required the involvement of both, cognitive and motivational variables.

Introduction

Reading comprehension is a fundamental literacy skill for the acquisition and construction of knowledge. To learn from written sources, students need first to comprehend the information included in them, and then be able to recall the stored information when prompted. The scientific literature on reading comprehension substantially agrees that the final outcome greatly depends on students' motivational and cognitive factors (Alhabahba, Pandian & Mahfoodh, 2016; Boscolo & Mason, 2003). Prior studies have shed light on several cognitive components of reading comprehension. On the other hand, less is known about the contribution of motivational variables on comprehension of the text immediately after reading it, as compared to recall of texts (Baker & Wigfield, 1999; Guthrie, Wigfield & You, 2012). Moreover, previous studies have demonstrated how the relative contributions of predictors of reading comprehension depend on how it is measured, suggesting that different reading outcome measures might not tap the same array of motivational and cognitive processes (Andreassen & Bråten, 2010; Cutting & Scarborough, 2006). This study explored the differential contribution of motivational (reading motivation and topic interest) and cognitive factors (inference-making skills and metacognition) on secondary school students' literal and inferential comprehension, and recall of text content read in the past.

Reading comprehension and recall from text

When a reader engages with a text, the final outcome can be very different depending on the level of depth of his/her elaboration processing. For instance, a disengaged reader

might still be able to access a literal comprehension of the text, and even a deeper level if he/she has high levels of prior knowledge. But an engaged reader, with high interest and/or reading motivation might be able to elaborate the text to a deeper level, so that text content is integrated with prior knowledge. Reading comprehension assessments are often theory-based and guided by Kintsch's classical model of reading comprehension, in which the differences between the text-base and the reader's situational model of text content are reflected by the use of literal and inferential information (Kintsch, 1986, 1994). In the textbase, the reader processes the text as a network of concepts and propositions. In the situational model, the textbase model is integrated with the readers' general knowledge. Literal comprehension requires the reader to recognise the information exactly as presented in the text, whereas inferential comprehension requires a reasoning beyond the text and, therefore, is more cognitively demanding. Most of the studies on reading comprehension assessed this process through multiple-choice questions on literal or inferential information included in the text, immediately after students had read it. Conversely, some authors proposed the use of free recall as a measure of reading comprehension (Boscolo & Mason, 2003; Carlisle, 1999; Snow, 2002). A free recall task is cognitively more demanding than a multiple-choice reading comprehension assessment because the student needs to produce language, rather than simply recognising the right choice in a set of alternatives. Several authors have emphasised how the relative importance of motivational and cognitive predictors depends on how we choose to measure comprehension (Cutting & Scarborough, 2006; McNamara, Kintsch, Songer & Kintsch, 1996). Thus, in this study I conducted our analyses on three different measures, literal and inferential reading comprehension, and free recall.

Motivational components of reading comprehension

Reading motivation

Motivation is considered a multidimensional core predictor of reading comprehension, moderating the impact of cognitive processes on reading comprehension performances (Guthrie et al., 2012; Schiefele et al., 2012; Taboada, Tonks, Wigfield & Guthrie, 2009). Specifically, reading motivation is defined as a pattern of goals, values and beliefs that constitute the reader's approach to the processes and outcomes of reading (Guthrie et al., 2012). However, most of our knowledge on reading motivation derives from studies on elementary school students, and not much is known on older students (Retelsdorf, Köller & Möller, 2011). Moreover, several researchers studied the effects of motivation on reading comprehension as a one-dimensional term, not acknowledging its multi-dimensional nature (Conradi, Jang & McKenna, 2013). Instead, reading motivation is better understood as a variety of factors influencing students' engagement with text, which can be clustered into four main constructs, self-efficacy, intrinsic and extrinsic motivation, and social aspects of reading (Baker & Wigfield, 1999; Conradi et al., 2013; Wigfield & Guthrie, 1997). Self-efficacy is defined as students' evaluation of their competence in reading, based on Bandura's self-efficacy theory (1977), according to which individuals who believe they are successful at an activity will more likely engage with it. This construct includes students' evaluation of their reading competence, their willingness to read

challenging material, and their desire to avoid reading activities (Wigfield & Guthrie, 1997).

Intrinsic motivation defines students' reading because they are interested, curious, or just motivated for its own sake (Deci & Ryan, 1985; Lau, 2016). This construct includes the desire to read about a specific topic (i.e., curiosity; Renninger, Hidi & Krapp, 1992), the enjoyment experienced while reading about a specific topic (i.e., involvement; Schallert & Reed, 1997), the subjective importance attributed to the value of reading as a task (i.e., importance; Wigfield & Eccles, 1992), and students' awareness of what they do not like about reading (i.e., reading work avoidance; Nicholls, Cheung, Lauer & Patashnick, 1989). Extrinsic motivation defines students' reading to perform well in the eyes of others. This construct includes the pleasure of being recognised as good reader, receiving good grades, and outperforming others in reading (Deci & Ryan, 1985). Finally, the construct of social aspects of motivation is based on the idea that reading is inherently a social activity (Guthrie, McGough, Bennett & Rice, 1996). This construct includes the process of sharing the meanings gained from reading with people around us, and reading as a process to meet the expectations of others. On the basis of these theoretical assumptions, Wigfield and Guthrie developed the *Motivation for Reading Questionnaire* (1997) which allows the researcher to conduct a comprehensive analysis of the effect of this construct on reading comprehension and recall performances.

Topic interest

The degree of interest that we have in a certain topic represents a crucial variable in learning from texts (Boscolo & Mason, 2003). Although interest can be considered as a motivational variable, and thus confused with other motivational constructs, several studies demonstrated that its effect on reading comprehension is different from the effect played by reading motivation (Schiefele, 1999). Interest can be generated by certain environmental or task conditions (i.e., situational interest), or a relatively stable orientation towards certain domains (i.e., individual, Ainley, Hidi & Berndorff, 2002). Thus, situational interest describes an environment that makes reading interesting, whereas individual interest describes a specific topic that is interesting for a person, so that he or she is motivated to read about it. In this study, I focused on the role of individual interest in comprehending and recalling a history text on the discovery of America. Interest should influence reading comprehension by determining how individuals select and persist in elaborating certain information in preference to another. Both Schiefele (1999) and Wigfield and Eccles (1992) agreed that is preferable to differentiate between components of motivation, because it is reasonable to believe that sometimes individuals read because feelings are involved (e.g., "I like to read autobiographies about historical figures"), and other times they read because the topic has some personal significance for them (e.g., "It important to know about past historical events and learn from them"). Prior studies on topic interest before reading a text have confirmed that it plays a moderating role in reading comprehension (e.g., Boscolo & Mason, 2003). However, most of the studies on topic interest have examined its association with reading comprehension through free recall tasks (see for instance Schiefele, 1999), and their results cannot be automatically extended to other reading comprehension tasks.

Cognitive components of reading

Prior knowledge

Current research on reading comprehension proposes that prior knowledge is the strongest reading comprehension predictor (Alexander & Jetton, 2000). Prior knowledge is defined as the reader's actual knowledge, available before a certain learning task and structured in schemata. This variable is expected to have a large influence on reading comprehension as it helps the reader to construct a coherent mental representation of the text, and fill in the gaps in the information stated in the text (Kintsch, 1994; Ozuru, Dempsey, & McNamara, 2009). In support of this argument, several studies have demonstrated that prior knowledge facilitates (Tarchi, 2010) and enhances (Tarchi, 2015) reading comprehension.

Inference-making skills

Inferences are a central component of skilled reading, essential to ensure good understanding of a text (Rapp, Broek, McMaster, Kendeou & Espin, 2007). To construct the meaning of a text, readers have to go beyond literal information through the generation of inferences (Cain, Bryant & Oakhill, 2004). Indeed, inferences are what makes the reader move from a mere interpretation of individual sentences to a global meaning that integrates multiple sentences (Best, Rowe, Ozuru & McNamara, 2005). Readers are required to make many different types of inferences, such as establishing referential coherence, pointing out casual antecedents, and understanding characters' emotional reactions (Cain et al., 2004). At times, inferences can lead the reader astray, especially when the text wants to "trick" the reader through jokes, 'whodunits' and the like. For this reason, it is important for the reader to continuously monitor the comprehension process to ensure coherence between inferences drawn and information found later in the text.

Metacognition

Recent trends within the domain of reading comprehension led to an increasing emphasis on the role of metacognitive awareness of one's cognitive processes (Mokhtari & Reichard, 2002) and monitoring of the learning process (Cain et al., 2004). Most researchers agree that metacognition includes several components (Flavell, 1976; Veenman, Van Hout-Wolters & Afflerbach, 2006). Traditionally, two major metacognitive components were considered, metacognitive knowledge and regulation of cognition. The former includes knowledge about how human beings process information, including one's own learning processes, whereas the latter includes the use of strategies to control cognitive activities, and to ensure that a cognitive goal has been met (Brown, 1978; Flavell, 1976). In terms of reading, metacognitive knowledge translates into knowledge of reading strategies and awareness of the reading activity purposes, that is, tactics to engage and comprehend text congruent to the reason/s why we are reading. Instead, regulation of cognition translates into monitoring of the reading activity and sensitivity to the text, that is executive function directing the reader's cognitive process while reading in accordance

to the structure and cognitive demands of the specific text we are reading (Brown, 1978; Kolić-Vehovec & Bajšanski, 2006).

The effect of reading comprehension assessment on motivational and cognitive processes

Many studies include literal and inferential questions to assess reading comprehension, but children's performances of each question type are rarely compared (Eason, Goldber, Young, Geist, & Cutting, 2012). However, combining different types of questions into one comprehension construct might pose several risks, such as overlooking specific difficulties (Cutting & Scarborough, 2006; Eason et al., 2012). To the best of our knowledge, no previous study has comparatively explored the influence of motivational and cognitive variables on literal comprehension versus inferential comprehension versus free recall. Instead, prior research has compared other types of reading comprehension assessments, and found a difference in the contribution of motivational and cognitive variables. For instance, Ozuru et al. (2007) and Schaffner and Schiefele (2013) explored the effect of text availability (i.e., access to the text while answering the questions) on reading comprehension performances. Ozuru et al. (2007) conducted a study with 41 undergraduate students, and, according to their results, the availability of the text while answering to the questions reduced the impact of prior knowledge, in favour of other motivational and cognitive factors.

Schaffner and Schiefele (2013) conducted two studies on the influence of motivational and cognitive factors on reading comprehension in two conditions, with as opposed to without text accessibility. According to their results, comprehension measured without text access was more demanding for memory and inferential processing, whereas comprehension with text access was more strongly predicted by motivation. Surprisingly, prior knowledge did not contribute to reading comprehension in either of the two conditions, probably because one of their cognitive measures, reasoning ability, outweighed it as a predictor of comprehension. Moreover, metacognition contributed to reading comprehension only in the without-text condition, whereas the authors expected this factor to contribute to comprehension with text access too. It must be noticed that their measure of metacognition included only students' knowledge of reading strategy (excluding metacognitive knowledge, for instance), thus a different and more comprehensive measure of metacognition might yield different results. Intrinsic motivation was a significant predictor in both conditions, as it explained a significant portion of variance in reading comprehension performance with and without access to text. From these studies it can be noticed that tasks that are more cognitively demanding, in this case comprehension without text access, require a stronger interplay between motivational and cognitive factors. In particular, when the text is not accessible, readers can only rely on their ability to access the situational model created at the time of reading (Ozuru et al., 2007).

Rationale and research questions

This study examined how the contributions of motivation and interest (as motivational factors), and prior knowledge, metacognition and inference-making (as cognitive factors) differ as a consequence of reading comprehension assessment, specifically immediate reading comprehension through multiple choice at different levels of the text versus free recall. Results of the study will contribute to our understanding on how different means of assessing contribute to reading comprehension performance. For instance, finding that motivational variables impact on free recall and not literal comprehension might suggest that a teacher more often use free recall to trigger students' engagement with text. Immediate reading comprehension through multiple choice questions is a reliable measure to assess the depth of reading comprehension (literal and inferential comprehension), whereas free recall is a reliable measure to assess how much information students retain after reading a text. The use of these two variables also permits study of the extent to which free recall depends upon the situational model created at the time of reading, and whether motivational and cognitive variables influence this relationship.

The research questions for this study were:

1. Do students' motivational and cognitive skills bring the same contribution to immediate reading comprehension versus free recall? According to my hypothesis, the relative contribution of motivational and cognitive predictors changes as a function of the reading comprehension measure, with some measures better than others at assessing the contribution of specific predictors. Moreover, free recall would require a stronger contribution from cognitive variables than literal and inferential comprehension do, because it is a more demanding process.
2. Do motivational factors moderate the association between the construction of a situational model and reading comprehension? According to my hypothesis, motivational factors moderate the association between cognitive predictors and free recall. I expect that the relative importance of cognitive factors for reading comprehension changes as a function of level of motivation. For instance, inference-making skills might be more important to reading comprehension in individuals with low levels of reading motivation, and less important in individuals with high levels of motivation.

Method

Participants

The participants in this study were 146 students attending grade 7 in three different schools in a middle-size city in central Italy (72 males and 74 females; ages 12-14 years, sample mean 12.92 years). All participants spoke Italian as a primary language. The students' parents gave their informed consent for participation. The measures were administered with due adherence to the requirements of privacy and informed consent requested by the Italian law (Law Decree DL-196/2003). Regarding the ethical standards

for research, the study referred to the last version of the *Declaration of Helsinki* (World Medical Association, 2013). Students diagnosed with learning and/or developmental disabilities, foreign born with significant language problems, and deemed poor decoders by their teachers took the tests regularly, but were excluded from the data analyses. In order to calculate the sample's socio-economic status, students were asked to write down their parents' occupations. From this data, a socio-economic index of occupational status was derived, according to Ganzeboom, de Graaf, Treiman and de Leeuw's indications (1992). Participants had a middle-high socio-economic status, and no significant differences between the classrooms in which students were included were found.

Materials and measures

The tests were administered at a time agreed upon with the teachers during school hours in class, over the course of three sessions. All tests were group administered. The order of the independent variables (reading motivation, topic interest, prior knowledge, metacognition and inference-making skills) and dependent variables (literal comprehension, inferential comprehension and free recall) was counter-balanced. In experiments, the order in which tests are administered can affect the behaviour of the subjects, due to fatigue or outside factors changing the behaviour of many of the subjects. To counteract this, in this study, the order in which tests were administered was changed from class to class, reducing the chances of the order or other factors adversely influencing the results. Following, I will present all the measures with translation of sample items from Italian to English. All materials were available in Italian, except for the *Motivation for Reading Questionnaire*, which was translated into Italian by the author.

Reading motivation

Reading motivation was assessed through the *Motivation for Reading Questionnaire* (MRQ; Wigfield & Guthrie, 1997). The MRQ includes 53 items evaluated on a 4-point Likert scale, with choices ranging from *very different from me*, *a little different from me*, *a little like me*, and *a lot like me*. The MRQ included 11 dimensions, however this factorial structure was not confirmed by subsequent studies (Watkins & Coffey, 2004). Consequently, in this study I referred to the four main motivation constructs described by Wigfield and Guthrie (1997): self-efficacy, intrinsic and extrinsic motivation, and social aspects of reading. An analysis of the inter-items' correlations showed a poor reliability for the reading work avoidance dimension (within the intrinsic motivation construct), thus I excluded it from the analysis.

Self-efficacy (9 items)

This dimension included the belief that one can be successful at reading, reading challenge, and the satisfaction of assimilating ideas from the text. An example of item was: *I learn more from reading than most students in the class* (reading efficacy). The alpha coefficient of this scale was .79.

Intrinsic motivation (14 items)

This dimension includes the scales of curiosity (desire to learn about a certain topic), reading involvement (enjoyment of experiencing texts), and importance of reading (how

important reading is for the student). An item example was: *I make pictures in my mind when I read* (reading involvement). The alpha coefficient of this instrument was .80.

Extrinsic motivation (15 items)

This dimension includes the scales of competition in reading, i.e. desiring to outperform others in reading, recognition for reading (gratification for being rewarded in reading), and reading for grades (the desire to receive high grades in reading from the teacher). An example of item was: *I like to finish my reading before other students* (competition). The alpha coefficient of this instrument was .77.

Social aspects (12 items)

This dimension includes the scales of social reasons for reading (sharing information from texts with family and friends), and compliance (reading because of an external goal or requirement). An example of this item was: *I visit the library often with my family* (social). The alpha coefficient of this instrument was .76.

Topic interest in history

Topic interest in history was assessed through a 15-item questionnaire on a 5-point Likert scale (from 1 to 5). In the interest questionnaire students were asked to indicate how they expected to feel while reading the text (“bored”, “stimulated”, “interested”, “indifferent”, “involved”) and describe the value of the text’s topic to them personally (“meaningful”, “unimportant”, “useful”, “worthless”) (Schiefele & Krapp, 1996). An example of this item was: *In my opinion, it is useless to know about historical problems, because they are out of our control, and we cannot do much to resolve them.* The alpha coefficient of this instrument was .92.

Prior knowledge

Students’ prior knowledge of the topic of the history text was assessed through a 10-item multiple-choice questionnaire. The alpha coefficient of this instrument was .85. An example item was:

After World War I, Germany had to: A. increase their army; B. cede the regions of Alsace and Lorraine to Italy; C. pay a huge amount of money to the winner states; D. cede their production of coal in the Saar region to Austria.

Metacognition

Students’ metacognition approach to reading was assessed through a standardised test (Pazzaglia, De Beni & Cristante, 1994). The test is based on Brown’s metacognitive model of reading comprehension, and it assessed four areas through 10 items: awareness of reading aims, knowledge of strategies to improve comprehension, monitoring during comprehension, and sensitivity to the text. The alpha coefficient of this instrument was .73. Some examples of this test were:

According to you, a good reader: A. reads everything with the same accuracy; B. changes his/her way of reading according to text difficulties; C. always reads aloud.

Some of the following sentences have some mistakes. Find and underline them: "The student tried to answer to the teacher's question, but he did not succeed because he had studied very much".

Semantic inferences

The students read a short passage, and answered 10 multiple-choice questions on information that was not explicitly stated in the text. The alpha coefficient of this instrument was .78. An example item was:

I only had with me 8-10 people who were guiding me and carrying what I needed for a few days. Why was Piaggio travelling with other 8-10 people? A. because he did not trust just one person; B. because they were at the same time guides and bearers and he had a lot of stuff to carry; C. because he was afraid of an assault; D. because he felt affection towards them.

Reading comprehension of history text

Students read a 1204-word history text on the post-war period, extracted from a textbook for Italian secondary schools ("*Il dopoguerra*", da Ruata Piazza & Venturi, 2001). This topic was chosen because according to the national curriculum of the Ministry of Education it is included in the grade 8 program. Thus, teachers did not discuss this topic with our participants at the time of the study, which allowed the researcher to explore the influence of motivational and cognitive variables on reading comprehension without confounding variables related to the teacher. After reading the text, students were asked three types of question, literal, inferential, and free recall, all without access to the text.

Literal comprehension

Students answered five questions on information explicitly stated in the text. The alpha coefficient of this instrument was .73. An example item was:

Peace agreements established that from the dissolved Habsburg Empire new nations should have risen: Republic of Austria [...], Republic of Czechoslovakia [...], Reign of Yugoslavia [...], Republic of Poland [...], republic of Hungary. Which nations were created from the dissolution of the Hapsburg Empire? A. Austria and Germany; B. Spain and Portugal; C. Serbia and Croatia; D. Austria and Hungary.

Inferential comprehension

Students answered five questions, which required the connection (bridge) between different parts of the text. The alpha coefficient of this instrument was .78. An example item was:

England and France aimed [...] at preventing Germany from recovering from the loss and re-becoming the major continental power. [...] to be connected with [...] At the end, in Versailles, the Peace Agreement was signed, and it imposed heavy conditions on the German State (June, 1919): [...] reduction of the army to 100,000 men. Why was the German army reduced to just 100,000 men? A. because all the other soldiers died during

the war. B. because German soldiers had to take service with other nations' armies. C. to prevent it to become a power again. D. because soldiers had to work in the factories and in the fields abandoned during the war.

Free recall

Students were asked to recall as much information as they could from the history text they had read, by writing it down. Students were prompted with a question that recalled the main topic covered by the reading: *What were the consequences of World War I?* Students' scores were quantified in terms of number of propositions correctly remembered from the text. Two independent raters coded the material, and inter-rater agreement was acceptable ($k = .93$).

Data analyses

I examined the skewness and kurtosis of each dependent variable to verify the normality of their distribution. Variables that were not normally distributed were normalised through increasing monotonic transformations (Fox, 2008). The first research question was explored through a multivariate generalised linear model (GLM), in which prior knowledge, inference-making skills, metacognition, interest and reading motivation dimensions were included as covariates, and literal comprehension, inferential comprehension, and free recall were included as dependent variables. I explored both, the effect of the independent variables on reading comprehension as a whole process, and separately on the different levels of reading comprehension (literal, inferential, and recall). This data analysis method allows exploring both the influence that the set of cognitive and motivational variables have on reading comprehension as a whole, and the influence that each variable has on the separate levels of comprehension. GLMs are particularly effective in analysing the simultaneous effects of multiple variables.

The second research question was explored through a series of moderation analyses, with cognitive variables as independent variables, free recall as dependent variable, and motivational variables as moderators of the relationship between the independent and dependent variables. The moderation analyses were conducted through PROCESS, an SPSS Macro created by Hayes (2012). The moderation effects were derived from linear regression models, and tested through the bootstrapping strategy (Preacher & Hayes, 2008).

Results

Descriptive statistics for all variables are reported in Table 1.

Contribution of cognitive and motivational variables on literal comprehension, inferential and free recall

According to the multivariate GLM, prior knowledge, inference-making skills, topic interest, and self-efficacy contributed to explaining variance in the set of reading comprehension measures (literal, inferential, and free recall), whereas metacognition,

intrinsic motivation, extrinsic motivation, and social motivation did not bring any statistically significant contribution (Table 2).

Table 1: Descriptive statistics of all variables included in the study ($n = 146$).

	Min	Max	Mean	SD
PK*	0	10	7.42	1.83
Inferences	0	14	5.68	2.30
Metacognition	3.5	14.0	9.442	2.01
Topic interest	23	75	51.29	9.78
MRQ - Self-efficacy	9	33	21.24	4.72
MRQ - Intrinsic	19	50	34.63	6.64
MRQ - Extrinsic	15	52	32.72	7.18
MRQ - Social	12	43	27.10	6.02
HIS_Literal questions	2	5	3.88	0.97
HIS_Inferences questions*	1	5	4.23	0.92
HIS_Free recall	4	17	10.00	2.90

Note: * Variables normalised through monotonic increasing transformations (Fox, 2008). PK = Prior Knowledge; MRQ = Motivation for Reading Questionnaire; HIS = History.

Table 2: Results from the multivariate GLM testing the contribution of cognitive and motivational variables on reading comprehension measures (literal comprehension, inferential comprehension, and free recall).

	λ	F	df	p	η^2
PK_norm	.95	1.65	3,135	.18	.05
Inferences	.86	5.49	3,135	.00	.14
Metacognition	.94	2.19	3,135	.09	.06
Topic interest	.90	3.80	3,135	.01	.10
MRQ - Self-efficacy	.89	4.36	3,135	.01	.11
MRQ - Intrinsic	.97	.99	3,135	.40	.03
MRQ - Extrinsic	.97	1.08	3,135	.36	.03
MRQ - Social	1.00	.12	3,135	.95	.00

According to the univariate analyses, the GLM was not statistically significant in explaining variance in literal comprehension of text, $F(8, 135) = 0.98$, $p > .05$, $\eta^2 = .07$. The GLM was statistically significant in explaining variance in inferential comprehension of text, $F(8, 135) = 2.10$, $p < .05$, $\eta^2 = .14$, and free recall, $F(8, 135) = 5.86$, $p < .001$, $\eta^2 = .31$.

More specifically, inferential comprehension of text was explained by self-efficacy only. Free recall was explained by prior knowledge, inference-making skills, metacognition, and topic interest (see Table 3 and Figure 1).

Table 3: Results from the univariate analysis testing the contribution of cognitive and motivational variables on reading comprehension measures (inferential comprehension, and free recall)

	Inferential comprehension					Free recall				
	Sum of squares	df	F	<i>p</i>	η^2	Sum of squares	df	F	<i>p</i>	η^2
Prior knowledge	.04	1	.43	.52	.00	32.22	1	4.97	.03	.05
Inferences	.14	1	1.53	.22	.01	79.71	1	12.29	.00	.11
Metacognition	.00	1	.03	.87	.00	39.25	1	6.05	.02	.06
Interest	.02	1	.25	.62	.00	57.79	1	8.91	.00	.08
MRQ_Self efficacy	.85	1	9.22	.00	.08	9.91	1	1.53	.22	.01
MRQ_Intrinsic	.22	1	2.40	.12	.02	3.51	1	.54	.46	.01
MRQ_Extrinsic	.19	1	2.04	.16	.02	3.88	1	.60	.44	.01
MRQ_Social	.00	1	.00	.99	.00	2.19	1	.34	.56	.00

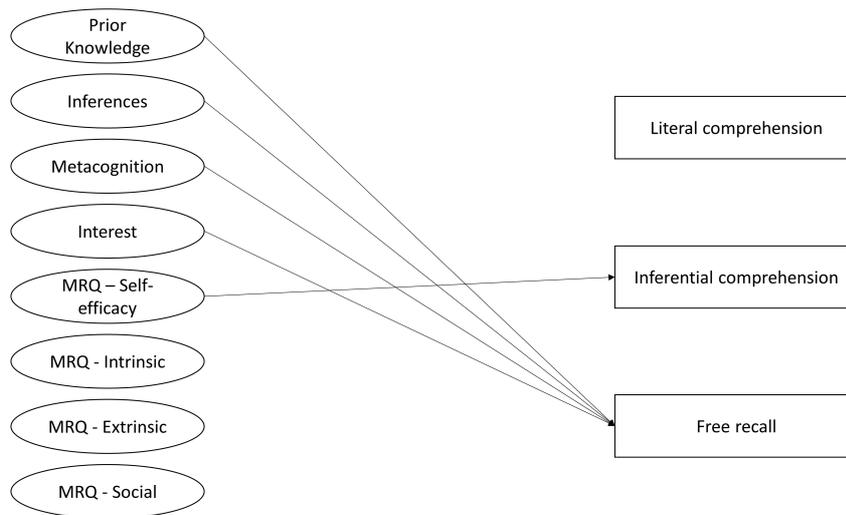


Figure 1: Graphical representation of relationships between cognitive and motivational variables, and levels of reading comprehension.

Moderation effect of motivational variables on the association between cognitive variables and comprehension measures

As the results of the GLM analyses indicated that only free recall was explained by an interplay of motivational and cognitive variables, I explored the moderation effect of topic interest (the only statistically significant motivational variable on free recall) on the association between cognitive factors (prior knowledge, inference-making skills and metacognition, all significant predictors of free recall) on free recall as a measure of reading comprehension. Among all cognitive variables tested, only the effect of inference-making skills on free recall was moderated by readers' levels in topic interest. Overall the model was statistically significant and explained 19% of the variance in free recall, $F(3, 148) = 11.79, p < .001$. The effect of the interaction between interest and inferences on

free recall was statistically significant, and contributed to explain 3% of the variance in free recall, $F(1, 148) = 5.80, p < .05$. The association between inferences and free recall was statistically significant at low ($t = 4.51, p < .001$) and medium levels of interest ($t = 4.45, p < .001$), but not at high levels of interest ($t = 1.86, p > .05$) (see Figure 2).

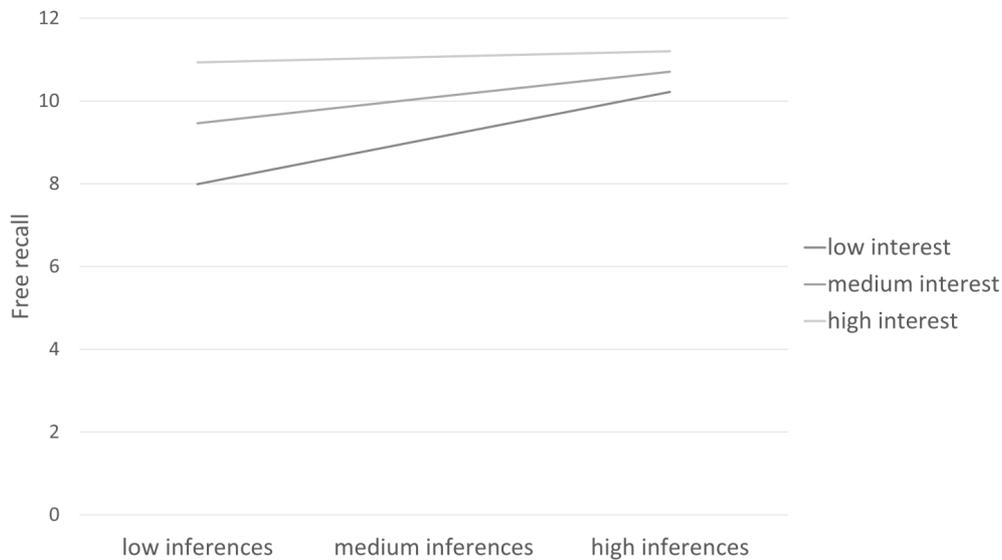


Figure 2: Graphical representation of the moderating effect of topic interest on the influence of inferences on free recall of an expository text (data points represents unstandardised estimates of effects of inferences on free recall as influenced by interest in the topic).

Discussion

This study explored the reciprocal interplay between motivational and cognitive factors in influencing reading comprehension and recall of an expository text by secondary school students. Overall, our results confirm that the relative contribution of motivational and cognitive predictors depends on how reading comprehension is measured (Cutting & Scarborough, 2006). The set of motivational and cognitive variables included in this study contributed to explaining students' performance in inferential comprehension and free recall, but not their performance in literal comprehension.

The failure of motivational and cognitive variables to explain literal comprehension performance is not surprising. Past studies have demonstrated that poor comprehenders do not differ from good comprehenders in answering literal questions, suggesting that literal comprehension might not be a reliable indicator of reading comprehension (Cain & Oakhill, 1999). Although any higher level of comprehension depends on literal comprehension, literal questions are generally easier to answer than other types of questions, and they do not require deep processing of the text, but rather bottom-up processes, such as word level skills, might be sufficient, and might not demand any level of comprehension, other than identifying key words associated with the question (Eason

et al., 2012). Less demanding tasks reduce the necessity for higher-order skills, such as prior knowledge (Ozuru et al., 2007; Voss & Silfies, 1996), working memory and inferential processing (Schaffner & Schiefele, 2013).

Inferential comprehension and free recall were both predicted by the motivational and cognitive processes assessed in this study, although the relative contribution of the predictors changed as a function of the question type. Inferential comprehension was explained by reading motivation, in particular by self-efficacy. In line with Ozuru et al.'s (2007) and Schaffner and Schiefele's (2013) findings, students who were more willing to read the text and spend more time on it, were also able to construct a situational model of the text itself, as typically assessed by inferential questions (Kintsch, 1994). Students who feel that they are efficacious in reading will also achieve their goals, and this success motivates them to engage even more in reading activities, which increases their reading performance (Walker, 2003). Surprisingly, cognitive variables did not contribute to explaining variance in inferential comprehension, differently from suggestions by previous studies (Eason et al., 2012). Probably, readers are able to implement higher-order processing if they still have access to the text. Higher-order processing is not always necessary. In everyday reading activities students might need to be taught how to "skim read", to know "what is there", and how to go back for re-reading, in case one might feel a need for further text elaboration. Conversely, they can only rely on the efforts made while they were reading, a variable strictly associated to motivation (Schaffner, Schiefele, & Ulferts, 2013). Or, finally, this result might be because the task was within the cognitive capacities of all the students (students with learning and language difficulties having been excluded).

Free recall appeared to be the most demanding task (Ozuru et al., 2007). Motivational and cognitive variables were all involved when students had to recall information included in the text previously read. Among motivational variables, topic interest and not reading motivation contributed to free recall performances. This finding is consistent with Schiefele's studies (1996, 1999), who specifically worked on the influence of topic interest on learning from text. An interested reader might read to actually learn something from the text, creating the conditions for him/her to deeply engage with the text. Consistently, prior knowledge, metacognition and inferences contributed to free recall. As hypothesised in previous studies (Ozuru et al., 2007; Schaffner & Schiefele, 2013), a free recall task should emphasise those cognitive processes that help students to construct a situational model, as this is the only representation they can count on. Conversely, when answering questions with text access, students can update their text representation while processing the questions. Previous studies widely agree that situation models can be constructed if the students are able to create links within the text, and to fill the gaps in the text by connecting information from text to relevant background knowledge (Oakhill, 1983). The results of this study confirmed Schaffner and Schiefele's finding (2013) that metacognitive competence predicted students' reading comprehension performances in the most demanding condition and extended it by including a measure of self-regulation, in addition to metacognitive knowledge. Students with high metacognitive competence are typically aware of the purpose of reading (in this study, reading for study), are able to read the text strategically, and are able to monitor their comprehension process (Kolić-Vehovec &

Bajšanski, 2006; Mokhtari & Reichard, 2002). Moreover, students with high metacognitive competence are also able to use the reading comprehension question as a feedback upon their actual comprehension of the written information, giving them possibilities for correcting misunderstanding and revising their situational model.

Motivational variables partially contributed to moderate the association between cognitive factors and reading comprehension. However, the moderating influence of topic interest did not contribute to moderate the application of cognitive skills to reading comprehension, differing from findings in previous studies (e.g., Boscolo & Mason, 2003). Low and medium levels of interest influenced the association between inferences and free recall, whereas high levels of interest did not. To interpret this unexpected result, other processes should be taken into account. For instance, previous studies have demonstrated that motivational variables increase the amount of time that readers dedicate to the reading activity, which in turn improves their reading comprehension performances (Schaffner et al., 2013; Wigfield & Guthrie, 1997). Thus, I could hypothesise that students with low levels of interest in the topic discussed in the text need to rely more on the efficacy of the cognitive basis of reading comprehension to construct a situational model of the reading and be able to recall information. Instead, students with high levels of interest in the topic would probably spend more time on the reading activity (because they consider the topic important and/or because they receive a positive feedback while reading), reducing the importance of the cognitive basis in the construction of the situational model of the text. However, the research design of this study does not allow us to draw a conclusion, and future studies should include a measure of reading amount to confirm this hypothesis.

Conclusions

Overall, this study confirmed that literal comprehension, inferential comprehension and free recall of a history text appear to be differently influenced by motivational and cognitive variables. In addition, students' free recall performances appear to depend on the situational model that they were able to construct when they were exposed to the text, as the association with inferential comprehension shows. Our results confirm concerns raised by other scholars, that reading measures might not tap the same array of processes, and might be influenced to different degrees by a specific motivational or cognitive predictor (Cutting & Scarborough, 2006).

Results from this study are affected by a few limitations. Firstly, prior knowledge was assessed with a set of multiple-choice questions on the topic of the text, but other important dimensions of prior knowledge were not included. For instance, future studies could explore the influence of students' depth of knowledge in the topic discussed in the reading (see Tarchi, 2010; 2015). Also, while prior knowledge might be associated with better results, prior knowledge might obviate the need for (or even interfere with), rather than contribute to, reading skills. Secondly, future studies should focus on the reading behaviour occurring during the reading comprehension phase. As previously said, reading behaviour variables might explain why certain variables influenced immediate reading comprehension and not free recall, or *vice versa*. For instance, more interested students

might decide whether the text is trustworthy or relevant before reading it, or motivated students might spend more time in reading the text or switch more often between questions and text in order to answer (see Schaffner et al., 2013).

On an educational level, each motivational and cognitive process included in this study played an important role for comprehending and/or recalling a text, and teachers should empower the interplay between these processes, in addition to strengthening the levels of each of them. But it could also be possible to identify alternative paths to achieve high levels of free recall. For instance, a very interested student might not need excellent levels in inferences to deeply understand a text. Or students might be encouraged to put more effort in reading especially when texts are of less interest and familiarity to them. It is then important to include measures of interest and motivation along with the more traditional cognitive assessments of reading comprehension to help students learn from written expository texts. This study also suggests caution in clinical assessment, as the detection of a reading comprehension deficit might depend on the type of measure implemented.

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