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Components of reading comprehension and scholastic achievement

Chiara Meneghetti *, Barbara Carretti, Rossana De Beni

Department of General Psychology, University of Padova, Italy

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Abstract

The aim of this study was to understand whether the reading comprehension process is better explained by a single or by multiple factors. 184 students (9 to 13 years old) were presented with a recently devised battery of tests, that measure ten aspects of reading comprehension. Structural equation modelling showed that a two factors model better accounts for the data compared to a one or a three factors model. Results confirmed the hypothesis which distinguishes between 'basic' and 'complex' aspects of reading comprehension. The second goal of the study was to analyze the relationship between the two-components model and scholastic achievement. Our results highlighted that the more 'complex' aspects of reading comprehension, reflecting some metacognitive knowledge and control processes, are the better predictors of scholastic achievement.

Keywords: Reading comprehension; Scholastic achievement

1. Introduction

Reading comprehension is a complex cognitive ability requiring the capacity to integrate text information with the knowledge of the listener/reader and resulting in the elaboration of a mental representation.

Current models of reading comprehension highlight the importance of considering the role of different cognitive processes during text comprehension. For example, memory both in its short- and long-term components is broadly considered to have a fundamental role. Indeed, the reader has to store and manipulate information in working memory during the processing of the text, but at the same time in order to construct a coherent representation of the text usually he/she has to refer to his/her prior knowledge (van den Broek, 1994).

The studies on reading comprehension have often adopted an individual differences viewpoint as an attempt to account for the processes and components that might differentiate skilled and less skilled readers, the latter usually named 'poor comprehenders' (Oakhill, Cain, & Bryant, 2003). Poor comprehenders are those individuals who have an average IQ but are specifically impaired in understanding the meaning of a text. The comparisons between good and poor comprehenders are usually made using tasks measuring either global or specific aspects of reading comprehension, such as the ability to make inferences (Cain & Oakhill, 1996, 1999; Ehrlich & Remond, 1997; Nation & Snowling, 1998, 1999; Stothard & Hulme, 1992; Yuill & Oakhill, 1991). The results of these studies have shown that poor comprehenders are at a particular disadvantage when they are required to execute a process that requires integrating newly encountered information with information encountered earlier in the text or retrieved from long-term memory. So, for example, poor comprehenders have

* Corresponding author. General Psychology Department, Via Venezia, 8, 35131 Padova, Italy.
E-mail address: chiara.meneghetti@unipd.it (C. Meneghetti).

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problems interrelating successive topics (Lorch, Lorch, & Morgan, 1987) and integrating information to derive the overall gist or main theme of a passage (Palincsar & Brown, 1984). Furthermore, poor comprehenders differ from good comprehenders in their ability to integrate text information, understand story structure and monitor their own understanding (Cain & Oakhill, 1996, 1999; Cain, Oakhill, Barnes, & Bryant, 2001; Ehrlich & Remond, 1997; Yuill & Oakhill, 1991). Poor comprehenders are less sensitive to semantic inconsistencies in the text compared to good comprehenders (Garner, 1981). At the same time less skilled comprehenders are more prone to allow the intrusion of irrelevant information (Gernsbacher & Faust, 1991; Gernsbacher, Varner, & Faust, 1990).

Also from a metacognitive point of view, poor comprehenders have difficulties. It has been shown that they seem less aware of the importance of giving meaning to a text stressing the relevance of the decoding phase to the detriment of comprehension (Baker & Brown, 1984; Pazzaglia, De Beni, & Cacciò, 1999). Moreover, they sometimes do not realize when they do not understand (Garner & Reis, 1981), they rarely use reading strategies (Brown, Armbruster, & Baker, 1986) and they have more difficulty in adjusting the strategy to the task (Palincsar & Brown, 1984). Also the ability to evaluate the complexity of the text, to detect text structure, to monitor comprehension and to spot anomalies are factors which can discriminate between good and poor comprehenders (August, Flavell, & Cliff, 1984; Brown et al., 1986; Garner, 1981).

The short review of the main findings on poor comprehenders' performance reveals a heterogeneous pattern of difficulties. However this does not mean that all these aspects necessarily occur simultaneously in all cases of comprehension difficulty. In agreement with this view, Cornoldi, De Beni, and Pazzaglia (1996) discussed the idea that poor comprehenders show a high level of variability in their cognitive and metacognitive profiles. Cornoldi et al. (1996) longitudinally studied a group of poor and good comprehenders comparing their performance in a number of learning measures (e.g. reading and listening comprehension, decoding skills), cognitive measures (such as the Primary Mental Abilities by Thurstone and Thurstone (1963) and working memory) and metacognitive aspects related to reading comprehension (such as knowledge of reading goals, strategy use and text sensitivity). The single cases analysis highlighted that a reading comprehension failure generally implied a lower metacognitive control on reading comprehension, whereas in some participants it implies also a listening comprehension difficulty or a poor use of strategies. Poor comprehenders also failed, as a group, in a series of working memory tasks, but in some cases this deficit was limited to those tasks that need to rely on sentence processing. These results led the authors to claim that all these aspects are necessary prerequisites contributing, at higher levels, in the role of reading performance facilitators. Thus, a lower performance in metacognitive and cognitive tasks could produce a lower performance in reading comprehension. Conversely, low reading comprehension could affect some or all cognitive and metacognitive abilities.

Furthermore, the mental model studies offer the possibility of understanding the kind of differences between the effective and ineffective reader (Lorch & van den Broek, 1997; McNamara, Kintsch, Songer, & Kintsch, 1996). Perrig and Kintsch's (1985) model proposes the distinction between a text-based representation, which maintains the verbal characteristics of the message, and a situation model, representing the situation described therein in which the text content is integrated into the comprehender's knowledge system. Following this line of research, some studies found that good comprehenders differ in a number of reading-related skills allowing them to build better-integrated and richer situation model (e.g. Lonka, Lindblom-Ylanne, & Maury, 1994; van Dijk & Kintsch, 1983).

This variability in the reading comprehension performance suggests the need to device tools that offer a composite measure of reading comprehension. Indeed, Palincsar and Brown (1984) identified six different component skills, which, they claim, make up the comprehension ability, including the activation of relevant background knowledge, generation of inferences, and monitoring of both ongoing comprehension and the internal consistency of the text. More recently, Hannon and Daneman (2001) proposed a composite tool that measures the ability to access and integrate long-term-memory knowledge, to make text-based inferences and recall new text information from long-term memory. The authors used these components to predict the performance of university students on a typical test of global reading comprehension, demonstrating that their new tool was better in predicting a global measure of reading comprehension than for example a typical working memory task. Furthermore, Oakhill et al. (2003) investigated the relevance of some abilities in accounting for reading comprehension in children between 7 and 9 years old. Oakhill et al. (2003) included in their longitudinal study tasks measuring aspects of reading comprehension that result from the individual differences approach and have been revealed to be important for a good reading comprehension, i.e. the ability to make inferences, to follow the story structure of a text and comprehension monitoring. Moreover they added an evaluation of the working memory capacity (the classic Reading Span Test devised by Daneman & Carpenter, 1980). The results in both phases of the longitudinal study revealed that a significant portion of variance in the comprehension skill is accounted for by measures of text integration, metacognitive monitoring, and working memory capacity.

In the present study, we extended this line of research exploring the components of the reading comprehension ability. The first aim of the study was to identify the structure of reading comprehension processes testing three theoretical models: a first model in which reading comprehension could be considered as a unique factor, a second model in which two factors (basic and complex aspects of reading comprehension) could be identified and finally a model in which metacognitive, cognitive and very basic aspects of reading comprehension could be distinguishable. Such a research approach has implications for both the theoretical knowledge on reading comprehension as well as for educational practice. From the theoretical point of view, it sheds light on the factors that influence a good reading comprehension performance. Indeed, with this kind of research it is possible to highlight which factor is mainly involved during text processing, more precisely than considering good comprehension as doing well in general comprehension tasks. Moreover, understanding which aspect is better in predicting a global measure of reading comprehension is also important for knowing how to improve reading comprehension. Indeed in a training context, one needs to have information about which components of comprehension are failing (e.g., literal or inferential skills, strategy to understand different kind of texts) because it is much easier to see how such components could be trained than to see how the unanalyzed ability (performance on a comprehension test) could be trained.

If reading comprehension can be divided into two or three aspects we might expect a difference in the involvement of these components in students with different scholastic achievement. Thus, testing which component could be considered as a predictor of academic achievement is the second main aim of this research. A number of other studies have attempted to analyze the specific contribution of reading comprehension to scholastic achievement. Actually, the role of reading comprehension is pretty obvious. Indeed, it is not possible to learn something about history or geography without understanding the textbook, however what is more interesting is whether or not it is possible to highlight the role of some aspects over others. Royer, Abranovic, and Sinatra (1987), for example, stressed above all the importance of prior knowledge. Indeed in their study the course-relevant reading comprehension performance was a significant predictor of course performance but not of the grade point average (GPA) of a group of college students. However, more recently, Taraban, Rynearson, and Kerr (2000) highlighted that college students could be differentiated on the basis of global scores of academic proficiency, a reading comprehension score or a specific course score (English) reported to differently use reading comprehension strategies. These results converge towards the importance of certain components of reading comprehension (in this case the metacognitive aspects) in predicting scholastic achievement. Taken together, these results suggest that the good reader may have more skills in controlling and monitoring the strategy necessary to elaborate a mental model. Thus in the present study we might expect that the complex components of reading comprehension, including metacognitive abilities, may be better predictors of scholastic achievement.

To summarize, this study intends to analyze the unity or distinctiveness of reading comprehension and the relationship between different components of reading comprehension and scholastic achievement. To test these hypothesis a large sample of students were administered a battery of 10 tasks measuring different aspects of reading comprehension (De Beni, Cornoldi, Carretti, & Meneghetti, 2003). The ten aspects measured are: 1. *Characters, Times and Events*; 2. *Events and Sequences*; 3. *Syntactic Structure*; 4. *Connections between parts of the text*; 5. *Inferences*; 6. *Text Sensitivity*; 7. *Text Hierarchy*; 8. *Mental Model*; 9. *Text Flexibility*; 10. *Errors and Inconsistencies* (see Material section for the description of each task).

To pursue our aims, we used Confirmatory Factor Analysis (CFA) to specify the degree to which reading comprehension aspects are unitary or not and their relevance in scholastic achievement. CFA is similar to the Exploratory Factor Analysis (EFA) technique. We used CFA indexes to compare the goodness of the three hypothesized models: the first model tests the unique component of reading comprehension, the second tests the ‘basic’ and ‘complex’ aspects of reading comprehension, and the third the ‘basic’, ‘complex’ and ‘metacognitive’ aspects. To this first model we added a second part i.e. performance in Mathematics and Italian.

2. Method

2.1. Participants

One hundred eighty four students aged between 9 and 13 participated in the Study (see Table 1 for the composition of the sample). They were part of a larger study aimed at the standardization of the battery of tasks for reading comprehension abilities (see De Beni et al., 2003).

Table 1
Composition of sample (males/females, grade of school)

	N	Gender	
		Males	Females
III grade	65	41	24
IV grade	18	8	10
V grade	45	21	24
VI grade	56	29	27
Total	184	99	85

2.2. Materials

2.2.1. Tasks description

The battery is composed of ten tasks (De Beni et al., 2003; see also Carretti, Meneghetti, & De Beni, 2005). Each task consists of one or two passages (either narrative, descriptive or argumentative) and 15 questions requiring both a multiple choice answer (in 80% of cases) and a short open answer (in 20% of cases). The maximum score for each test is 15. A brief description of each task is reported below.

Characters, Times and Events (CTE). The aim of this task is to measure the ability of the student to individuate and recognize the characters of the story, the events and the location in which events take place and as well as the duration of events. The task, for example, required participants to spot the name of characters and identify if the characters are real, likely or fantastic and relate the relationship between them.

Events and Sequences (ES). The aim is to measure the ability of students in identifying the main events and their logical and chronological order, the actions of the characters and their internal response to external events. Task requirements are for example: to order the events, to reconstruct the order of the facts or their logical succession.

Syntactic Structure (SS). The aim is to measure the ability of the student to understand the text focusing on the syntactic elements of the text. For example to recognize the different meaning of sentences in relation to the position of punctuations; the role of articles, the characteristics of hypothetical sentences, the distinction between passive and active sentences, direct and indirect discourse.

Connections between parts of the text (CON). The aim is to measure the ability of the students to make connections between different information in the text on the basis of their semantic and logical criterion in order to create a consistent structure of meaning. In this task, participants are asked to put in co-referential relation close or far elements of the text and/or illustrations; to connect synonyms and words related to the same characters, to connect information and attribute the correct meaning to words.

Inferences (INF). The aim is to measure the ability of the students to make inferences from the text. Inferences are a way to achieve information not explicitly stated in the text. An inference is the output of the interaction between the reader's knowledge and the information in the text (Graesser, Wiemer Hastings, & Wiemer Hastings, 2001). There are three distinct types of semantic inferences: logical (based on an explicit premise), pragmatic (based on our knowledge about the world) and plausible (based on the possible occurrence of an event not supported by information in the text). In this task, participants have to guess the meaning of an unknown word on the basis of the content (lexical inference) or infer about the meaning of a sentence using their own knowledge (semantic inferences).

Text Sensitivity (TS). The aim is to measure the ability of the student in recognizing the complexity of the text and identifying the information on the basis of its relevance, as well as discerning different literally genres (descriptive, narrative and argumentative) and the structure of different kinds of text. Task requirements are for example: to predict the content of the text from the title; to make predictions about text difficulty; to identify information according to the reader's purpose.

Text Hierarchy (TH). The aim is to measure the ability of the student in attributing the correct relevance to information in the text. This ability allows students to grasp the main ideas of the text allocating them to a correct order of importance. The task consists for example, of hypothesizing the main information contained in the text based on the title alone or selecting the main elements of information eliminating the irrelevant ones.

Mental Model (MM). The aim is to measure the ability of the student in constructing a mental model of the text, i.e. the ability to select relevant information in the text and integrate it with prior knowledge to form a consistent mental representation. Depending on the type of text the representation can be spatial, causal, temporal or can refer to the characteristics and emotions of the characters (for a review Zwann & Radvansky, 1998). In this task, for example, participants have to create a spatial mental model from a route description and to update a mental model.

Text Flexibility (TF). The aim is to measure the ability of the student to change or to modify the approach to the text in relation to their own aims or task requirements. This task tests the ability to plan and to monitor text comprehension. In this task, for example, students are led to reflect on the usefulness of several strategies in relation to different task requirements (the best strategy to learn a poem or to summarize a text, etc.).

Errors and Inconsistencies (EI). The aim is to measure the ability of the student to monitor the level of comprehension and to check for congruent and incongruent information in the text. In this task, participants are required to identify incongruent words according to text meaning, to detect the change in the meaning of a word in relation to the change of sentence context.

2.3. Procedure

The tasks were administered by a class teacher previously informed about the aim of the study. Children were instructed to read the texts silently and answer the 15 questions. The procedure allowed participants to have the texts available for consultation during the answering phase. This methodology was adopted to obtain a pure measure of reading comprehension, avoiding memory load. Students had no time limit in carrying out each task. Only when 90% of the students had completed the task, the task was ended. The score was computed assigning one point for each correct answer. At the end of the scholastic year the evaluations report for each student in Mathematics and Italian was collected. The grades for these two subjects were chosen since they are representative of the students' general scholastic achievement.

3. Results

Because the multivariate techniques of the Confirmatory Factorial Analysis assume multivariate normal distribution for scores on the 10 tasks we calculated the kurtosis indexes. As shown in Table 2 the ten kurtosis indexes indicate a good approximation to normality, even if the score tend to have a more central distribution indicated by the negative sign. The total Cronbach's α for the ten tasks indicate a high reliability of .92.

Our primary goal was to analyze how the 10 aspects of comprehension could be grouped into sub-components. On the basis of the literature and of the characteristics of the tests we compared three theoretical models (see Fig. 1). The

Table 2
Descriptive statistics for the 10 tasks ($N=184$)

	M	SD	Kurtosis
1. Characters, Times and Events	9.77	2.72	−0.54
2. Events and Sequences	9.98	3.56	−0.58
3. Syntactic Structure	9.63	2.68	−0.38
4. Connections between parts of the text	8.99	3.17	−0.22
5. Inferences	8.91	2.76	−0.24
6. Text Sensitivity	8.27	2.59	−0.38
7. Text Hierarchy	7.23	2.43	−0.34
8. Mental Model	7.26	2.36	−0.28
9. Text Flexibility	7.44	3.18	−0.66
10. Errors and Inconsistencies	7.72	3.38	−0.81

first theoretical model (Model A) would imply a unique construct for the reading comprehension abilities. The other two models assume the distinction in sub-aspects of reading comprehension as suggested by most reading comprehension studies (Hannon & Daneman, 2001; Oakhill et al., 2003; Palincsar & Brown, 1984). In one case (Model B) the distinction is between 'basic' aspects which incorporate the essential elements of text comprehension (for example the ability to identify the characters of a story, the succession of events and facts, the comprehension of syntactic structure, the ability to connect the different parts of a text and to make inferences) and 'complex aspects' (i.e. more elaborate competences such as the ability to predict the content of the text from the title, to select the main elements eliminating the irrelevant ones, to select different strategies in relation to the text etc.). In the current model we hypothesize a distinction between 'basic' components (i.e. the first five tasks: 1. *Characters, Times and Events*; 2. *Events and Sequences*; 3. *Syntactic Structure*; 4. *Connections between parts of the text*; 5. *Inferences*) and more 'complex' and demanding components (the seconds five tasks: 6. *Text Sensitivity*; 7. *Text Hierarchy*; 8. *Mental Model*; 9. *Text Flexibility*; 10. *Errors and Inconsistencies*).

Other studies have highlighted the relevant role of the metacognitive and strategic aspects of reading comprehension (Cornoldi et al., 1996; Lahtinen, Lonka, & Lindblom-Ylanne, 1997; Slotte & Lonka, 1998, 1999) in order to build a high quality mental representation. For this reason we hypothesized a third model (Model C) that grouped the tasks that measure very 'basic' aspects (1. *Characters, Times and Events*; 2. *Events and Sequences*; 3. *Syntactic Structure*); this theoretical basic component is supported by studies that identify word knowledge (Carroll, 1993; Oakhill, Cain, & Yuill, 1998) and the syntactic skills (Rego & Brjant, 1993) as essential aspects to understand a text. More elaborate cognitive aspects can require a different competence such as the ability to make *Connections between parts of the text* (Task 4) or semantic and lexical *Inferences* (Task 5), in order to elaborate a good mental model (Task 8). Finally the third component hypothesized includes tasks that for their features are more metacognitive (6. *Text Sensitivity*; 7. *Text Hierarchy;* 9. *Text Flexibility*; 10. *Errors and Inconsistencies*); these aspects include the ability to identify the relevant information, appreciate and utilize text instructions, modify ones own reading strategy in relation to the different kind of texts and recognize incongruent words following text meaning.

All the CFA models were performed with Lisrel 8 statistical package (Jöreskog & Sörbom, 1996). This program uses maximum-likelihood estimation to derive the specific parameters based on the correlation matrix between the ten tasks (see Table 3). The Table 3 showed high level of correlation between the ten tasks ($p \leq .01$).

For comparison between models, we evaluated the fit of each model to the data by examining multiple fit indexes (Schemelleh-Engel, Moosbrugger, & Müller, 2003): the χ^2 statistic, the Standardized Root Mean Squared Residual (*SRMR*), Bentler's Comparative Fit Index (*CFI*), Akaike's Information Criterion (*AIC*) and the Expected Cross Validation Index (*ECVI*). The SRMR, as well as χ^2 statistic, assesses "badness of fit," as it is the square root of the averaged squared residuals (i.e., differences between the observed and predicted covariances). A rule to evaluate the obtained value is that the *SRMR* should be less than .05 for a good fit (Hu & Bentler, 1995), whereas values smaller than .10 may be interpreted as acceptable. The *CFI* ranges from zero to one with higher values indicating better fit. For this index, .97 is indicative of good fit relative to the independence model, while values greater than .95 may be interpreted as

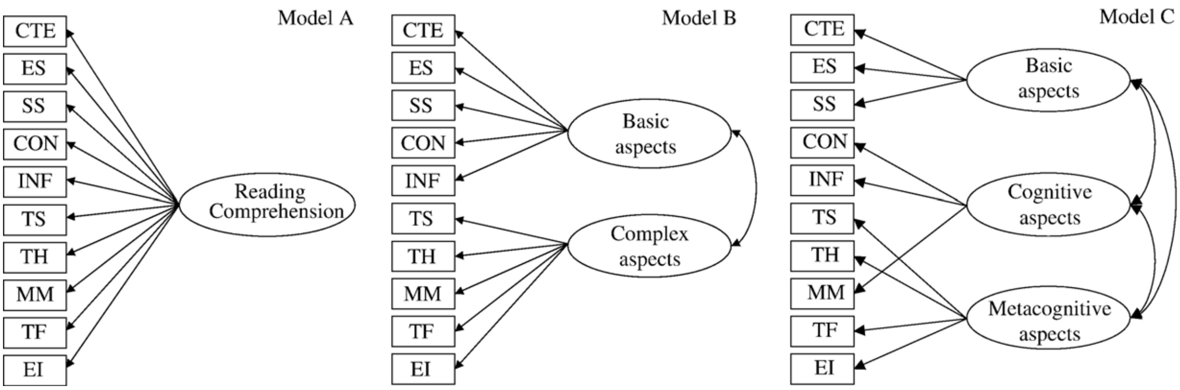

Fig. 1. The three theoretical models. Abbreviations: Characters, Times and Events (CTE), Events and Sequences (ES), Syntactic Structure (SS), Connections between parts of the text (CON), Inferences (INF), Text Sensitivity (TS), Text Hierarchy (TH), Mental Model (MM), Text Flexibility (TF), Errors and Inconsistencies (EI).

Table 3
Correlation between ten tasks

	1	2	3	4	5	6	7	8	9
1. Characters, Times and Events	–								
2. Events and Sequences	.554	–							
3. Syntactic Structure	.583	.571	–						
4. Connections between parts of the text	.539	.451	.585	–					
5. Inferences	.568	.553	.629	.523	–				
6. Text Sensitivity	.475	.524	.554	.454	.553	–			
7. Text Hierarchy	.425	.458	.500	.435	.490	.473	–		
8. Mental Model	.480	.466	.428	.413	.450	.536	.395	–	
9. Text Flexibility	.506	.543	.552	.457	.556	.598	.491	.516	–
10. Errors and Inconsistencies	.571	.595	.546	.459	.598	.505	.474	.557	.535

an acceptable fit. The Akaike's Information Criterion (*AIC*; Akaike, 1987) adjusts χ^2 for the number of estimated parameters and can be used to compare competing models that need not be nested (Schemelleh-Engel et al., 2003). In the case of this index, the model with the minimum *AIC* value is regarded as the best fitting model. Finally, *ECVI* is a measure of the discrepancy between the model-implied covariance matrix in the analyzed sample and the covariance matrix that would be expected in another sample of the same size (Jöreskog & Sörbom, 1993, p. 120). Comparing several models, the smallest *ECVI* estimate indicates the model with the best fit. In Table 4 these indexes are reported.

The values obtained clearly converge towards a two-components model of reading comprehension. Indeed, all the Model B indexes are better than those of both Model A and C. As shown in Table 4 the no significant $\chi^2=31.32$, $p=.59$, the SRMR value of 0.027 was well below the criterion of the 0.05, and the CFI value of 1.00 was above the criterion of .95, whereas the lower AIC and the ECVI indexes for Model B suggest this model to be the better one. To summarize, all the indexes indicated that model B fit the data well. These results confirm the possibility of grouping the reading comprehension ability into two components: one which includes the more basic aspects of comprehension and the other the more elaborate ones. Considering these results we turned to the second objective of this research.

The second step of the study aimed to understand the relationship between reading comprehension and scholastic achievement. To this end we extracted, from the evaluations in Mathematics and Italian, a latent factor that refers to scholastic achievement. The correlation between the scores for each task and the teachers' judgment in the two subjects is reported in Appendix A. For this model we considered just the χ^2 statistic, the standardized root mean squared residual (SRMR) and the Bentler's Comparative Fit Index (CFI).

The latent variable called "scholastic achievement" was inserted in the equation as an endogenous factor (see Fig. 2). The final model obtained a good fit indexes ($\chi^2=67.38$, $df=51$, $p=.061$ SRMR $=.043$ CFI $=.99$). Furthermore, it was evident that the better predictor of scholastic achievement was the factor that loaded on the more complex aspects of reading comprehension.

In addition to these analyses, we ran a regression analysis in an attempt to understand the specific role of certain abilities in predicting scholastic achievement. A regression analysis was run, using a stepwise selection method with the scores obtained in the five tasks loaded in the complex factor as predictors (*Text Sensitivity*, *Hierarchy of text*, *Mental model*, *Text Flexibility, Errors and inconsistencies*) and a combined score from the academic evaluations as the dependent variable. The results showed that the best predictors for scholastic achievement were text sensitivity

Table 4
Fit indexes for the three models depicted in Fig. 1

	χ^2	*df*	*p* value	SRMR	CFI	AIC	ECVI
Model A One factor	40.20	35	0.25	0.031	1.00	80.20	0.44
Model B Two factor	31.32	34	0.59	0.027	1.00	73.32	0.42
Model C Three factor	38.93	32	0.16	0.030	1.00	84.93	0.46

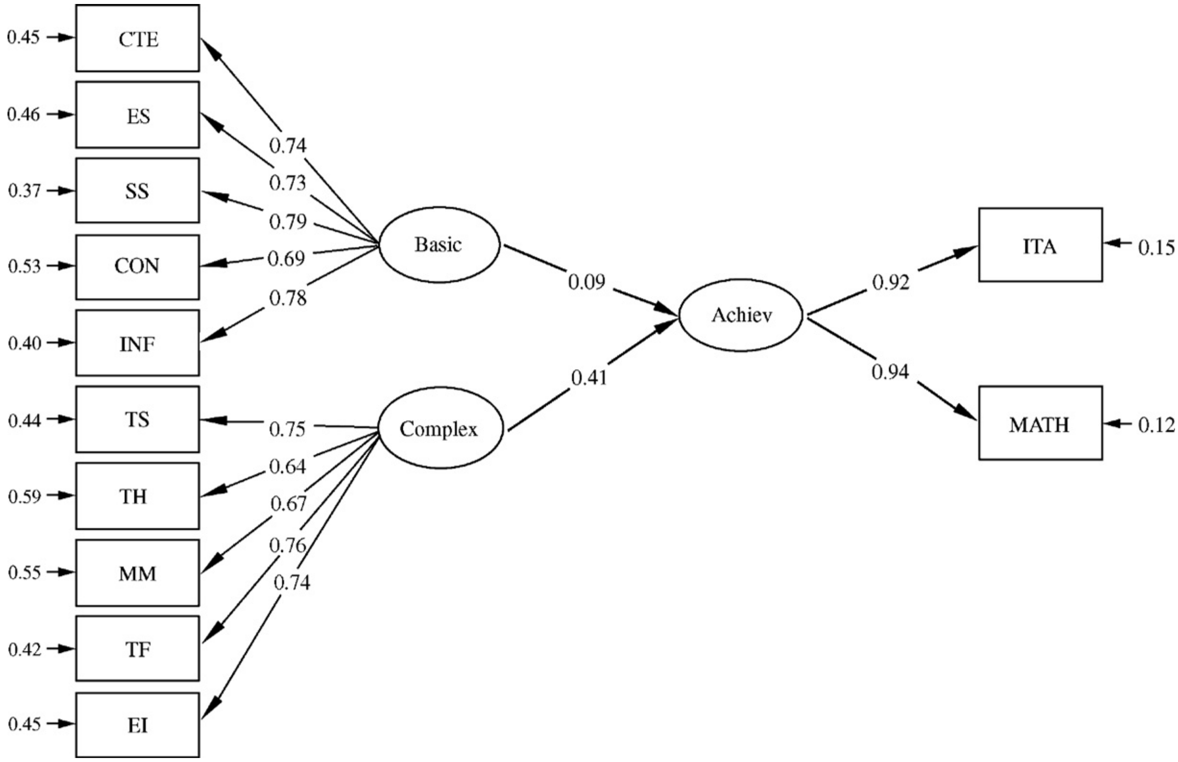

Fig. 2. The figure represents the model that considers the relationship between the two factors of reading comprehension (basic and complex aspects) and scholastic achievement. Abbreviations: Characters, Times and Events (CTE), Events and Sequences (ES), Syntactic Structure (SS), Connections between parts of the text (CON), Inferences (INF), Text Sensitivity (TS), Text Hierarchy (TH), Mental Model (MM), Text Flexibility (TF), Errors and Inconsistencies (EI). Basic aspects of reading comprehension (Basic), Complex aspects of reading comprehension (Complex), Scholastic Achievement (Achiev), Grade in Italian (ITA), Grade in Mathematics (MATH).

which accounted for 18% of variance (R^2=.18, β=0.31 $p<.001$) and text flexibility which accounted for 3% of variance (R^2=.21, β=0.23 $p<.01$).

4. Discussion and conclusion

The current study aimed to carry out a depth analysis of reading comprehension. A battery of tasks, recently devised in Italy (De Beni et al., 2003), allowed us to measure ten different aspects of reading comprehension, thus considering a broader range of abilities compared to studies carried out so far. For example, in some tasks participants were required to identify the main and secondary characters of a text, the temporal and causal structure of a text or the ability to make conjunctions between different parts of the text. Together with these basic aspects, other tasks measured the ability to recognize relevant information within the text and detecting incongruent elements and the success in the construction of the final product of reading comprehension, i.e. a coherent mental model. In addition, some metacognitive components related to reading comprehension are taken into account. For example, the flexibility in strategy use and the ability to foresee text content are estimated.

Using this articulated battery, in the first part of the study we tested whether or not reading comprehension could be considered a unique construct. Three theoretical models were compared with confirmatory factor analysis (CFA). In the first model reading comprehension is conceived of as a unique construct. All the measures obtained from the battery were supposed to load on a single factor. The second model contemplates two latent factors, a first factor that involves aspects requiring a continuous work on and from the text and a second one in which readers mostly rely on self-regulated aspects of cognition. Finally, the third model distinguishes three factors within the ten measures of reading comprehension. In addition to a factor that considers the very basic aspects of reading comprehension, the two additional factors differentiate between metacognitive and cognitive operations on the text.

The results showed that the two-components model better accounted for the data compared to the other models tested. This finding suggests that reading comprehension, as measured by the tasks used, could not be considered as a unique construct. Actually, the distinction into two factors probably relies on the nature of the skills involved in the tasks. The skills loading into the first factor offer to a reader a basic level of the understanding of the text, probably reached even in the first phases of the development of this ability. In these phases the reader is not completely aware of all the characteristics of the reading comprehension tasks. For example, he/she could ignore that a text can contain irrelevant or wrong information, or he/she is less aware of the fact that a text can be differentiated in function of its complexity allowing a modulation of the effort spent in the understanding process. The skills representing the second factor are, thus, the representation of a higher expertise and understanding of the meaning of the reading comprehension processes. This factor, named here “Complex aspects”, refers to refined or more sophisticated aspects of reading comprehension.

The purpose of the second part of the study was to understand the relationship between the reading comprehension model that includes the ‘Basic’ and the ‘Complex’ components and scholastic achievement. In particular, we wanted to analyze the specific role of one latent factor (Basic aspects) with respect to the other (Complex aspects). To this aim, the previous model was used to predict scholastic achievement, measured with evaluations given by the teachers at the end of the academic year.

The results highlighted that scholastic achievement is better predicted by the latent factor referring to the more complex aspects than by that measuring the basic aspects of reading comprehension. It is worth noticing that basic aspects of reading comprehension made a lower level contribution in explaining scholastic performance. The findings of this second part of the study confirm the reflections made when discussing the two-factor model of reading comprehension obtained. The “Complex aspects” factor with its metacognitive mark, give the reader an opportunity of reaching a more refined level of reading comprehension and seems to be more strictly linked to general measure of scholastic achievement.

The results of both models can be interpreted in relation to mental model studies which evidenced that the use of the generative strategy during text comprehension increases the active transformation of knowledge for the construction of an accurate mental model (Lahtinen et al., 1997; Slotte & Lonka, 1998, 1999). In this view, ‘Basic aspects’ should structure the abilities to elaborate the text-base representation, which refers to a level strictly linked with the text structures. In fact, the ability to identify the characters in a story, as well as the succession of facts and events requires comprehension based on the structure of the text. While, the ‘Complex aspects’ structure the abilities of the mental model representation that involve active constructive processing, elaboration, or efforts to understand. The second model (see Fig. 2) highlighted these more elaborate aspects as the ‘key’ components in predicting scholastic performance. These students are aware and able to monitor and use the appropriate comprehension strategies for a specific text; the efficient comprehension skills consent the building up of an accurate situation model of the scenario described and offer the elements to recall and memorize it successfully (Pressley, 2000).

The worst CFA indexes for the three componential model in comparison with the two-componential model does not necessarily signal the absence of a contribution of the metacognitive aspects during the elaboration of the mental model. The potential metacognitive aspects measured with the *Text Sensitivity*, *Text Hierarchy, Text Flexibility*, *Errors and Inconsistencies* tasks are included in the ‘elaborated’ aspects of the second model. These results indicate that the metacognitive aspects are not independent but included in what we called the ‘Complex’ component. These results confirm the importance of metacognition for learning. Although the fact that the aspects investigated in the five tasks, loading in the complex aspect factor, are specific for reading comprehension, they refer to the more general components of metacognitive control.

The regression analysis gives further information about which are the most relevant predictors within the five aspects of scholastic achievement. The fact that text sensitivity and text flexibility are the better predictors of scholastic achievement highlights the fundamental role of metacognition in facilitating learning. It suggests that it is important to incorporate activities on text sensitivity (i.e. title identifications task or text genre identification) in the school reading curricula (van den Broek, Lynch, Naslund, Ievers-Landis, & Verduin, 2003). These skills would be likely candidates for training. In fact, the statistical verification of these models has significant educational applications; allowing for a better planning of the training required to promote reading comprehension. Thus following from the results obtained here, it appears clear that training for better reading comprehension should consider both the ‘Basic’ and ‘Complex’ aspects of this ability, since these aspects result in specific consequences to scholastic performance.

To summarize, the first part of the study highlighted the possibility of distinguishing different components within the reading comprehension construct. In addition, the results of the second part of the study highlighted the importance of a second level analysis of the reading comprehension ability, above all when the goal of its evaluation is the planning of training activities, confirming the importance of metacognition for successful learning.

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Appendix A

Correlations between the scores obtained in the ten tasks and the two measures of scholastic achievement

	Italian	Mathematics
1. Characters, Times and Events	.328	.360
2. Events and Sequences	.282	.299
3. Syntactic Structure	.331	.375
4. Connections between parts of the text	.415	.428
5. Inferences	.255	.283
6. Text Sensitivity	.422	.427
7. Text Hierarchy	.297	.304
8. Mental Model	.333	.307
9. Text Flexibility	.414	.374
10. Errors and Inconsistencies	.203	.204

$N = 184$.

References

Akaike, H. (1987). Factor analysis and AIC. *Psychometrika*, *52*, 317−332.

August, D. L., Flavell, J. H., & Clift, R. (1984). Comparison of comprehension monitoring of skilled and less skilled readers. *Reading Research Quarterly*, *20*, 39−53.

Baker, L., & Brown, A. L. (1984). Metacognition skills of reading. In D. Pearson, R. Barr, M. Kamil, & P. Monsenthal (Eds.), *Handbook of reading research.* New York: Longman.

Brown, A. L., Armbruster, B. B., & Baker, L. (1986). The role of metacognition in reading and studying. In J. Orasanu (Ed.), *Reading comprehension: From research to practice.* Hillsdale, NJ: Erlbaum.

Cain, K., & Oakhill, J. (1996). The nature of the relation between comprehension skill and the ability to tell a story. *British Journal of Developmental Psychology*, *14*, 187−201.

Cain, K., & Oakhill, J. V. (1999). Inference making and its relation to comprehension failure. *Reading and Writing*, *11*, 489−503.

Cain, K., Oakhill, J. V., Barnes, M. A., & Bryant, P. E. (2001). Comprehension skill, inference making ability and their relation to knowledge. *Memory & Cognition*, *29*, 850−859.

Carretti, B., Meneghetti, C., & De Beni, R. (2005). Evoluzione delle abilità di comprensione in studenti dalla 3[a] elementare alla 1[a] media [The evolution of reading comprehension abilities in students from third to sixth grade]. *Età Evolutiva*, *80*, 5−16.

Carroll, J. B. (1993). *Human cognitive abilities: A survey of factor-analytic studies.* New York: Cambridge University Press.

Cornoldi, C., De Beni, R., & Pazzaglia, F. (1996). Reading comprehension profiles. In C. Cornoldi & J. Oakhill (Eds.), *Reading comprehension difficulties: Processes and intervention.* Mahwah, NJ: Erlbaum.

Daneman, M., & Carpenter, P. A. (1980). Individual differences in working memory and reading. *Journal of Verbal Learning and Verbal Behavior*, *19*(4), 450−466.

De Beni, R., Cornoldi, C., Carretti, B., & Meneghetti, C. (2003). *Nuova guida alla comprensione del testo: Volume 1 [A new guide to reading comprehension].* Trento: Edizioni Erickson.

Ehrlich, M. F., & Remond, M. (1997). Skilled and less skilled comprehenders: French children's processing of anaphoric devices in written texts. *British Journal of Developmental Psychology*, *15*, 291−309.

Garner, R. (1981). Monitoring of passage inconsistency among poor comprehenders: A preliminary test of the "piecemeal processing" explanation. *Journal of Educational Research*, *74*, 159−162.

Garner, R., & Reis, R. (1981). Monitoring and resolving comprehension obstacles: An investigation of spontaneous text lookbacks among upper-grade good and poor comprehenders. *Reading Research Quarterly*, *16*, 569−582.

Gernsbacher, M. A., & Faust, M. E. (1991). The mechanism of suppression: A component of general comprehension skill. *Journal of Experimental Psychology. Learning, Memory, and Cognition*, *17*, 245−262.

Gernsbacher, M. A., Varner, K. R., & Faust, M. E. (1990). Investigating differences in general comprehension skill. *Journal of Experimental Psychology. Learning, Memory, and Cognition*, *16*, 430−445.

Graesser, A. C., Wiemer Hastings, P., & Wiemer Hastings, K. (2001). Constructing inferences and relations during text comprehension. In T. Sanders & J. Schilperoord (Eds.), *Text representation: Linguistic and psycholinguistic aspects*, *Vol. 8* (pp. 249−271).Amsterdam, Netherlands: John Benjamins Publishing Company.

Hannon, B., & Daneman, M. (2001). A new tool for measuring and understanding individual differences in the component processes of reading comprehension. *Journal of Educational Psychology*, *93*, 103−128.

Hu, L., & Bentler, P. (1995). Evaluating model fit. In R. H. Hoyle (Ed.), *Structural equation modeling. Concepts, issues, and applications* (pp. 76−99). London: Sage.

Jöreskog, K. G., & Sörbom, D. (1993). *Structural equation modeling with the SIMPLIS command language.* Chicago: Scientific Software.

Jöreskog, K. G., & Sörbom, D. (1996). *LISREL 8 user's reference guide.* Chicago: Scientific Software.

Lahtinen, V., Lonka, K., & Lindblom-Ylanne, S. (1997). Spontaneous study strategy and the quality of knowledge construction. *British Journal of Educational Psychology*, *67*, 13−24.

Lonka, K., Lindblom-Ylanne, S., & Maury, S. (1994). The effect of study strategy on learning from text. *Learning and Instruction*, *4*, 243−271.

Lorch Jr., K. G., Lorch, E. P., & Morgan, A. M. (1987). Task effects and individual differences in on-line processing of the topic structure of a text. *Discourse Processes*, *10*, 63−80.

Lorch, R. F., & van den Broek, P. (1997). Understanding reading comprehension: Current and future contribution of cognitive science. *Contemporary Educational Psychology*, *22*, 213−246.

McNamara, D. S., Kintsch, E., Songer, N. B., & Kintsch, W. (1996). Are the good text always better? Interaction of text coherence, background knowledge, and level of understanding in learning from text. *Cognition and Instruction*, *14*, 1−43.

Nation, K., & Snowling, M. J. (1998). Individual differences in contextual facilitation: Evidence from dyslexia and poor reading comprehension. *Child Development*, *69*, 996−1011.

Nation, K., & Snowling, M. J. (1999). Developmental differences in sensitivity to semantic relations among good and poor comprehenders: Evidence from semantic priming. *Cognition*, *70*, 1−13.

Oakhill, J., Cain, K., & Bryant, P. E. (2003). The dissociation of word reading and text comprehension: Evidence from component skills. *Language and Cognitive Processes*, *18*, 443−468.

Oakhill, J. V., Cain, K., & Yuill, N. M. (1998). Individual differences in children's comprehension skill: Towards an integrated model. In C. Hulme & R.M. Joshi (Eds.), *Reading and spelling: Development and disorder* (pp. 343−367). Mahwah, NJ: Lawrence Erlbaum Associates Inc.

Palincsar, A. S., & Brown, A. L. (1984). Reciprocal teaching of comprehension-fostering and comprehension-monitoring activities. *Cognition and Instruction*, *1*, 117−175.

Pazzaglia, F., De Beni, R., & Cacciò, L. (1999). The role of working memory and metacognition in reading comprehension difficulties. *Advances in Learning and Behavioral Disabilities*, *13*, 115−134.

Perrig, W., & Kintsch, W. (1985). Propositional and situational representations of text. *Journal of Memory and Language*, *24*, 503−518.

Pressley, M. (2000). Development of grounded theories of complex cognitive processing: Exhaustive within and between study analyses of thinking-aloud data. In G. Schraaw & J.C. Impara (Eds.), *Issues in the measurement of metacognition* (pp. 262−296). Lincoln, NE: Buros Institute of Mental Measurement.

Rego, L. L. B., & Brjant, P. E. (1993). The connection between phonological, syntactic and semantic skills and children's reading and spelling. *European Journal of Psychology of Education*, *8*, 235−246.

Royer, J. M., Abranovic, W. A., & Sinatra, G. M. (1987). Using entering reading comprehension performance as a predictor of performance in college classes. *Journal of Educational Psychology*, *79*, 19−26.

Schemelleh-Engel, K., Moosbrugger, H., & Müller, H. (2003). Evaluating the fit of structural equation models: Tests of significance and descriptive goodness-of-fit measures. *Methods of Psychological Research Online*, *8*, 23−74.

Slotte, V., & Lonka, K. (1998). Using note during essay-writing: Is it always helpful? *Educational Psychology*, *18*, 445−459.

Slotte, V., & Lonka, K. (1999). Review and process effect of spontaneous notemaking on text comprehension. *Contemporary Educational Psychology*, *24*, 1−20.

Stothard, S. E., & Hulme, C. (1992). Reading comprehension difficulties in children: The role of language comprehension and working memory skills. *Reading and Writing*, *4*, 245−256.

Taraban, R., Rynearson, K., & Kerr, M. (2000). College students' academic performance and self-reports of comprehension strategy use. *Reading Psychology*, *21*, 283−308.

Thurstone, T. G., & Thurstone, L. L. (1963). *Primary mental ability.* Chicago: Science Research Associates.

van den Broek, P. (1994). Comprehension and memory for narrative texts: Inferences and coherence. In M. A. Gernsbacher (Ed.), *Handbook of psycholinguistics* (pp. 539−588). San Diego, CA: Academic Press.

van den Broek, P., Lynch, J. S., Naslund, J., Ievers-Landis, C. E., & Verduin, K. (2003). The development of comprehension of main ideas in narratives: Evidence from the selection of titles. *Journal of Educational Psychology*, *95*, 707−718.

van Dijk, T. A., & Kintsch, W. (1983). *Strategies of discourse comprehension.* New York: Academic Press.

Yuill, N. M., & Oakhill, J. V. (1991). *Children's problems in text comprehension: An experimental investigation.* Cambridge: Cambridge University Press.

Zwaan, R. A., & Radvansky, G. A. (1998). Situation models in language comprehension and memory. *Psychological Bulletin*, *123*, 162−185.