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Comparison of the effectiveness of comprehension and meta-comprehension intervention programs in poor comprehenders

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Abstract

Both comprehension training (CT) and metacomprehension training (MCT) have been shown to be effective in improving reading comprehension in poor comprehenders, but there has been no comparative analysis of their efficacy. This study compared CT and MCT with the objective of verifying their effectiveness in improving comprehension skills and determining which program produces the better results. Thirty elementary school students (average age = 9.35 years) and 30 middle school students (average age = 12.63 years) with deficits in reading comprehension and metacomprehension skills were assigned to three experimental conditions: CT, MCT and a control condition (C). Both training programs improved comprehension relative to the control group in both age groups, but MCT was more effective than CT. Training both cognitive skills and metacognitive skills

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underlying reading comprehension is the most effective way of improving reading in readers with poor comprehension.

Keywords: Comprehension training; Metacomprehension training; Metacognitive awareness; Poor comprehenders; Educational implications.

1. Introduction

Surveying research in academic difficulties reveals that research focused on difficulties arising primarily from a deficit in reading or writing while less attention has been given to reading comprehension. Some teachers assume that students' reading comprehension skills will develop naturally, without the need for explicit instruction (Denton & Fletcher, 2003). Their primary concern is therefore to ensure that the child is capable of reading well, and that reading performance is in line with age norms and educational level; ability to access the meaning of a text assumes secondary importance, almost as if there were a desire to eliminate a possible pedagogical complication that may be tackled later on, when the child has fully automated the process of learning. Many teachers assume that students who can read words accurately are also capable of understanding what they read and learning from a text simply through reading, so they rarely teach students strategies for reading in a way that will maximize understanding of content (Edmonds, Vaughn, Wexler, Reutebuch, Cable, Klingler *et al.*, 2009). We argue that reading instruction is not complete even when students are able to decode words efficiently. Students may need additional instruction in techniques which will help them understand what they read (Boulware-Gooden, Carreker, Thornhill, & Joshi, 2007). To equate effective reading with accurate decoding of written text is to risk unwittingly in transmitting a distorted view of reading, in which decoding takes precedence over searching for meaning. Many training programs developed for students with reading difficulties who require additional help seem to be based on the assumption that improving decoding will automatically lead to improvements in comprehension.

However, reading comprehension depends on several cognitive processes, including the ability to represent the content of a text due through use of working memory and attentive processes (van den Broek, Kendeou, Kremer, Lynch, Butler, White *et al.*, 2005).

1.1. Reading comprehension and processes involved

The Simple View of Reading model argues that reading comprehension ability can be predicted by two components both considered necessary for success in reading: decoding and linguistic comprehension (Gough & Tunmer, 1986). However, other studies claim that comprehension requires the ability to gather the most important information from a text while

ignoring or discarding irrelevant intrusions (Perfetti & Hogaboam, 1975), including activating inferential processes in order to compensate for parts of the text which are not related or not actually present (Cain & Oakhill, 2006; van den Broek, 1994), comprehending the structure of a text and its logical, and temporal, connections (Meneghetti, De Beni, & Cornoldi, 2007) and activating control processes and metacognitive knowledge (De Beni & Pazzaglia, 1990).

The aim of the present research was to evaluate the effect of different remedial interventions on the comprehension defects. It seems likely that children with similar comprehension problems differ in terms of metacognitive skills, i.e. their explicit knowledge of mental functioning and self-monitoring (Brown, Brandsford, Ferrara, & Campione, 1983; Cornoldi, 1995; Flavell, 1981; Kuhn, 2000). In fact, metacognition implies monitoring, interpretation, evaluation and regulation of their cognitive processes (Quattropani, Lenzo, Mucciardi, & Toffle, 2015). Much research has investigated the relationship between comprehension and metacognitive skills (Boulware-Gooden *et al.*, 2007; De Beni & Pazzaglia, 1990; Dunlosky & Lipko, 2007; Lonciari, Melon, Torchetti, Bravar, & Carozzi, 2008; McKeown, Beck, & Blake, 2009; Michalsky, Mevarech, & Haibi, 2009; Pazzaglia & Rizzato, 2001; Pedron, Micheletto, Tressoldi, & Lucangeli, 2009; Rosiglioni & Dal Santo, 2010) and numerous studies have attempted to characterize the typical "poor comprehender" and obtain insights into how comprehension problems might be tackled (Cain & Oakhill, 2006; Carretti, Cornoldi, & De Beni, 2002, 2007; Catts, Adlof, & Weismer, 2006; Nation, Clarke, Marshall, & Durand, 2004; Padovani, 2006).

1.2. Poor comprehenders

Poor comprehenders are children with specific reading comprehension difficulties: they are able to read accurately, but have poor understanding of what they read (Clarke, Snowling, Truelove, & Hulme, 2010; Duff & Clarke, 2011). Notably, comprehension difficulties may express at different levels of processing: they may be limited to the level of individual words or the connections between sentences, or extend to paragraph level (Kurlowicz & Tuffanelli, 2007; Padovani, 2006; Tressoldi & Zamperlin, 2007; Tuffanelli, 2009).

Poor comprehenders, unlike poor decoders, do not have problems with phonological processing (Catts *et al.*, 2006; Nation, Cocksey, Taylor, & Bishop, 2010). Clarke and colleagues (2010) demonstrated that decoding

ability is only important to comprehension in the early stages of learning to read; as children grow older decoding becomes automatic and oral comprehension becomes the most important predictor of ability to comprehend text. However, Keenan, Betjemann and Olson (2008) have argued that decoding is fundamental to comprehension, and since it is easier to define decoding failures rather than comprehension failures, decoding problems are easier to deal with than comprehension deficits. Unlike decoding ability, which can be easily and accurately valued in the school environment, difficulties with comprehension may often remain hidden. Nation and Angell (2006) noted that teachers often fail to spot comprehension difficulties.

Edmonds and colleagues (2009, p. 274), noted that "*there may be a diminishing relationship between accuracy (e.g., word recognition and fluent reading) and comprehension. Word-level interventions are associated with small to moderate effects on comprehension*". In fact, research has shown that improvements in reading rate and accuracy are not always associated with improved comprehension (Allinder, Dunse, Brunken, & Obermiller-Krolikowski, 2001; Kuhn & Stahl, 2003). This indicates that although the two skills are related (correct decoding plays a part in comprehension, and likewise good comprehension accelerates decoding) they involve different cognitive processes (Keenan *et al.*, 2008; Kendeou, van den Broek, White, & Lynch, 2009; Nation & Angell, 2006).

Interesting evidence on this issue was provided by longitudinal research on readers with poor comprehension skills, which found no clear deficits in phonological awareness tasks, thus confirming that problems with comprehension are not primarily due to a decoding impairment. Instead deficits were found on non-phonological linguistic tasks such as semantic inference, syntactic processing and oral comprehension (van den Broek *et al.*, 2005).

1.3. Cognitive training vs. meta-cognitive training

In literature there are two lines of research that investigated separately and sectorally the role of cognitive or metacognitive processes involved in comprehension of text. Cognitive training (CT) aims to enhance the cognitive components involved in reading comprehension (ability to process the structure and characteristics of the text; ability to recognize critical information; ability to recognize inferences; activation of relevant knowledge; ability to order events logically etc.) (De Beni & Pazzaglia,

1990). The Meta-cognitive training (MCT) promotes metacognitive knowledge of reading objectives, the existence of different reading strategies and the need to use these strategies flexibly according to the difficulty of the text and the reading objective, trying to individualize errors and over-all incongruence present in the text and to verify the acquisition of content or the necessity to proceed to new reading of the same material (Whitebread, 2011). Most research on reading programs (Boulware-Gooden *et al.*, 2007; McKeown *et al.*, 2009; Michalsky *et al.*, 2009; Spörer, Brunstein, & Kieschke, 2009) has focused on these two components of metacognition and on developing effective, flexible study strategies in which these approaches can be used independently by readers.

Most research concerning primary school children has been directed at the cognitive skills underlying text comprehension (processing information about characters, places, times, events, logical sequences, chronological factors etc.) but other studies have found the importance of the metacognitive processes' role (Florit, Levorato, & Roch, 2008). In fact, Schisler, Joseph, Konrad, and Alber-Morgan (2010) highlighted the importance of metacognitive skills in understanding text. This study compared the effects of oral retelling, written retelling and passage review strategies on third grade students' accuracy and speed on a reading comprehension task. It was found that oral retelling coupled with repeated readings and phrase drill error correction was the most effective method of promoting accurate comprehension.

Since both types of training make improvements in text comprehension skills, it remains to be investigated which of the two is the one that produces the best results. It is also important to verify whether the effectiveness of strategies is independent from factors such as age and/or the type of deficit highlighted by the reader. As regards the age factor, it was found that the difficulties related to text comprehension occur in older children relate to levels of a more complex linguistic elaboration which concern inferential reasoning, monitoring of comprehension, use of context and knowledge and use of the narrative structure of a text. Consequently, most research on text comprehension in children up to the age of ten takes into account cognitive processes, whereas research on text comprehension in older children concentrates on metacognitive competence (McCallum, Krohn, Skinner, Hilton-Prillhart, Hopkins, Waller *et al.*, 2011). Previous research on comprehension in older children includes an intervention study which examined the effectiveness of two programs designed to improve the reading comprehension of at-risk high school students. Participants in this

study were divided into three groups: two experimental conditions and one control. The results showed that the metacognitive training program produced significant improvements in understanding of text (Padovani, 2006; Filippello, Spadaro, Sorrenti, Mafodda, & Drammis, 2016). Regarding the deficit exhibited by children, research has shown that poor comprehenders benefit most from reading interventions which target comprehension – for example, instruction focused directly on comprehension strategies, such as modeling and thinking aloud about how to self-question and how to reflect during and after reading - as well as from becoming actively involved in monitoring their understanding and in processing text meaning (Edmonds *et al.*, 2009; Bråten & Anmarkrud, 2013). Poor comprehenders lack the vocabulary and metacognitive skills needed to monitor their understanding and reflect on what they have read (Boulware-Gooden *et al.*, 2007). Direct teaching of multiple reading strategies is an effective method of enhancing reading comprehension (Spörer *et al.*, 2009).

Therefore, since it is difficult to find research in literature that compares the two types of intervention, the aim of this study was to investigate whether metacognitive training, targeted to develop cognitive and process control skills, it can produce a greater effect even in children under age and in poor comprehenders than what comprehension training can accomplish.

1.4. The present study

Here, we aim to assess the effectiveness of two kinds of reading comprehension training program in two groups of children with comprehension deficits (9-11 year-olds and 12-13 year-olds). The choice of age groups was dictated by the desire to compare children with different levels of education; it was not practical to include children under the age of 9 as the research objectives included assessment of metacognition which is only beginning to emerge in children of this age (Pazzaglia, De Beni, & Cristante, 1994). Even children aged 9-11 years old are usually excluded from this type of research.

The second aim of the research was to investigate the relative effectiveness of two different intervention programs in producing improvements in the deficiencies assessed (Rosiglioni & Dal Santo, 2010). More specifically, we wanted to investigate whether a MCT program targeting cognitive and monitoring skills, would produce a greater improvement in reading comprehension of poor comprehenders than CT.

If comprehension deficits are primarily due to impairments in specific semantic processes (recognizing the main characters, identifying the important information, grasping the logical temporal or spatial structure of events etc.), then CT should produce significant improvements in the sphere of reading comprehension. By contrast, if deficits are determined by the metacognitive processes underlying comprehension, then MCT – including stimulation of reflection, development of mindfulness and metacognitive skills and on the use of thoughtful strategies and control mechanisms should lead to improvements in metacognitive skills and hence to a positive effect on reading comprehension.

2. Methods

2.1. Participants

We tested 451 potential participants aged between 9-11 years and 476 potential participants aged 12-13 years in order to select children who met the DSM-5 criteria (American Psychiatric Association, 2014) for normal intelligence and adequate decoding skills but had deficits in comprehension and metacomprehension ability. All participants were individually assessed using the tests described below.

The use of multiple eligibility criteria greatly reduced the number of participants. The majority of potential participants met the main eligibility criteria (IQ in the normal range; metacognitive deficit) but also demonstrated decoding deficits as well as comprehension deficits and thus had to be excluded. All students selected to participate had normative scores of reading accuracy (9-11 years = range 3-10 errors: sufficient performance based on the criterion indicated by the Test; 12-13 years = range 3-6 errors: sufficient performance based on the criterion indicated by the Test) and reading speed (9-11 years = range 31-60 time in seconds: sufficient performance based on the criterion indicated by the Test; 12-13 years = range 20-24 time in seconds: sufficient performance based on the criterion indicated by the Test), but scores of comprehension and meta-comprehension ability were at least two standard deviations below their respective age means.

The sample consisted of two groups of 30 poor comprehenders, all of an average socio-cultural level. Participants were drawn from three different schools; there was an equal number of boys and girls in each age group. The average age for the younger group was 9.35 years (*SD* = .52; range: 9-11

years old) while it was 12.63 years the older group (*SD* = .49; range: 12-13 years old).

Participants in the two groups were randomly assigned to one of three experimental conditions, 10 children in CT, 10 children in MCT or 10 children in control (C) conditions. Participants in the CT and MCT conditions received specific training in comprehension or metacomprehension skills, while participants in the C condition followed the standard Italian language curriculum.

The homogeneity of participants in the various experimental conditions in terms of reading skills, reading comprehension and understanding of goals was evaluated using simple *t*-test comparisons. Table 1 summarizes the descriptive statistics for key study variables measured 9-11 and 12-13 years old students at the pre training phase.

Table 1 - *Descriptive statistics for key study variables measured 9-11 and 12-13 years old students at the pre training phase*

			Reading accuracy	Reading speed	Comprehension	Meta-comprehension
		N	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*
9-11	CT	10	3.7 *(1.82)*	45.62 *(2.19)*	.95 *(.10)*	.78 *(.08)*
	MCT	10	4.4 *(1.43)*	45.33 *(2.28)*	.92 *(.08)*	.81 *(.06)*
	C	10	3.9 *(1.66)*	45.61 *(.69)*	.94 *(.07)*	.80 *(.08)*
12-13	CT	10	4.7 *(.82)*	23.14 *(1.06)*	.76 *(.08)*	.87 *(.19)*
	MCT	10	3.3 *(2.1)*	22.13 *(2.03)*	.80 *(.08)*	.99 *(.13)*
	C	10	4.2 *(1.87)*	21.88 *(2.11)*	.79 *(.12)*	.98 *(.16)*

Table 2 shows that there were no significant differences between participants in the three experimental conditions on the tests administered during the pre-training (selection) phase.

Table 2 - *Single comparison between groups (comprehension, meta-comprehension trainings and control condition) of students with 9-11 and 12-13 years old during pre-training phase*

		Reading accuracy		Reading speed		Comprehension		Meta-comprehension	
		t	*p*	*t*	*p*	*t*	*p*	*t*	*p*
9-11	CT *vs.* MCT	-.95	.35	.29	.78	.78	.45	-.84	.41
	CT *vs.* C	-.26	.80	.02	.99	.23	.82	-.55	.59
	MCT *vs.* C	.72	.48	-.37	.72	.66	.52	-.25	.81
12-13	CT *vs.* MCT	1.99	.06	1.39	.18	-1.04	.31	-1.6	.13
	CT *vs.* C	.77	.45	1.69	.11	-.63	.54	1.33	.19
	MCT *vs.* C	-1.02	.32	.28	.78	.21	.83	.18	.86

Note: CT = Comprehension Training, MCT = Metacomprehension Training; C = Control condition.

2.2. Measures and Procedure

General intellectual functioning was assessed using Raven's matrices (Raven, 1947). All the students had adequate general intellectual functioning (IQ score between 90 and 105; $M = 96.83$; $SD = 5.67$).

Decoding skills were assessed using the MT Reading Test for elementary schools and junior schools (Cornoldi & Colpo, 1995, 1998). This test requires the child to read a text passage. Reading speed and accuracy scores are obtained.

Reading comprehension was assessed using the MT Comprehension Test for primary schools and middle schools (Cornoldi & Colpo, 1995, 1998). The test requires the student to read a passage and then answer a series of multiple-choice questions (10 for primary and 10 for middle schools). Responses are used to establish the student's comprehension level. This test allows students to be assigned to one of five performance categories: standard achieved, good level, sufficient, insufficient or seriously insufficient. Only students who obtained a score at least 2 SD below the mean for their respective age were included in this research.

Metacognitive competence was assessed using the Metacomprehension Test (Pazzaglia *et al.*, 1994) a widely-used tool for the detailed testing of both metacognitive knowledge and monitoring ability. The instrument consists of 32 items with multiple choice response between two, three or four alternatives, which include: metacognitive knowledge about the reading goals, the strategies and the characteristics of the text; the ability to identify and correct errors and anomalies, add or delete the punctuation marks, order the information according to their degree of importance, etc. As with the comprehension test, this metacognition test allows students to be assigned to one of five performance categories: standard achieved, good level, sufficient, insufficient or seriously insufficient. Participants included in the sample had "seriously insufficient" and "insufficient" metacognitive skills.

The same tests used for the assessment of Decoding skills, Reading comprehension, and Metacognitive competence were administered to participants in post-training phase.

2.3. Training

The training developed by De Beni Cornoldi, Carretti, and Meneghetti (2003) for students of 9-11 years and 12-13 years-old was used in both intervention conditions. However, the main interest in this study was in

metacognitive factors related to the understanding of text and the use of a multi-component approach to skill training, even in children as young as 9 to 11 years, a period in which metacomprehension has been little studied.

Because we wanted to compare the two training programs (CT; MCT) in both age groups (9-11 years; 12-13 years old) we kept the overall number of activities in each training domain similar, so that differences between programs could not be attributed to differences in scheduling.

Ten fundamental skills which support comprehension were identified; these were organized into three categories (content, elaboration and metacognition). The first two categories were the subject of the CT program, whilst the third was the main focus of the MCT program. The 10 fundamental skills included in the training programs for both age groups are described in table 3.

Table 3 - *Description of thematic areas of intervention for comprehension (CT) and metacomprehension (MT) trainings proposed for students of 9-11 and 12-13 years old*

		CT	MT
9-11 years old	1	People, places, periods (epoch and duration of episode).	Identify literary genres.
	2	Facts, characteristics of people, places, periods and facts in different kinds of text.	Search for a title appropriate to the text.
	3	Distinguish different kinds of facts, order chronological sequences, order logical sequences and insert missing facts.	Judge the difficulty of a text.
	4	Punctuation, articles, negotiation and hypothetical sentences.	Identify difficult sections of the text.
	5	Pronouns, focus of sentence (active/passive), indirect speech.	Distinguish between easy and difficult texts.
	6	Put information from the text or image into relation, connect information with similar meaning and make connections between ideas.	Work on the text from different perspectives and on different aspects.
	7	Lexical inferences, semantic inferences and bridge inferences.	Choose strategies suitable to purpose and type of text.
	8	Pick out important elements, excluding details and identify repeated elements/ideas.	Find errors and inconsistencies.
	9	Find the essential meaning, identify the central idea and order elements hierarchically.	Find ambiguities of meaning.
	10	Create simple mental models, create interpersonal mental models, modify the mental model of a text, understand meaning of word given the context of text.	Use of punctuation.

12-13 years old	1	People, places, periods (epoch and duration of episode).	Orient oneself in choice of texts.
	2	Facts and different textual genres.	Identify the main characteristics of different text genres.
	3	Identify the typology of facts, order chronological and logical sequences and infer missing facts.	Identify important information in texts of different genres.
	4	Punctuation, negotiation, hypothetical phrases and indirect speech.	Use the title.
	5	Pronouns, conjugations, adverbs, propositions, ambiguity, textual cohesion and putting information from the text or image in relation.	Judge the difficulty of a text.
	6	Connect information with similar meaning and make connections between ideas.	Work on a text on different levels.
	7	Lexical inferences, semantic inferences and bridge inferences.	Choose strategies suitable for the reading purpose and type of text.
	8	Title and pick out important elements.	Apply strategies selected as best ones.
	9	Find basic meaning, group the information and select elements of text.	Find errors, inconsistencies and ambiguities of meaning.
	10	Activate spatial mental models, activate interpersonal mental models, update mental model and inferential processes.	Use of punctuation.

The structure of training sessions was similar in the CT and MCT programs. During the first segment material from the preceding session was briefly reviewed; this was followed by a second, clearly defined segment dedicated to a new activity. Activity cards described in table 2 were made available to participants, so each student could study the new material and use the new work methods flexibly, according to the activity and the type of work required. This had the advantage of ensuring that students were directly involved in their own learning an made use of self-correction, which proved a highly effective method of making the students aware of their own mistakes and conscious of their own ability to correct themselves and thus learn from mistakes. Each training session concluded with the students writing brief answers, based on their personal experience, to two simple questions: “What did I learn today?” and “What difficulties did I encounter?” These questions prompted students to reflect on the activities of the session and demonstrate their awareness of the problems they had encountered.

Training took place during school hours under the direction of an education psychologist and the poor comprehenders were divided into age groups for training. Because the participants in the MCT and CT conditions were following a difference schedule the training sessions did not take place

in their normal classrooms. Every training activity was supported by an activity card and all the children were provided with one card at a time. The psychologist described the activity and asked the children to complete the task. The group only moved onto the next activity when all of the children had completed the exercise. Students in both intervention conditions followed similar schedule, with 2 two-hour training sessions per week for five weeks.

Students in the C condition followed the normal school curriculum for the Italian language, which is based on theories and methods that do not provide specific training for poor comprehenders.

3. Data Analysis

As the data were expressed as frequencies they were arcsine-transformed according to the formula provided by Freeman and Tukey (1950). Separate multivariate analyses of variance were conducted for the two age groups. *t*-tests were used to verify group differences in planned comparisons between pre- and post-training assessments and between different therapies across different groups. The Statistical Package for the Social Sciences (SPSS 17) was used to analyze the data.

4. Results

Table 4 shows planned comparisons pre and post-training means and standard deviations for the three experimental conditions, with respect to measures of comprehension and metacomprehension.

Table 4 - *Descriptive statistics for key study variables measured 9-11 and 12-13 years old students at the planned comparisons pre and post training phases*

			Comprehension	Meta-comprehension
		N	*M (SD)*	*M (SD)*
9-11	CT	10	.14 (.10)	.07 (.02)
	MCT	10	.54 (.17)	.19 (.06)
	C	10	.04 (.09)	.00 (.01)
12-13	CT	10	.10 (.07)	.21 (.06)
	MCT	10	.21 (.15)	.19 (.06)
	C	10	-.00 (.13)	.04 (.11)

4.1. Reading Comprehension

In both age groups there was a significant difference between pre- and post-training comprehension scores among the three groups (MCT, CT, C) [9-11 years old: $F(4,52) = 16.10$; $p < .001$; $np2 = .55$; 12-13 years old: $F(4,52) = 6.92$; $p < .001$; $np2 = .35$] . These results confirmed that the differences between pre- and post-training assessments were not due to variance in the individual characteristics of participants but rather to the training programs.

The comparisons of difference between the scores of the post and pre training showed that

younger children who had taken part in the CT [$t(9) = 2.24$; $p < .05$] or MCT programs [$t(9) = 7.97$; $p < .001$] had better comprehension scores compared to C. Students who had taken part in the MCT had better comprehension scores compared CT [$t(9) = -6.18$; $p < .001$].

The pattern of results was similar in the older children. Students who had taken part in the CT [$t(9) = 2.15$; $p < .05$] or MCT programs [$t(9) = 3.32$; $p < .01$] had better comprehension scores compared to C. Students who had taken part in the MCT had better comprehension scores compared CT [$t(9) = -2.04$; $p < .05$].

4.2. Metacomprehension

Also for the measure of metacomprehension there was a significant difference between pre- and post-training scores among the three groups for the 9-11 [$F(4,52) = 13.48$; $p < .001$; $np^2 = .51$] as well as the 12-13 age group [$F(4,52) = 2.55$; $p < .001$; $np^2 = 16$].

Comparing the differences between the scores of post and pre-training, it was found that younger children who had taken part in the CT [$t(9) = 8.01$; $p < .001$] or MCT programs [$t(9) = 8.76$; $p < .001$] had better comprehension scores compared to C. Students who had taken part in the MCT had better comprehension scores compared CT [$t(9) = -5.39$; $p < .001$].

As regard older children, students who had taken part in the CT [$t(9) = 4.16$; $p < .001$] or MCT programs [$t(9) = 3.74$; $p < .001$] had better comprehension scores compared to C. Students who had taken part in the MCT had no better comprehension scores compared CT [$t(9) = .68$; $p > .05$].

5. Discussion and conclusion

The main aim of this research was to assess the impact of two reading comprehension training programs in children aged 9 11 years and 12-13 years with comprehension and metacomprehension deficits. All participants who followed one of the two training programs showed an improvement in reading comprehension and metacomprehension skills after the training. In both age groups participant assigned to the CT or MCT condition had better reading comprehension skills at the post-training assessment than participants assigned to the C condition. This result confirms effectiveness of two training (CT and MCT) demonstrated by previous studies (De Beni & Pazzaglia, 1990; Florit *et al.*, 2008).

At the pre-training assessment there were no differences between the experimental conditions in terms of comprehension and metacomprehension processes. At the post-training assessment participants of all ages in both intervention conditions performed better on the tests of comprehension and cognitive and monitoring skills than participants in the C condition. These results indicate that in the absence of specific training in skills related to reading comprehension – as in the C condition – reading comprehension ability does not improve significantly over 10 weeks in children in this age range.

The second aim of this study was to investigate whether MCT, which targets cognitive and monitoring skills, had a greater beneficial effect on reading comprehension in poor comprehenders than CT. This is an innovative aspect of this study because in literature it has been neglected in comparison between these two types of training. The results indicated that MCT was more effective at improving reading comprehension skills than CT in both age groups. As expected, the MCT program was more effective than the CT program at improving cognitive and monitoring skills in younger students. Our results were consistent with an earlier study (Pazzaglia & Rizzato, 2001), in showing that MCT utilized a more effective remedial technique for reading comprehension difficulties than training, which only targeted cognitive processes underlying the acquisition of meaning from texts. In addition, these results were clearly confirmed by the fact that no differences in metacomprehension skills were found comparing students that followed the CT with C. In older students, however, the MCT and CT programs were similarly effective at increasing cognitive and monitoring skills. However, separate comparisons between the two intervention conditions and the C condition indicated that only participants

in the MCT condition performed significantly better than C participants at the post-training assessment.

It appears that both interventions were similarly effective in the older age group. There may be no extra benefit from MCT in the older group because by the older students age, their adopted reading strategy is not very susceptible to change because they have already automated a study method which does not take account of the importance of metacognitive processes. Our results confirmed that MCT had a greater positive impact on reading comprehension than CT which, although it resulted in a significant improvement in performance during training, had a smaller beneficial effect than MCT. In both age groups the performance of participants in the C condition changed little during the training phase. The MCT program, but not the CT program, resulted in post-training performance that was significantly better more effective than that of the participants in the C condition. This confirmed that although specific training in metacognitive skills is a necessary and effective strategy for improving cognitive reflection, the benefits on comprehension can be achieved without a specially designed training program. Comparison of the two intervention programs indicated that MCT was a more effective method of improving reading comprehension than training which only targeted the cognitive processes underlying reading comprehension.

The strong point of the presented work was that the same level of reading comprehension in all participants was achieved, favoring the stimulation of reflection on the effects of targeted intervention programs, placed in comparison with one another.

The small number of participants in each condition means that generalization of these findings may not be warranted; however, we argue that these findings provide sufficient evidence to encourage the development of intervention programs which place more emphasis on stimulating cognitive and particularly metacognitive processes underlying reading comprehension, and that such programs would not only improve reading but would also, inevitably, promote metacognitive competence. In our case, opportunely structured metacognitive treatment, as compared to training limited solely to the improvement of the main cognitive processes, develops comprehension and metacomprehension skills to a greater degree than a traditional educational program (Kangsepp, 2011).

In summary, our results suggest that students who received specific training in metacognitive skills learned to take a more active, more self-aware approach to reading comprehension tasks. They suggest that MCT

may have a wider role in learning environments. In particular, we hope that future research will assess the feasibility of integrating MCT into the standard educational curriculum, and that MCT will be offered to all students to improve their study skills (Borkowski & Muthurishna, 2011). These results should encourage further investigation into the efficacy of similar interventions at higher educational levels, extending the research to include students who arrive at secondary school with serious reading difficulties and whose comprehension problems have been neglected or perhaps not addressed at all.

6. Educational implications

This innovative study makes an original contribution to the literature on reading interventions. Although there has been some research on interventions targeting comprehension deficits, most studies have used training methods focusing exclusively on either cognitive or metacognitive skills rather than comparing them. There is increasing interest in assessing reading comprehension and understanding the processes underlying good comprehension as it is the final goal of reading and poor comprehension skills can lead to poor academic achievement (RAND, 2002).

The results of this study, and previous intervention studies (De Beni *et al.*, 2003), provide information about how best to help poor comprehenders and should inform the design and development of new interventions and pedagogical techniques to improve reading comprehension in school-age children. Our findings suggest that promoting metacognitive skills, in other words training students to be more aware of their mental processes, will lead to a general improvement in school performance. As De Beni and Pazzaglia (1990, 1991) had pointed out that a reader, especially a less skilled reader, who is not aware that the goal of reading is first and foremost to understand the text will not bother to reflect and check his or her understanding. It is therefore important that schools commit to improving students' capacity to learn, since this seems to be one of the determining factors in successful academic performance (Boulware-Gooden *et al.*, 2007; Bråten & Anmarkrud, 2013; Edmonds *et al.*, 2009; McKeown *et al.*, 2009; Meneghetti *et al.*, 2007; Pedron *et al.*, 2009; Rosiglioni & Dal Santo, 2010). Teachers' social feedback plays a critical role in acquisition of metacognitive skills. Guided and systematic analysis of mistakes and successes offers an excellent opportunity to improve students' awareness of their strengths and weaknesses and encourage them to adopt an effective studying strategy

based on metacognitive skills, which will help them to become independent learners (Andreassen & Bråten, 2011; Logan, Medford, & Hughes, 2011; Michalsky *et al.*, 2009; Spörer *et al.*, 2009).

The reading-related skills which should receive most attention in teaching of reading and in remedial interventions are metacognitive skills (Pazzaglia *et al.*, 1994), particularly reflective skills, namely awareness of the goal of reading (Why am I reading this text?), use of specific and appropriate reading strategies (How can I read in order to understand? Does this text require close reading or will skim-reading be sufficient?), use of textual indicators such as titles, graphics, illustrations (Does the text help me?) and the use of prior knowledge (What do I already know about the topic?). The positive impact of MCT on learning suggests that teaching of metacognitive skills should begin early, perhaps with the simple exercises to develop students' awareness and control over the processes which underpin understanding of text.

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