The Relations Among General Intelligence, Metacognition and Text Learning Performance

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Abstract

The main aim of this study was to investigate the relations among text learning performance, general intelligence and the three components of metacognition; namely metacognitive knowledge, metacognitive monitoring and metacognitive control. The participants were 91 fifth graders. The results of the study indicated no significant correlations among metacognitive knowledge, metacognitive control and general intelligence. On the other hand, metacognitive monitoring and general intelligence correlated significantly. The results of the regression analysis showed that metacognitive knowledge did not contribute to students' text-learning performance whereas metacognitive monitoring and metacognitive control, together with general intelligence, were found to be significant predictors in explaining students' text-learning performance.

Keywords: Metacognition, metacognitive knowledge, metacognitive monitoring, metacognitive control, general intelligence, text-learning.

Introduction

Metacognition

Metacognition is one of the best predictors of academic achievement. According to Nelson (1999) metacognition is a specific kind of cognition that can be defined as a person's cognitions about his own cognition. Flavell (1979) defined metacognition as knowledge about cognition and control of cognition. Metacognition is a multi-faceted structure with three main components, namely *metacognitive knowledge, metacognitive monitoring* and *metacognitive control* (Dunlosky and Metcalfe, 2009).

Metacognitive knowledge is what we know about our own cognitive operations (Flavell, 1979). This knowledge is mostly statable and sometimes fallible (Brown, 1987). Metacognitive knowledge involves knowledge about; the individual's own cognitive characteristics (person knowledge), the nature of different cognitive tasks (task knowledge) and the strategies for different cognitive tasks (strategy knowledge) (Flavell, 1979, 2000).

Metacognitive monitoring is the ongoing assessment of cognitive activities (Dunlosky & Metcalfe, 2009). Thanks to metacognitive monitoring, the individual can decide if he understood the text he has just read or learned the times table by heart (Schwartz & Perfect, 2002).

Metacognitive control is the regulation of ongoing cognitive activities. It involves decisions whether to stop, to continue or to change the process of the cognitive activity. Therefore, metacognitive control involves conscious and unconscious decisions depending on the information from metacognitive monitoring. (Dunlosky & Metcalfe, 2009; Nelson & Narens, 1996).

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Metacognition and Intelligence

It's well established that both metacognition and intelligence have their own unique roles on academic achievement. However, the relation between metacognition and intelligence is still a matter of debate (Hertzog & Robinson, 2005). Some researchers approach metacognition and intelligence as related constructs whereas according to some researchers the two constructs are not related at all. According to Manning, Glasner and Smith (1996), gifted children are more skilful users of their metacognitive skills. Schraw and Graham (1997) suggest that the development of metacognitive knowledge is related to experience whereas metacognitive skills (especially planning and monitoring) are related to intelligence. As a result, children with high IQ are comparable to normal children in terms of metacognitive knowledge but they are advantageous in metacognitive skills.

The researchers who accept metacognition and intelligence as related constructs, mostly are the ones who believe that metacognition is a subcomponent of intelligence. In the works well known intelligence theorists like Binet and Simon (1916), Naglieri and Das (1997), Sternberg (2003, 2005) and Cornoldi (2010), metacognition is regarded as a subcomponent of intelligence.

In their study with 3rd and 5th graders, Schneider, Körkel and Weinert (1987) found positive significant correlations between metacognitive knowledge and intelligence. In Swanson (1990) study, he found that the students with high metacognitive knowledge and high IQ had also high strategy use. In another study, Swanson (1992) reported a positive significant correlation between 5th graders metacognitive knowledge and intelligence. Alexander and Schwanenflugel (1994) reported that 2nd and 3rd grade children with high IQ had more sophisticated strategy knowledge than normal IQ children. Rozencwajg (2003) who studied the relation between metacognition and intelligence in scientific problem solving of 12 and 13 year olds, reported a positive significant correlation between metacognitive knowledge and crystallized intelligence whereas metacognitive knowledge did not correlate with fluid intelligence. Also, the researcher found a positive correlation between metacognitive monitoring and fluid intelligence whereas metacognitive monitoring did not correlate with crystallized intelligence. Alexander, Johnson, Albano, Freygang and Scott (2006) investigated the relation between metacognition and intelligence in two studies. The first cross-sectional study with kindergarteners, 1st, 3rd, 5th graders and college students, they reported positive significant correlations between metacognitive knowledge and intelligence for all age groups. In the second study with kindergarteners and 1st graders, they again reported positive significant correlations between metacognition and intelligence for all age groups. In a study that compared normal students, students with learning difficulties and students with developmental disorders, Short (1992) found positive significant correlations between metacognitive knowledge and intelligence for both groups.

However, there are also a number of studies that found no significant correlation between metacognition and intelligence. In Allon, Gutkin and Bruning (1994) study with 9th graders, the researchers found .15 non-significant correlation between the two variables. Coutinho (2006) also reported non-significant correlation between metacognition and intelligence for college students. Similarly, Yalçın and Karakaş (2008) investigated the relation between intelligence and metacognition but found non-significant correlation between the two variables for 8 to 14 year olds. Karakelle (2012) showed that general intelligence did not contribute to metacognitive awareness of college students.

Furthermore, there are also studies that reported negative significant correlations between metacognition and intelligence. For instance, in their study with 6th graders Dresel and Haugwitz (2005) reported a negative significant correlation between cognitive skills and metacognitive strategy use.

Veenman and colleagues investigated the relations between metacognition and intelligence in terms of their contributions to learning performance. Gathering the results from several studies with various task types and various age groups, they developed three models for explaining the relation between the two variables. *The intelligence model*, regards metacognition and intelligence as highly correlated constructs. However, metacognition cannot have a predictive value for learning, independent of intellectual ability. *The independency model,* regards metacognition and intelligence as entirely independent predictors of learning. According to t*he mixed model,* metacognition is related to intelligence to a certain extent, but it has a surplus value on top of intellectual ability for the prediction of learning (eg. Veenman, Elshout & Meijer, 1997; Veenman & Verheij, 2003; Veenman & Beishuizen, 2004; Veenman, Wilhelm & Beishuizen, 2004; Veenman, Kok& Blöte, 2005; Veenman & Spaans, 2005; Van der Stel & Veenman, 2008).

As summarized above, there is no consistency among the results from various studies investigating the relations among metacognitive components and intelligence. One explanation for these inconsistent results might be the fact that in these studies, the researchers investigated different metacognitive components. That is to say, in some studies the researchers investigated only metacognitive knowledge whereas others investigated metacognitive control. Although there are studies that investigated both metacognitive knowledge and control, none of these studies addressed these components separately in their analysis.

This study investigated the relation between general intelligence and metacognition as predictors of text learning performance, addressing all three components of metacognition, namely; metacognitive knowledge, metacognitive monitoring and metacognitive control separately.

Method

Participants

The participants of the study were fifth graders from five schools. All participants were from middle SES families. Two fifth grade classes from each school and, 5 girls and 5 boys from each class were recruited randomly. Total number of 100 students participated in the study. Of all the participants, 9 students' think aloud protocols were coincided with the break time. Because of too much background noise, the recordings were not clear so they were excluded from the analysis. Therefore, the data from 91 students (47 girls and 44 boys; M*age:* 10.04, age range: 9-11) were included.

General Intelligence. Raven Standard Progressive Matrices (RSPM) was used for the study. RSPM was developed by Raven to assess general intelligence (g). It assesses visual-spatial perception, cognitive flexibility, abstract thinking and analytical thinking there are total 60 items. The test can be used with participants older than six year olds. The maximum point is 60 and minimum is 0 (Raven, 2000). RSPM is accepted to be the best test to assess general intelligence (Carpenter, Just & Shell, 1990; Colom et al, 2005; Duncan et al, 2000; Ven & Ellis, 2000). The validity and the reliability for Turkish children was investigated by Karakaş (2006). Accordingly, test-retest reliability was 0.79($p<.001$) for total scores and 0.64($p<.001$) for duration scores. For concurrent validity, the researchers investigated whether the instrument differentiated age groups. The results of linear regression analysis showed that the correlation between total scores and age was .21 and between total time and age was .07.

Jr MAI (Form A). The Turkish version of the Jr. Metacognitive Awareness Inventory- Form A was used for the study (Sperling et al., 2002). Jr. Metacognitive Awareness Inventory-Form A (Jr. MAI-A), a self-report inventory, was developed as a measure of general metacognitive awareness of children in grades 3-5. Jr. MAI is a 3-point likert type scale ranging from 1 ("never") to 3 ("always"). The inventory consists of 12 items. The Turkish version of Jr. MAI was adapted by Karakelle and Saraç (2007).

Think Aloud Protocols. For this study, think aloud protocols were used to assess metacognitive control. The students were presented a text learning task. The text for this study, taken from Demirel (1995), was about the design, working principles and types of air balloons. The text consisted of nine paragraphs with 456 words. Prior to the study, seven fifth grade teachers read the text and judged it as appropriate for fifth grade readers. The children were instructed to think aloud while studying the text. All the readers' utterances were audiotaped and transcribed. All the transcriptions were segmented according to Cote, Goldman & Saul (1998). The text segmented into sentences. The students' utterances after each sentence was identified as the unit of analysis. For the scoring of utterances Taxonomy of Metacognitive Activities in Text-studying (TMATS), developed by Meijer, Veenman and van Hout-Wolters (2006) was used. The utterances of the students' in each segment categorized under one of five categories in the taxonomy: orientating, planning, executing, evaluating and elaborating. The students were awarded 1 point for each metacognitive activity. Examples of metacognitive activities were presented in Table 1.Three judges scored all the protocols independently. The inter-rater reliability between the first and the second judge was 97%, between the first and the third judge was 98% and between the second and the third judge was 93%.

Table 1.
Examples of Utterances Scored as Metacognitive Control

Type of Metacognitive Activity	**Statement**
Orientation	"I know this Zeplin, I have one movie, French people are fighting with the Germans. They blow up the Zeplin. "
Planning	"I want to read the part about vents again"
Executing	"I'm taking a note"
Monitoring	"I don't know what vent means"
Evaluating	"Thankfully I read it twice as I couldn't understand it at first"
Elaborating	"The other paragraph was about free balloons. They could move by the help of wind but these can move by the help of their engines."

Accuracy Ratings. Accuracy measures the degree to which children's confidence judgments match their actual test performance (Hacker, Bol & Bahbahani, 2009; Hacker, Bol, Horgan & Rakow, 2000; Pressley & Ghatala, 1989). Metacognitive monitoring accuracy was calculated by taking the absolute value of the difference between students' ratings on the prediction scale and their performance. In this study, the students' performance was assessed by a post-test consisting of 15 multiple choice questions (4 = .77). Six of the questions were text implicit and 9 of the questions were text-explicit. The students' prediction judgements (JOL) were used to measure metacognitive monitoring accuracy. After the children studied the experimental text, they were asked to rate how well they think they understood the text on a rating scale ranged from 1, designating "not at all", to 4, designating "very well". For each reader, the difference between the rating on the prediction scale (converted into percentages) and performance score (converted into percentages) was calculated and the absolute value of this difference was taken. With this formula, the accuracy scores ranged between 0 and 100, with the scores of 0 indicating perfect accuracy and scores of 100 indicating total inaccuracy. To prevent any confusion due to reverse points, all scores were subtracted from 100 and consequently the accuracy scores for this study ranged between 0 and 100, with the scores of 100 indicating perfect accuracy and scores of 0 indicating total inaccuracy.

Text-learning Performance. The same text "Balloons" was used for assessing text-learning performance. The comprehension test consisted 6 text-implicit and 9 text-explicit multiple choice comprehension (total 15 questions).A pilot study with 30 fifth graders was carried out for reliability and validity analysis. For validity, the scores of highest 27% (12 students) and lowest 27% (12 students) were compared using independent samples t-test. The results showed that the test is a valid measure (t (22)= 14, 28, $p < .01$). For reliability, KR-20, Alpha, Spearman-Brown and Guttmann coefficients were calculated. The results were .88; .77, .74, .74, respectively. These results proved that the test is valid and reliable.

Procedure

Participants received Raven Standard Progressive Matrices in groups of 10 in a suitable room in their school. One or two day after RSPM, all the students invited for the individual session. The first author, in a quiet room in the school, assessed all students individually during school time. In a typical session, the researcher started with a short chat about the aims of the study and expectations of the researchers. Then the experimental text, "Balloons", was introduced. The student's think aloud process was audio-taped. After the student mentioned that he was ready for the test, he was instructed to rate his confidence in understanding the text on a likert type rating scale ranging from "very confident" to "not at all confident". Then he was presented with the learning performance test. There was no time limit for the performance test. At the end of the session, the student completed Jr. MAI (Form A).

Findings

Descriptive statistics for all variables are presented in Table 2.

Table 2.

Descriptive Statistics For General Intelligence, Metacognitive Knowledge, Metacognitive Monitoring, Metacognitive Control and Text Learning Performance

	General Intelligence	Metacognitive Knowledge	Metacognitive Monitoring	Metacognitive Control	Text Learning Performance
Mean	40,18	31,86	77,11	23,14	8,81
Std. Dev.	7,47	2,51	17,91	19,30	2,69
Variance	55,77	6,31	359,81	345,05	7,22
Skewness	-,67	-,36	-,82	,51	-,15
Std. Error (Skewness))	-,41	,25	,25	,26	,25
Kurtosis	-,43	-, 50	,05	-,42	-,69
Std. Error (Kurtosis)	,50	,50	,50	,52	,50
Minimum	21,00	25,00	33,00	1,00	3,00
Maximum	56,00	36,00	100,00	44,00	15,00

Pearson product-moment correlation coefficients were computed to investigate the interrelations among the variables. Correlations are presented in Table 3.

Table 3.

Correlations Among Variables

	Text Learning Performance	General Intelligence	Metacognitive Knowledge	Metacognitive Monitoring	Metacognitive Control
Text Learning Performance	1	.49*	.16	.53**	-.18
General Intelligence		1	.21	.29*	.11
Metacognitive Knowledge			1	-.08	.11
Metacognitive Monitoring				1	-.30
Metacognitive Control					1

*p< .01

** p< .001

As shown in Table 3, general intelligence correlated significantly with metacognitive monitoring. However, no significant correlation was found among general intelligence, metacognitive knowledge and metacognitive control.

Using hierarchical regression analysis, the unique and shared proportions of variance accounted for in text learning performance by general intelligence and metacognitive knowledge were estimated. Text learning performance was entered in the analysis as the dependent variable whereas general intelligence and metacognitive knowledge were the independent variables. To investigate the unique contribution of general intelligence, it was entered in the analysis in the first stage as a control variable. Metacognitive knowledge was entered in the second stage. The results of the analysis were presented in Table 4.

Table 4.
Results of Hierarchical Regression Analysis for the prediction of Text Learning Performance with General Intelligence and Metacognitive Knowledge

Variables	R^2	B	Std. Error (B)	β	t	F	Partial r	Part r
1. Stage								
Constant		1,61	1,37		1,18			
General Intelligence	,244	,18	,03	,49	5,34*	28,47*	,49	,49
2. Stage								
Constant		-,13	3,30		-,04			
General Intelligence	,247	,18	,03	,49	5,14*	14,30*	,48	,49
Metacognitive Knowledge		,06	,10	,06	,58		,06	,14

*p< .01, **p< .001

As presented in Table 4, in the first stage of the analysis general intelligence accounted for 24,4% of variance in text learning performance. The results of the F test indicated that general intelligence contributed to text learning performance F (1, 89) = 28,47, p< .001.

In the second stage, metacognitive knowledge was added to the model and increased the proportion of variance by .003. This indicated that general intelligence and metacognitive knowledge together accounted for 24,7% of variance in text learning performance. However this increase in variance was not statistically significant (F(1,87)= .34, p< .01). Although F test yielded a significant result ΔF(2, 89) = 14,30(p< .001), Beta coefficient and t test results indicated that general intelligence contributed to text learning performance (β= .49, p< .01) whereas the contribution of metacognitive knowledge was not significant (β= .06, p< .01).

Using hierarchical regression analysis, the unique and shared proportions of variance accounted for in text learning performance by general intelligence and metacognitive monitoring were estimated. Text learning performance was entered in the analysis as the dependent variable whereas general intelligence and metacognitive monitoring were the independent variables. To investigate the unique contribution of general intelligence, it was entered in the analysis in the first stage as a control variable. Metacognitive monitoring was entered in the second stage. The results of the analysis were presented in Table 5.

Tablo 5.

Results of Hierarchical Regression Analysis for the prediction of Text Learning Performance with General Intelligence and Metacognitive Monitoring

Variables	R^2	B	Std. Error (B)	β	t	F	Partial r	Part r
1. Stage								
Constant		1,97	1,36		1,45			
General Intelligence	,233	,17	,03	,48	5,15*	26,70*	,48	,48
2. Stage								
Constant		-1,15	1,38		-,83			
General Intelligence	,393	,13	,03	,37	4,23*	28,20*	,41	,35
Metacognitive Monitoring		,06	,01	,42	4,80*		,46	,40

*p< .01, **p< .001

In the first stage of the analysis general intelligence accounted for 23,3% of variance in text learning performance. The results of the F test indicated that general intelligence contributed to text learning performance F (1, 89) = 26,70, p< .001.

In the second stage, metacognitive monitoring was added to the model and increased the proportion of variance by .17. This indicated that general intelligence and metacognitive monitoring together accounted for 39,3 % of variance in text learning performance. This increase in variance was statistically significant (F(1,87)= 28,20, p< .01). Beta coefficient and t test indicated that general intelligence (β= .48, p< .01) and metacognitive monitoring (β= .37, p< .01) together contributed significantly to text learning performance (β= .42, p< .01). In order to see unique and shared contributions of general intelligence and metacognitive monitoring to the variance explained, Part r values were investigated. The results showed that the unique contribution of general intelligence was 12,2% whereas the unique contribution of metacognitive monitoring was 16%. To calculate the shared contribution of the two variables, the unique contributions of both variable were added (12,2+16= 28,2) and then the result was subtracted from the total variance explained (39,3-28=11,3). The shared variance was found to be 11,1%.

Using hierarchical regression analysis, the unique and shared proportions of variance accounted for in text learning performance by general intelligence and metacognitive control were estimated. Text learning performance was entered in the analysis as the dependent variable whereas general intelligence and metacognitive control were the independent variables. To investigate the unique contribution of general intelligence, it was entered in the analysis in the first stage as a control variable. Metacognitive control was entered in the second stage. The results of the analysis were presented in Table 7.

Table 7.

Results of Hierarchical Regression Analysis for the prediction of Text Learning Performance with General Intelligence and Metacognitive Control

Variables	R^2	B	Std. Error (B)	β	t	F	Partial r	Part r
1. Stage								
Constant		1,69	1,36		1,26			
General Intelligence	,26	,18	,03	,51	5,28**	27,85**	,49	,49
2. Stage								
Constant		2,33	1,31		1,78			
General Intelligence	,323	,18	,03	,54	5,83**	19,07**	,55	,54
Metacognitive Control		-,06	,02	-,26	-2,81*		-,30	-,26

*p< .01, **p< .001

In the first stage of the analysis general intelligence accounted for 26% of variance in text learning performance. The results of the F test indicated that general intelligence contributed to text learning performance $F(1, 82) = 27{,}85$, $p < .001$. In the second stage, metacognitive control was added to the model and increased the proportion of variance by .07. This indicated that general intelligence and metacognitive control together accounted for 32,3% of variance in text learning performance. This increase in variance was statistically significant ($F(1,80) = .36$, $p < .01$). As the result of the F test investigating the significance of the second model was also significant $\Delta F(2, 82) = 19{,}07$ ($p < .001$), it can be assumed that the variance in text learning performance can be explained by general intelligence and metacognitive control together. Beta coefficient and t test showed that general intelligence ($\beta = .54$, $p < .01$) and metacognitive control ($\beta = -.26$, $p < .01$) together contributed significantly to text learning performance ($\beta = .44$, $p < .01$). In order to see unique and shared contributions of general intelligence and metacognitive control to the variance explained, Part r values were investigated. The unique contribution of general intelligence was 29,1% whereas the unique contribution of metacognitive monitoring was 6,8%. To calculate the shared contribution of the two variables, the unique contributions of both variable were added (29,1 (-6,8)= 22,3) and then the result was subtracted from the total variance explained (32,3-22,3=10). The shared variance was found to be 10%.

Discussion

As predictors of learning performance, the relation between intelligence and metacognition is studied by metacognition researchers as well as intelligence researchers. However, the inconsistent results from several studies make it difficult for researchers to draw precise conclusions about the nature of this relationship. Current study investigated whether these inconsistent results are due to the fact that the studies investigated different components of metacognition. In this framework, the aim of the study is to investigate the relations among general intelligence and the three components of metacognition as predictors of text learning performance.

Results showed that metacognitive knowledge and general intelligence did not correlate with each other. In the literature, there is no consensus on the relationship between these two variables. Short (1992), Swanson (1992), Alexander and Schwanenflugel (1994) Alexander, et al. (2006) found significant correlations between metacognitive knowledge and intelligence which contradicts with the results of the current study. However, regarding the assessment of intelligence, all the studies mentioned above used tests assessing both verbal and non-verbal intelligence. In the current study, intelligence was assessed with a non-verbal tests. According to various researcher verbal and non-verbal tests of intelligence measures different types of intelligence. Verbal tests measure what Cattell (1963) called crystallized intelligence, that is, the ability to make use of acquired information. This typre of intelligence is effected by education and other learning experiences. On the other hand, non verbal tests of intelligence measures, what Cattell (1963) called fluid intelligence, that is the capacity to think logically and solve problems in novel situations and is independent of acquired knowledge. In the current study, intelligence was measured using RSPM, which is a non verbal test of intelligence. In the literature RSPM is accepted as a test that measures fluid intelligence (e.g., Borella, Caretti & Mammarella, 2006; Bracken, Howell & Crain, 1993; Chamorro-Premusic, Moutafi & Furnham, 2005; Gray, Braver & Todd, 2003; Rubin, Brown & Priddle, 1978; Shamosh & Gray, 2007). Like all types of knowledge, metacognitive knowledge is acquired through learning and experiences. Then it's logical to suggest that metacognitive knowledge relates to crystallized intelligence rather than fluid intelligence. In his study, Rozencwajg (2003) found a significant correlation between intelligence, measured by a verbal test and metacognitive knowledge whereas metacognitive knowledge did not have a significant correlation with intelligence, measured by a non verbal test.

Hierarchical regression analysis showed that general intelligence and metacognitive knowledge together accounted for 24,7% of variance in text learning performance. However, metacognitive knowledge did not contribute to text-learning performance. Although the impact of intelligence on academic achievement is still under debate, results from recent studies indicate that general intelligence is a powerful predictor of skill and knowledge acquisition at school (e.g.; Baumert, Lüdtke, Trautwein & Brunner, 2009; Pammer & Kevan, 2007). So, the results of the current study is compatible with the aforementioned studies. On the other hand, the result of this study that metacognitive knowledge did not contribute to text-learning performance. Contradicts with the findings from many studies in the literature. In their study with third and fourth graders Van Kraayenoord and Schneider (1999) found metacognitive knowledge as a powerful predictor of reading success. Similarly, the results of Roeschl-Heils, Schneider and van Kraayenoord (2003) study indicated that metacognitive knowledge was a significant predictor of seventh and eighth graders' reading comprehension. In these studies, metacognitive knowledge specific to reading was assessed. However, in the current study, metacognitive knowledge was assessed by a domain general questionnaire. It can be assumed that metacognitive knowledge may be domain specific and when assessed by domain general questionnaires it may not have a predictive value for reading success.

Results indicated that metacognitive monitoring and general intelligence correlated significantly. Rozencwajg (2003), too, reported positive significant correlation between metacognitive monitoring and fluid intelligence of 12-13 year olds.

Regression analysis showed that general intelligence and metacognitive monitoring together accounted for 39,3% of variance in text learning performance. Both variables had their own unique contributions in predicting text-learning performance. The unique contribution of general intelligence was 12,2% and the unique contribution of metacognitive monitoring was 16%. The shared variance by two variables was 11,1%. The finding that metacognitive monitoring contributed to text learning performance is compatible with several studies. Cain, Oakhill and Byrant (2004) found that metacognitive monitoring predicted reading achievement of eighth, ninth and eleventh graders. Kolic-Similarly in Vehovec and Bajsanski (2006) study, metacognitive monitoring predicted reading performance of fifth, sixth, seventh and eighth graders.

According to the results of the current study, metacognitive monitoring contributed to text learning performance on top of general intelligence. This finding confirmed the mixed model proposed by Veenman and in explaining the relationship between metacognition and intelligence as predictors of learning performance. As explained in the introduction, the mixed model proposes that metacognition is related to intelligence to a certain extent, but it has a surplus value on top of intellectual ability for the prediction of learning.

Results of the study indicated that the correlation between metacognitive control and general intelligence was not significant. There are inconsistent results in the literature regarding the relation between metacognitive control and intelligence. Several studies reported significant correlations between the two variables (e.g.; Van der Stel & Veenman, 2008; Van der Stel & Veenman, 2009; Veenman &Spaans, 2005; Veenman, Wilhelm & Beishuizen, 2004). However, in Veenman, Kok and Blöte (2005) study, the researchers did not found a significant correlation between metacognition and intelligence. This inconsistency may be due to the tasks and techniques used for assessing metacognition. In all the studies cited above, the researchers assessed metacognitive control using think aloud protocols, as in the current study. However, learning tasks were all different. Van der Stel and Veenman (2008) used a text learning tasl whereas Veenman, Kok and Blöte (2005) used a problem solving task. Veenman and Spaans (2005) used a computer simulated deductive task. In terms of scoring metacognitive activities some researchers merely counted the number of metacognitive activities from the protocols (e.g.; Veenman, Kok &Blöte, 2005), other researchers, on the other hand, assessed metacognitive activities according to the quality of the activities(e.g.; Van der Stel & Veenman, 2008). These task and scoring differences lead to inconsistent results.

The results of the regression analysis showed that general intelligence and metacognitive control together accounted for 32,3% of variance in text learning performance. Both variables had their own unique contributions in predicting text-learning performance. The analysis showed that the unique contribution of general intelligence was 29,1% and the unique contribution of metacognitive monitoring was 6,8%. The shared variance by two variables was 10%. The finding that metacognitive control contributed to text learning performance is compatible with several studies. Samuelstuen and Braten (2005) study revealed that metacognitive control contributed to text learning performance of tenth graders. Van der Stel and Veenman (2008), in their study with 12 year olds, found that metacognitive control was a significant predictor of text learning performance.

In the current study, no correlation was found between general intelligence and metacognitive control. However, metacognitive control and general intelligence both predicted text learning performance. This finding confirmed the independency model proposed by Veenman and colleagues in explaining the relationship between metacognition and intelligence as predictors of learning performance. The independency model proposes that metacognition and intelligence are independent predictors of learning.

To sum up, the current study indicated that the nature of the relationship between metacognition and intelligence depends on the component of metacognition under investigation. However, the study has a number of limitations that brings about suggestions for future research. First of all, the results indicated that domain general metacognitive knowledge was not a significant predictor of learning. In the literature, several researchers reported consistently that domain specific metacognitive knowledge predicted learning performance. Thus, in future studies assessing both domain general and domain specific metacognitive knowledge will contribute our understanding. Again, another result of the current study that general intelligence and metacognitive knowledge did not correlate significantly, needs further investigation. In this study, RSPM was used as a measure of intelligence which is accepted widely as a measure of fluid intelligence (örn; Bracken, Howell & Crain, 1993; Borella, Caretti & Mammarella, 2006; Chamorro, Moutafi & Furnham, 2005; Gray, Braver &Todd, 2003; Rubin, Brown & Priddle, 1978; Shamosh &Gray, 2007). Fluid intelligence refers to an intellectual capacity rather than acquired knowledge. On the other hand crystallized intelligence is effected by experiences and learning (Horn, 1965). As metacognitive knowledge is like any kind of knowledge stored in long term memory, it can be assumed that it is more related to crystallized intelligence than fluid intelligence. In future studies investigating the relation between metacognitive knowledge and intelligence, crystallized intelligence should be involved as a variable.

Conclusions

The aim of this study was to investigate the relation between three components of metacognition and general intelligence as predictors of text learning performance. The findings of the study indicated that the nature of the relationship between metacognition and intelligence changes according to the component of metacognition under investigation. Metacognitive knowledge and general intelligence do not correlate significantly and metacognitive knowledge is not a predictor of text learning performance. On the other hand, metacognitive monitoring correlates significantly with general intelligence and both variables are significant predictors of text learning performance. Metacognitive control and general intelligence do not correlate significantly but both variables are independent predictors of text learning performance.

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