

# The relationship between the big-five model of personality and self-regulated learning strategies

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## Abstract

The study examined the relationship between the big-five model of personality and the use of self-regulated learning strategies. Measures of self-regulated learning strategies and big-five personality traits were administered to a sample of undergraduate students. Results from canonical correlation analysis indicated an overlap between the big-five personality factors and the set of self-regulatory learning strategies. The study also compared the relative contributions of the personality factors and the self-regulated learning strategies in predicting academic achievement. The results from hierarchical multiple regressions suggest that the personality trait of Intellect made an independent contribution to the variance in student GPA, whereas effort regulation mediated the effects of Conscientiousness and Agreeableness. The relevance of personality constructs in the learning context is discussed in terms of dispositions for active learning.

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Although self-regulated learning is a relatively new construct in the domain of educational psychology (Zimmerman, 1989), its theoretical importance and practical implications have drawn increasing research attention. While advances in understanding of self-regulated learning are evident, there are still unanswered questions. One of these questions concerns the extent to which self-regulated learning could be considered a “learnable” characteristic or a characteristic that could be tied to pre-existing individual differences. Stated differently, to what extent self-regulated learning is associated with stable personality dispositions has not been systematically investigated. The purpose of the current investigation is to determine if a set of self-regulated learning strategies, identified in previous research as being core elements of the self-regulation learning processes, varies as a function of cross-situational individual differences in terms of big-five personality traits.

## 1. The nature of self-regulated learning

Self-regulation theory originates from the psychological tradition of theory and research on self-control (Schunk, 2005). Several models of self-regulated learning have been proposed, the majority of which stem from

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Bandura's (1986) socio-cognitive theory of human functioning. An underlying assumption of Bandura's theory is that people are proactive, self-regulating agents, rather than passively shaped by their surroundings (Pajares & Valiante, 2002). Research conducted by Zimmerman and colleagues (Zimmerman, 1995; Zimmerman & Schunk, 2001, 2004) has found that self-regulating learners set proximal, attainable goals; are learning- rather than achievement-oriented; have an understanding that different learning tasks require different strategies and tend to use the most appropriate strategies effectively; possess high self-efficacy; control their achievement through strategies such as imaginary, self-instruction, and attention focusing; are mindful of the intermediate outcomes of their learning process and able to make accurate causal attributions for the learning outcomes; and finally, are open to adapt their learning strategies to the immediate requirements of each particular learning situation.

Pintrich (1995) characterizes self-regulated learning as constant adjustment of one's cognitive activities and processes to the demands of a particular learning situation (Pintrich & De Groot, 1990). In the conceptual framework formulated by Pintrich (2000), the self-regulation process consists of four phases, namely forethought; planning and activation; monitoring; control; and reaction and reflection. These phases are not necessarily linearly and temporally ordered, and each phase is characterized by distinctive learner's activities within four general areas — cognition, motivation, behavior, and context.

Both Zimmerman's (1995) and Pintrich's (1995) conceptualizations of self-regulated learning reflect a social-cognitive perspective on self-regulation. Under the social cognitive framework, self-regulation in academic setting has been conceived of as a set of skills that can be developed, rather than unchangeable or genetically rooted. Pintrich (1995) posited, for example, that students are able to learn to self-regulate in academic settings through self-reflection and exercise. Therefore, it is incumbent upon parents and teachers to cultivate these skills in students from a very early age (Coppola, 1995). Although research has shown that self-regulation develops from early childhood to adolescence (Demetriou, 2000; Weinstein, Husman, & Dierking, 2000), training and intervention studies have lent support to the arguments that self-regulation can be successfully taught to students of all grade levels, and that the skills acquired through self-regulation training lead to notable improvement in student academic achievement (Muthukrishna & Borkowski, 1995; Randi & Corno, 2000; Reid & Borkowski, 1987; Zimmerman & Schunk, 2001). Various aspects of self-regulated learning have been often conceptually treated as situational, context dependent variables. However, in actual research, self-report measures are often used, which are usually not situated in specific learning tasks or situations, begging the question of whether they are measuring stable individual differences across a class of learning situations. Very little attention has been devoted to the connection between self-regulated learning and individual trait-like characteristics (Hong & O'Neil, 2001). More recently, Zimmerman and Schunk (2004) proposed a four-level model of development of self-regulation skill whereby a learner gradually achieves full self-regulation through an internalization process. Although they identified the quality of modeling, social feedback, process goals, and achievement outcomes as sources of the development, they also identified two distinct types of learners, proactive learners and reactive self-regulators, thus implicating individual differences as a potential source of the development of self-regulation. In his action control theory of self-regulation, Kuhl (1985) identified state orientation and action orientation, a distinct individual difference perspective on stylistic differences regarding self-regulation of goals and action. Therefore, in addition to social-contextual and developmental underpinnings of self-regulation, a less recognized source of self-regulated learning may be individuals' predispositions to develop and exercise self-regulatory skills such as behaving proactively rather than reactively, engaging in elaborated information processing rather than surface processing. Such predispositions or behavioral propensities are traditionally studied as personality traits.

## 2. Personality and self-regulated learning strategies

Personality traits are conceptualized as stable individual difference characteristics explaining an individual's disposition to particular patterns of behavior, cognitions and emotions (Hogan, Hogan, & Roberts, 1996). Research stemming from the psychometric tradition has established empirically a five-factor structure of personality (McCrae & Costa, 1987), which includes the dimensions of Extraversion, Agreeableness, Conscientiousness, Emotional Stability (or Neuroticism), and Openness to Experience or Intellect (from here on the term Intellect will be used). The operationalization of these big-five traits include self-regulatory tendencies or propensities. For example, Conscientiousness includes features such as dependability and responsibility, the ability to plan, organize and persist in the service of achievement. Individuals high on the dimension of Intellect are depicted as deep and

complex, with a positive attitude toward challenging learning experiences (Barrick & Mount, 1991) as opposed to being simple and narrow-minded (McCrae & Costa, 1987).

The idea that personality is related to learning is not new. In his discussion of learning, Messick (1984) noted that underlying personality traits might be responsible for and create consistency in information processing, which, in turn, is measurable as a learning characteristic. There have been research efforts to forge links between big-five personality traits and learning characteristics similar to those depicted in the self-regulated learning literature.

Of the big-five factors, Conscientiousness has been linked to motivation and, more specifically, effort expenditure and persistence (Chamorro-Premuzic & Furnham, 2003). Geisler-Brenstein, Schmeck, and Hetherington (1996) found a positive relationship between Conscientiousness and methodic and analytic learning. Intellect was shown to be associated with deep approach to learning, elaborative learning (Geisler-Brenstein, et al., 1996; Slaats, Van der Sanden, & Lodewijks, 1997), meaning-directed learning, and constructive learning approach (Busato, Prins, Elshout, & Hamaker, 1999). Agreeableness was found to correlate positively with effort, and surface (reproductive) learning (Slaats et al., 1997; Vermetten, Lodewijks, & Vermunt, 2001). In explaining these results Vermetten et al. (2001) speculated that Agreeableness involves compliance and cooperativeness, which makes the agreeable individuals more likely to consolidate their learning and regulate their study habits in response to external demands. The willingness to make effort in learning is consistent also with the traits of imperturbability, which is typical of the agreeable individuals (McCrae & Costa, 1987).

The relationship between Extroversion or Neuroticism and self-regulated learning strategies might be complex. On the one hand, Extroversion could facilitate social behaviors such as help seeking and peer learning. On the other hand, extraverts were found to be poorer in reflective problem solving, because they tend to reach cognitive closure (i.e., exit the problem) prematurely (Matthews, 1997; see also Matthews & Zeidner, 2004). Besides, higher education involves complex tasks that often require great investment of resources. Sociability, impulsiveness, and distractibility implied by the construct of Extroversion would prevent the individuals who possess this quality from effectively regulating time and effort on these tasks.

As for Neuroticism, it is usually associated with the lack of effective cognitive skills (Eysenck, 1967). Yet, there is also evidence that Neuroticism can also facilitate motivation and effort expenditure, as is in the case of defensive pessimism by which anxious individuals, in anticipating a failure, gear up their efforts to preempt it (Norem & Cantor, 1986). However, the overall effect of Neuroticism tends to be negative rather than positive (see Matthews & Zeidner, 2004). Neuroticism was linked to poor critical thinking skills, analytic ability, and conceptual understanding, presumably because it tends to freeze higher-order cognitive functioning. It was found that individuals high in Neuroticism are likely to have a surface approach to learning, that is, to focus on memorizing and superficial features of the studied material instead of achieving deeper, meaningful understanding of it (Entwistle, 1988). In general, links of Conscientiousness, Intellect, and Agreeableness to components of self-regulated learning have more theoretical and empirical justifications than links of Extroversion and Neuroticism.

### **3. The relationship between personality, self-regulated learning strategies, and academic achievement**

A number of studies in the personality literature have examined the unique impact of personality variables on academic achievement. In general, empirical studies were successful in delineating a consistent relationship between Conscientiousness and academic achievement (Chamorro-Premuzic & Furnham, 2003; Colquitt & Simmering, 1998; Lay, Kovas, & Danto, 1998; Tross, Harper, Osher, & Kneidinger, 2000; Wolf & Johnson, 1995) but findings varied concerning the relationship between the remaining four personality dimensions and achievement. Intellect appears to be beneficial for academic achievement. The relationship between Intellect and academic achievement, however, has been shown to be less strong and not always statistically significant (e.g. Duff, Boyle, Dunleavy, & Ferguson, 2004). Research has shown a negative correlation between Neuroticism and achievement, suggesting that elevated emotional instability places individuals at the risk of diminished academic achievement. The research involving the connection between Agreeableness, Extroversion and achievement has generated mixed and inconclusive results (Duff et al., 2004; Eysenck & Cookson, 1969).

Studies in the self-regulated learning literature have indicated that various components of the self-regulated learning are associated with academic achievement, for example, effort regulation (e.g., Boekaerts, 1999; Chen, 2002),

management of time and study environment (e.g., Britton & Tessor, 1991; Zimmerman & Martinez-Pons, 1990), metacognition, elaboration and critical thinking (e.g., Pintrich, Smith, Garcia, & McKeachie, 1993).

There have been few studies investigating interrelationships of personality, self-regulated learning, and academic achievement. Theoretically, personality can be seen as a distal but pervasive influence on individuals' school functioning but its effects may not be specific to academic achievement. In contrast, self-regulated learning is a more proximal determinant of academic achievement, and as such should have a more direct bearing on academic grades.

#### 4. Purpose and scope of the study

The different self-regulation models, briefly reviewed above, reveal the construct of self-regulated learning represents a constellation of motivational and strategic components. It should be noted, however, that motivational aspects of self-regulation are not characteristics uniquely associated with self-regulation for an array of motivational constructs were developed long before the advent of the construct of self-regulation. On the other hand, as different as the self-regulated learning models could be, they all acknowledge the pivotal role of the learning strategies played in the process; the strategic components of this multifaceted construct appear to be exclusively associated with self-regulation, and therefore, necessitates examination in their own right. In view of the fact that the relationship between personality traits and self-regulated learning strategies has not been researched extensively, the primary purpose of the present study was to examine whether and to what extent the big-five model (Extroversion, Neuroticism, Agreeableness, Intellect and Conscientiousness) could predict students' perceptions of their use of self-regulatory strategies. The study focused on nine self-regulatory skills, which were identified by Pintrich et al. (1993) and, as reported by the authors, were based on a general model of learning and information processing. These nine strategies and skills are rehearsal, organization, elaboration, critical thinking, metacognition, effort regulation, time and environment management, help seeking, and peer learning. Cognitive (critical thinking, elaboration, organization, and rehearsal) and behavioral (time and effort management, peer learning and adaptive help seeking) self-regulatory skills are key components of the phases of control and monitoring in the Pintrich's (2000) model of self-regulated learning. We used Pintrich's conceptual framework of self-regulatory skills in this study, not only because there was an empirically tested instrument available to assess relevant constructs, but also because the framework encompass a wide range of behavioral and cognitive skills typically studied under the rubric of self-regulated learning.

Although relationships between personality traits and self-regulation learning skills have not been established, based on the accumulated research, a number of meaningful relationships can be explored, primarily with the constructs of Conscientiousness, Intellect, and Agreeableness, and more tentatively, with the constructs of Extroversion and Neuroticism. Consistent with theoretical arguments and previous research on the relationship between Conscientiousness, strategic learning, and cognitive abilities (e.g., Chamorro-Premuzic & Furnham, 2003; Geisler-Brenstein et al., 1996), meaningful connections exist between Conscientiousness on the one hand, and effort, time management, cognitive self-regulatory skills and metacognition on the other. Intellect can be associated with cognitive self-regulatory skills, metacognition, and time and effort management, because of the empirically supported assumptions regarding the relationships between this trait and conventional measures of intelligence, depth of information processing, elaborative learning and strategic learning (Busato et al., 1999; Geisler-Brenstein et al., 1996; Holland, Dollinger, Holland, & MacDonald, 1995; Slaats et al., 1997). Previous research (e.g., Slaats et al., 1997; Vermetten et al., 2001) also suggests that Agreeableness is associated with effort and time management. The links between Extroversion and cognitive and metacognitive skills is more difficult to justify based on the available literature; however, because of the natural gregariousness of the extroverted individuals (McCrae & Costa, 1987), this trait might have a positive bearing on help seeking and peer learning. Despite the fact that theoretical predictions about the relationship between the construct of Neuroticism and the array of self-regulatory skills are difficult to make, following Eysenck (1967), Entwistle (1988), Matthews and Zeidner (2004), a negative relationship between Neuroticism and cognitive skills and metacognition can be predicted.

According to Pintrich (2000), self-regulation potentially mediates the relationship between personal characteristics and academic achievement. Therefore, a secondary purpose of the study was to examine the extent to which self-regulatory skills predict academic achievement over and above the prediction afforded by the big-five factors.

## 5. Methods

### 5.1. Participants

A total of 219 undergraduate students enrolled in nine classes at a large university in Northeastern US were recruited for participation in the study. Undergraduate students were chosen, because they are more likely to have developed self-regulated learning strategies (Pintrich & Zusho, 2002). Sixty-one (28%) of the participating students were male and 158 (72%) were female. Less than 4% ( $n=8$ ) of the participants were international students. The ethnic composition of the sample was as follows: 85% Caucasian, 4% African–American, 5% Asian, and 6% other. The average age of the participants was 22 ( $SD=2.53$ ). The majority of the students in the sample majored in psychology (38%), followed by education (20%), English (12%), communication (6%), history (5%), mathematics (4%), and sociology (4%). Other undergraduate majors as diverse as biology and studio arts were represented by less than 2%.

### 5.2. Instrumentation

The participating students were administered a survey instrument consisting of three parts: demographic questionnaire, Mini-Markers: a brief version of Goldberg's Unipolar Big-Five markers, and the Motivated Strategies for Learning Questionnaire (MSLQ). The demographic part of the survey asked the participants to indicate their gender, age, ethnicity, major, grade point average (GPA), status (domestic or international student), birth order and plans to pursue a graduate degree. Self-reported GPAs are a relatively reliable indicator of student academic achievement. The correlations between actual and self-reported GPA are usually in the range of .70 to .90 (see Cassady, 2001).

#### 5.2.1. Mini-Markers: a brief version of Goldberg's Unipolar Big-Five Markers

The “Mini-Markers” represents a shorter version of the Goldberg's (1992) robust set of 100 adjectives used to measure the Big-Five personality dimensions. The instrument was developed by Saucier (1994) by the means of assessing the performance of the original adjectives of Goldberg's instrument in 12 different data sets, and reducing the number of adjectives to 40 optimally robust items. Traditional psychometric analysis has shown that compared to the original instrument of 100 items, the “Mini-Markers” was comprised of less difficult and more discriminating items. Factor analyses across different samples extracted relatively clean five-factor structures and the five subscales scores corresponding to the big-five personality dimensions had commendable internal consistency estimates. A criterion-related validity study has shown that the correlations between the Mini-Markers subscale scores and undergraduate GPA and SAT scores are comparable in magnitude to these obtained with the Goldberg's Unipolar Big-Five Markers (Dwight, Cummings, & Glenar, 1998). Each personality dimension is assessed by 8 items. Respondents are asked to indicate how accurately each adjective from the set of the 40 available adjectives describes him or herself on a 9-point Likert type scale ranging from 1 (Extremely Inaccurate) to 9 (Extremely Accurate). The internal consistencies of the subscales for the sample of this study ranged from .73 to .86 (see Table 1).

#### 5.2.2. The Motivated Strategies for Learning Questionnaire (MSLQ)

The MSLQ was developed by Pintrich et al. (1993) as a measure of self-regulated learning and is one of the most widely used self-regulated learning questionnaires both nationally and internationally (Duncan & McKeachie, 2005). It consists of 81 questions designated to capture two broad dimensions of self-regulation: motivation and learning strategies. Responses are provided on a 7-point continuous Likert type scale anchored by 1 (not at all true of me) and 7 (very true of me). The motivation section of the questionnaire consists of six subscales and the learning strategies section consists of nine subscales. Each subscale produces a subscale score by averaging the numeric values of the individual responses on the items making up that scale. Previous research has shown that the instruments' subscales have predictive ability, showing positive correlations with students' GPA and SAT scores and reliability estimates within an acceptable range (Duncan & McKeachie, 2005; Pintrich et al., 1993).

Since the interest in the study was in self-regulation in terms of metacognitive, cognitive and management skills, only the 9 self-regulatory subscales of the questionnaire were used. These subscales were: metacognition (representing the metacognitive construct of self-regulation); elaboration, critical thinking, organization and rehearsal (representing the cognitive aspect of the self-regulated learning); and environment and time management, effort regulation, peer learning and help seeking (representing the management component of self-regulation). Brief operational definition for each

Table 1

Correlation matrix: correlations between personality dimensions and self-regulatory learning strategies

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(1) Extroversion	(.86)	.19*	.10	.06	-.05	.07	-.07	.09	.06	.13	.01	.09	.05	.24**	-.00
(2) Agreeableness		(.76)	.25**	.24**	-.30**	.13	.05	.05	.05	-.05	.18**	.20**	-.08	.09	.19**
(3) Conscientiousness			(.80)	.14*	-.18**	.24**	.12	-.04	.18**	.07	.36**	.42**	-.09	.08	.15*
(4) Intellect				(.77)	-.10	.25**	.08	-.07	.31**	.34**	.19**	.23**	-.04	-.05	.31**
(5) Neuroticism					(.73)	-.03	-.01	.06	.02	.09	-.08	-.04	.09	.06	-.16*
(6) Metacognition						(.74)	.53**	.25	.67**	.50**	.55**	.45**	.27**	.23**	.13
(7) Organization							(.65)	.43**	.52**	.25**	.44**	.26**	.31**	.17*	-.03
(8) Rehearsal								(.60)	.23**	.06	.16*	.00	.22**	.17*	-.12
(9) Elaboration									(.71)	.57**	.53**	.41**	.18**	.22**	.12
(10) Critical thinking										(.84)	.31**	.30**	.33**	.19**	.12
(11) Time management											(.74)	.64**	.05	.22**	.23**
(12) Effort regulation												(.68)	-.12	.14*	.33**
(13) Peer learning													(.60)	.56**	-.11
(14) Help seeking														(.60)	.04
(15) GPA															–

\*\* $p < .01$ ; \* $p < .05$ .

construct is provided below. *Rehearsal*, the most basic learning strategy for processing of information, represents a verbal repetition of a material with the goal of memorization. *Elaboration*, a higher order learning skills, is operationally defined as paraphrasing and summarizing. *Organization* includes strategies such as outlining, taking notes and connecting different aspects of the material studied. The learning strategy of *Critical Thinking*, as the name implies, consists of critical evaluations of ideas and application of knowledge to new situations (Pintrich et al., 1993). *Metacognition*, often considered a central component of self-regulated learning, is defined as the individual's awareness, knowledge and control exercised over cognitive processes (Pintrich et al., 1993). *Management of Time and Study Environment* refers to choosing a physical environment conducive to learning, which is free of distractions and allows the student to stay focused on the task at hand (Zimmerman & Risemberg, 1997). The strategy of *Effort Regulation* is close in meaning to volition (Kuhl, 1985) and include an ability to deal with setbacks and failure in the process learning; allocating more effort to unsuccessfully performed tasks (Chen, 2002). *Peer Learning* is using a study group or friends to help learn and *Help Seeking* refers to looking for help from others – peers and instructors – in event of encountered learning difficulties (Pintrich et al., 1993). Based on the sample of this study, the internal consistency (Cronbach's Alpha) of the subscales ranged from .60 to .84 (presented on the diagonal of the correlation matrix in Table 1).

### 5.3. Procedure

Prior to conducting the study, institutional permission for conducting research with human subjects (IRB) was obtained. Data were collected over the course of four consecutive semesters. The survey was administered to students in nine sections of an introductory course in educational psychology. Although the sections were taught by different instructors (advanced doctoral students), same textbooks and similar class assignments were utilized across the nine different sections. The surveys were administered towards the end of the semester to allow the participants to make reasonable judgments about the strategies they tended to employ while studying. The participants were given 30 min at the end of the regular classroom time to complete the survey and the instructors were not present in the classrooms. The questionnaires were administered by the first author. Participants were informed that their participation is voluntary and could be terminated at any time upon their decision not to participate in the study. Partial credit for completing the instruments was given by the instructors.

### 5.4. Results

#### 5.4.1. Correlation analysis

In order to initially examine the interrelatedness of the big-five personality dimensions and the nine strategies of self-regulated learning zero order correlation coefficients were computed first. As can be seen in Table 1, small in size correlations were observed between the following pairs of variables: Extroversion and help seeking ( $r = .24$ ,  $p < .01$ )

Agreeableness and time management ( $r=.18, p<.01$ ); Agreeableness and effort regulation ( $r=.20, p<.01$ ); Conscientiousness and metacognition ( $r=.24, p<.01$ ); Conscientiousness and organization ( $r=.12, n.s.$ ); Conscientiousness and elaboration ( $r=.18, p<.01$ ); Intellect and metacognition ( $r=.25, p<.01$ ); Intellect and elaboration ( $r=.31, p<.01$ ); Intellect and time management ( $r=.19, p<.01$ ); and Intellect and effort regulation ( $r=.23, p<.01$ ). Three medium in size correlations were identified; these were the correlations between Conscientiousness and time management ( $r=.36, p<.01$ ); Conscientiousness and effort regulation ( $r=.42, p<.01$ ) and Intellect and critical thinking ( $r=.34, p<.01$ ).

Grade point average (GPA) had small correlations with Agreeableness ( $r=.19, p<.01$ ), Conscientiousness ( $r=.15, p<.05$ ), Neuroticism ( $r=-.16, n.s.$ ), metacognition ( $r=.13, n.s.$ ), rehearsal ( $r=-.12, n.s.$ ), elaboration ( $r=.12, n.s.$ ), critical thinking ( $r=.12, n.s.$ ), time management ( $r=.23, p<.01$ ), peer learning ( $r=-.11, n.s.$ ), and medium correlations with Intellect ( $r=.31, p<.01$ ) and effort regulation ( $r=.33, p<.01$ ).

#### 5.4.2. Canonical correlation analysis

Canonical correlation was performed between the set of the personality dimensions and the set of self-regulatory skills. Canonical correlation analysis is a multivariate statistical tool that examines the relationship between multiple independent and dependent variables; it involves finding a linear combination for each set of variables that maximizes the correlations between the composite variable for the set of independent variables and the composite variable for the set of the dependent variables (Tabachnick & Fidell, 2001). Additional linear combinations might be further produced to capture the residual variance not explained by the initial correlation.

The analysis was carried out by using SPSS MANOVA. Assumptions of normality and linearity, and absence of outliers were examined through SPSS descriptive programs and SPSS REGRESSION. The available data were screened for univariate outliers by examining  $z$  scores. No cases with absolute  $z$  score greater than 3.26 were identified (see Tabachnick & Fidell, 2001). The presence of multivariate outliers was assessed by the use of Mahalanobis distance. A dummy variable of random numbers was created and regressed on the 14 variables. By using the criterion of Mahalanobis distance with  $p<.001$ , 2 cases were identified as multivariate outliers and deleted (Tabachnick & Fidell, 2001) reducing the data set to 217 cases. Examination of univariate indices of skewness and kurtosis revealed no skewness above an absolute value of .71 and no kurtosis values above an absolute value of .63.

Five canonical functions were produced. With all of them included,  $\chi^2_{(45)}=181.94, p<.001$ , indicating a significant overlap in variability between the variables in the personality set and variables in the self-regulation strategies set. After removing the first and second canonical functions, the  $\chi^2$  were  $\chi^2_{(32)}=83.60, p<.001$  and  $\chi^2_{(21)}=36.81, p<.05$  respectively; subsequent  $\chi^2$  were not statistically significant,  $p>.05$ . These results suggest that the first three canonical functions could be reliably interpreted.

The results of the canonical analysis are presented in Table 2. The table contains the correlations between the variables and the first three canonical variates, standardized canonical variate coefficients, within-set variance accounted for by the canonical variates (percent of variance), redundancies, and canonical correlations.

The magnitude of the 3 canonical correlations was .52 (27% overlapping variance), .41 (17% overlapping variance), and .36 (13% overlapping variance) respectively.

Only variables with loadings exceeding .3 were interpreted (see Tabachnick & Fidell, 2001). Two variables from the personality set (Conscientiousness and Intellect) and five variables from the self-regulatory strategies set (critical thinking, metacognition, effort regulation, time management, and elaboration) were correlated with their corresponding first canonical variates. The results suggest that individuals high in Conscientiousness (.70) and Intellect (.77) tend to report also better critical thinking skills (.63), metacognition (.65), effort regulation (.82), time management (.65), and elaboration (.67).

The second pair of canonical variates indicated that low Intellect (-.40) and low Neuroticism (-.32) coupled with high Conscientiousness (.65) and high Agreeableness (.49) are associated with better time management skills (.45) and effort regulation (.41) but worse critical thinking skills (-.60). Finally, the third pair of canonical variates showed that high scores on the Extroversion dimension (-.90) are associated with high scores on the subscales of help seeking (.77) and rehearsal (.39).

#### 5.4.3. Hierarchical regression analyses

To test whether self-regulatory strategies mediate the effect of personality on achievement, a series of hierarchical multiple regressions were performed. According to Baron and Kenny (1986) mediation is demonstrated only if the

Table 2  
Results of canonical correlation analysis ( $N=217$ )

	First canonical variate		Second canonical variate		Third canonical variate	
	Correlation	Coefficient	Correlation	Coefficient	Correlation	Coefficient
<i>Personality set</i>						
Extroversion	.17	.10	-.14	-.28	.90	.88
Conscientiousness	.70	.65	.65	.61	.28	.02
Intellect	.77	.74	-.40	-.64	-.14	-.24
Agreeableness	.18	-.20	.49	.54	.28	.27
Neuroticism	-.07	.06	-.32	-.12	.26	.37
Percent of variance	.23		.19		.20	Total=.62
Redundancy	.06		.03		.03	Total=.12
<i>Strategies set</i>						
Rehearsal	-.15	-.20	.07	.00	.39	.53
Organization	.21	-.15	.17	.18	-.16	-.35
Elaboration	.67	.25	-.27	-.48	-.00	-.19
Critical Thinking	.63	.29	-.60	-.73	.16	.24
Metacognition	.65	.25	.02	.15	.06	.05
Time	.65	.12	.45	.51	-.04	-.34
Effort	.82	.47	.41	.37	.16	.30
Help seeking	.05	-.04	.10	.13	.77	.91
Peer learning	-.14	-.19	-.20	-.03	.23	-.29
Percent of variance	.27		.10		.10	Total=.47
Redundancy	.07		.02		.01	Total=.10
Canonical correlation	.52		.41		.36	

following three conditions are met: (1) the focal independent variable has a significant effect on the outcome variable; (2) the independent variable is also significantly related to the mediator; (3) and the effect of the independent variable diminishes (partial mediation) or essentially becomes zero (complete mediation) when the mediator is taken into account.

The inspection of the correlation coefficients in Table 1 indicated that the first two assumptions were met for the constructs of Conscientiousness, Intellect and Agreeableness; these variables showed significant positive relationships with GPA and were also significantly related to metacognition, elaboration, critical thinking, time management and effort regulation. Consistent with this observation, three hierarchical multiple regressions were carried out, the results of which are presented in Table 3.

The first regression examined the mediating effect of metacognition, elaboration, critical thinking, time management, and effort regulation on the relationship between Intellect and GPA. The second analysis focused on the link between Conscientiousness and GPA and the mediating effect on metacognition, elaboration, time and effort. The third analysis examined the mediation effect of time and effort on the relationship between Agreeableness and GPA. In all three analyses self-reported GPA was the dependent variable. Two-step regression analysis was conducted in each hierarchical regression; the personality variables were entered at step 1 as covariates and the corresponding set of self-regulation strategies at step 2. The regression assumptions for linearity, homoscedasticity of residuals, and lack of outliers were evaluated using SPSS Regression. No univariate and multivariate outliers were identified and collinearity diagnostics indicated no cause for concern. The plot of the predicted values of GPA against residuals showed that the multiple regression assumptions of linearity and homoscedasticity of residuals were met.

The unstandardized regression coefficients, the standard errors associated with them and the standardized regression coefficients are displayed in Table 3. At step 1, the regression coefficients of the three personality factors were all statistically significant. In hierarchical regression I, the regression coefficient of Intellect was slightly reduced at step 2 and the constructs of self-regulation (mainly effort regulation) contributed unique variance. Intellect explained 10% of the variance in GPA. Self-regulation strategies contributed another 8% unique variance to the prediction; after the last step with all independent variables in the equation, the variance explained was 18% [ $R^2=.18$ ,  $F(6, 216)=24.31$ ,  $p<.001$ ]. A different pattern emerged in hierarchical regressions II and II. After the corresponding sets of self-regulation strategies were entered at step 2; the regression coefficients for the effect of Conscientiousness and

Table 3  
Summary of hierarchical regression analysis for variables predicting grade point average ( $N=217$ )

	Model	Independent variable	$R^2$	$B$ (SE)	$\beta$	$\Delta R^2$
Hierarchical regression I	1	Intellect	.10	.02(.00)	.32**	
	2	Intellect		.02(.00)	.28***	.08
		Metacognition		-.04(.06)	-.06	
		Critical thinking		.00(.03)	.01	
		Elaboration		-.05(.05)	-.10	
		Effort regulation		.13(.04)	.27**	
		Time management		.04(.03)	.08	
Hierarchical regression II	1	Conscientiousness	.02	.01(.00)	.14*	
	2	Conscientiousness		.00(.00)	.00	.09
		Metacognition		-.02(.06)	-.04	
		Elaboration		-.01(.05)	-.03	
		Effort regulation		.15(.04)	.31**	
		Time management		.03(.05)	.06	
		Agreeableness		.01(.01)	.01	
Hierarchical regression III	1	Agreeableness	.02	.01(.01)	.15*	
	2	Agreeableness		.01(.01)	.10	.10
		Effort regulation		.01(.04)	.29**	
		Time management		.14(.04)	.02	

\*\*\* $p < .001$ ; \*\* $p < .01$ ; \* $p < .05$ .

Agreeableness on GPA became statistically non-significant, not different from zero. In both occasions, effort regulation completely mediated the relationships between Agreeableness and Conscientiousness and GPA. The percent of explained variance in hierarchical regression II and III was 11% [ $R^2 = .11$ ,  $F(5, 216) = 5.03$ ,  $p < .001$ ] and 12% [ $R^2 = .12$ ,  $F(3, 216) = 9.21$ ,  $p < .001$ ] respectively.

## 6. Discussion and conclusion

The present study attempted to explore the relationships between a selected set of self-regulated learning strategies and the big-five personality dimensions. Canonical correlation analysis was used to evaluate the overall relationship between self-regulation learning strategies and personality. In addition, hierarchical multiple regression was conducted to predict academic achievement, with the big-five personality dimensions as predictors and self-regulatory learning strategies as mediators. The study was partially successful in identifying behavioral regularities pertaining to learning and personality, and suggested that self-regulated learning strategies may be embedded in more general personality functioning.

The results of the study show that self-regulated learning strategies, which individuals typically employ in learning situations, co-vary with personality dimensions to a certain extent, implying that self-regulated learning, in general, might have personality underpinnings. The study lent support to the idea that there is a consistency in the learning strategies used by college students, which partially stem from habitual patterns of behaviors implied by personality trait theory. Canonical correlation analysis showed that personality factors and self-regulation learning strategies share a modest overlap; the personality dimensions and the self-regulation learning strategies cluster together in at least two different ways.

The first pair of canonical variates, accounting for significant relationships between personality and self-regulated learning strategies, indicated that high Conscientiousness and Intellect were related to higher tendencies for the use of time management and effort regulation and higher order cognitive skills such as elaboration, critical thinking, and metacognition. The fact that Conscientiousness was significantly related to students' tendencies to manage their learning efforts and structure their time and learning environment is not surprising. Students who were conscientious and described themselves as cooperative were likely to have a designated place for studying or choose a study place where they could be more focused, and to skillfully manage and make a good use of their study time. The intrinsic connectedness of Conscientiousness and time and effort regulation was expected because the construct of conscientiousness is expressed by attributes such as self-discipline, deliberation, hard-working attitude, order, dutifulness, compliance, and imperturbability (Chamorro-Premuzic & Furnham, 2003; McCrae & Costa, 1987). The empirical link between Intellect and the higher order cognitive skills of elaboration, critical thinking, and

metacognition is conceptually meaningful as well. Students' propensity for evaluating information critically, reflecting upon their own learning, and thinking about their own thinking while performing a task, is partially explained by habitual ways of acquiring and processing information.

The second significant pair of canonical variates linking relevant variables from the two sets revealed an interesting possible mechanism through which personality and self-regulation learning strategies might act together within educational context. The grouping of the variables suggests that students who are more conscientious, agreeable, and emotionally stable but with low scores on Intellect, are more likely to regulate their time and effort effectively despite their low critical thinking skills. This finding implies that Agreeableness, Conscientiousness and Emotional Stability not only predispose individuals to invest more time and efforts; they could also be important compensatory mechanisms for students lacking the intellectual potential to deal with the complexity of cognitive challenges posed in various academic situations.

As for the predictive efficacy of personality and self-regulated learning strategies on academic achievement, personality attributes do not fully explain student achievement but factors associated with the construct of self-regulation are also important; effort regulation and Intellect stands out from the other constructs in predicting students' GPA. These results suggest that, irrespective of the specific features of particular learning situations, students who tend to regulate their efforts and describe themselves as deep, intellectual, creative, imaginative and seeking new knowledge, are likely also to perform better in academic setting compared to their counterparts lacking these qualities. In addition, the study uncovered that self-regulated learning strategies, particularly effort regulation, mediate the relationship between Conscientiousness and academic achievement as well as that between Agreeableness and academic achievement.

The findings of the study are consistent with previous research indicating that effort regulation is one of the most salient predictor of academic achievement (Busato, Prins, Elshout, & Hamaker, 2000; Chamorro-Premuzic & Furnham, 2003; Chen, 2002; Pintrich et al., 1993) and that hard-working attitude enhances student ability to achieve positive outcomes (Chen, Fok, Bond, & Matsumoto, 2006) despite constraints that might be imposed by individual level predispositions. By employing objective criteria of achievement such as test scores on in-class examinations, Chen (2002) reported that only effort regulation was significantly associated with achievement in an introductory information system undergraduate course. In the process of criterion validation of MSLQ, the authors of the instrument found that the scores on Effort Regulation showed the strongest relationship with GPA as well (Pintrich et al., 1993).

Vygotsky (1978) once noted that, in order for educators to know where their students are going, they need to know also where they are coming from. In other words, educators need to be cognizant of their students' antecedent characteristics. The present study provides a glimpse of some of those antecedent characteristics and their potential impact on learning. Consistent with previous research on personality and learning, personality and academic achievement, the study found that self-regulated learning strategies have important personality correlates. Without discounting the assumption that academic self-regulated learning strategies and self-regulated learning in general are learnable characteristics, amenable to change with appropriate training and efforts, the results of the present study suggest that educators should be aware of the personality predispositions each student brings to a specific learning situation (Snow, Corno, & Jackson, 1996). It could be further hypothesized that the learnability or ease of the development of self-regulatory skills could be either mediated or moderated by those stable personality predispositions. While the present study uses personality variables as predictors, future research can set up self-regulation training as a treatment or intervention, and use personality variables as moderators to see whether certain personality characteristics indeed facilitate or impede the acquisition of self-regulatory skills under the treatment condition. From an intervention point of view, formal and informal assessment of students' personality characteristics may inform the instructor as to who will naturally develop self-regulatory skills in response to task demands imposed by specific classes and who may not develop these skills without explicit training. For example, the chances of a conscientious and agreeable child to develop good "study habits" in terms of self-regulatory skills are much higher than for a child who does not possess these qualities. In general, with the knowledge of the relationship between personality and self-regulated learning, teachers will be in a better position to explain and predict children's behavioral patterns in learning settings, and design individualized interventions accordingly. The results of the mediation analysis seems to suggest that effort regulation is only partly determined by the more distal and perhaps more basic traits of Conscientiousness and Agreeableness, thus amenable to interventions within educational or occupational contexts.

There are several limitations in the present study that are worth discussing with the aim of informing future research. The first limitation is that measures of self-regulatory skills (and for this matter, GPA) were not derived independently

of personality trait measures. The validity of the entire study relies on the assumption that participants fully differentiated the two sets of measures of big-five traits and self-regulated learning, with one tapping into habitual patterns of behavior (i.e., traits), and the other as a set of skills at one's disposal in dealing with academic tasks. More rigorous designs are needed to establish the validity of the established relationship between academic self-regulation and personality, using behavioral and observational measures of self-regulation that are independent of the sources of the measures of personality traits.

In addition, the validity of the inferences in the study hinges upon the reliability of the self-reported GPA as a measure of achievement. Although there are studies that have established nearly perfect positive correlations between actual GPA and self-reported GPA (e.g., Cassady, 2001), a number of writers have argued that there is a greater inflation by students with lower GPAs than by students with higher GPAs (Dobbins, Farh, & Werbel, 1993; Frucot & Cook, 1994). This limitation hampers the ability to interpret the results with confidence. For example, the effect of Intellect on GPA seemed to by-pass the self-regulatory strategies variables; the very variables that correlated well with Intellect failed to correlate significantly with GPA. Could it be that Intellect simply reflects more basic cognitive abilities, independent of learning strategies, directly contributing to academic achievement, or was it simply a problem of measurement?

The restricted nature of the sample studied should also be noted. One may ask whether the same pattern of results will be obtained if children and adolescents instead of young adult college students are involved. Therefore, the conclusions drawn should be considered with these sampling and measurement issues in mind.

For all these limitations, the study provides evidence suggesting the existence of important connections between personality and self-regulatory processes that warrant more research attention. The main contribution of the study is its identification of personality dispositions as a source of students' self-regulated learning strategies, in addition to its social-cognitive and developmental origins. The finding that both personality traits and self-regulated learning strategies contributed unique variance to GPA further adds credence to these constructs as having significant bearings on academic achievement.

Future research should further clarify how personality traits predispose individuals to employ self-regulated learning, and how these dispositions interact with learning conditions in developing relevant self-regulated strategies. The findings of the study are tentative and need to be verified in further research as the theoretical predictions made in the study were broad-brushed rather than fine-grained. A fully informed theoretical model incorporating motivational variables should be built and empirically tested. The possibility that constructs such as goal setting, self-efficacy, and intrinsic motivation might occupy an intermediate position between individual difference predisposition and the choice of self-regulatory strategies depending upon the specific characteristics of the learning contexts should be further explored. The impetus of the study was to bring to attention some deep connections between self-regulated learning and personality traits, rather than providing definitive answers. Future research can use relevant personality variables as moderators of self-regulation training or interventions in an experimental design to determine whether individuals with certain traits (e.g., Conscientiousness) are indeed more inclined to develop, or more motivated to use, specific self-regulatory skills.

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