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COGNITIVE ABILITY, SELF-UNDERSTANDING AND PERSONALITY: DYNAMIC INTERACTIONS IN ADULTHOOD

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::POVZETEK

KOGNITIVNE SPOSOBNOSTI, SAMORAZUMEVANJE IN OSEBNOST: DINAMIČNE POVEZAVE V ODRASLI DOBI

V pričujoči študiji smo raziskovali povezave med kognitivnimi sposobnostmi, samorazumevanjem in osebnostjo. Želeli smo ugotoviti, ali so sposobnosti na različnih področjih rezoniranja ter samoevalvacije in predstave o samem sebi na teh področjih, povezane z velikimi petimi faktorji osebnosti. Na podlagi dosedanjih raziskav smo predvidevali, da obstajajo povezave med dimenzijami kognicije, samorazumevanja in osebnosti.

Rezultati so pokazali, da so osebnostne značilnosti različno povezane s kognitivnim delovanjem in s predstavami o samem sebi kot kognitivnem subjektu. Kognitivne sposobnosti so bile sicer statistično pomembno, vendar šibko povezane z dvema od velikih petih dimenzij osebnosti, in sicer odprtostjo in vestnostjo. Faktor kognitivne samoreprezentacije pa je kazal visoko statistično pomembno povezavo z odprtostjo in zmerno korelacijo z ekstravertnostjo, prijetnostjo in vestnostjo.

Ključne besede: kognitivne sposobnosti, samoevalvacija, predstava o samem sebi, osebnost, razvoj

ABSTRACT

This study investigates the relations between cognitive ability, self-understanding, and personality. That is, the study was designed to specify if reasoning ability in different domains and self-evaluation and self-representation in these domains are related to each of the Big Five factors of personality. The general assumption, which is suggested by a number of recent studies, is that there indeed are relations between these three distinct dimensions (i.e., cognition, self-understanding, and personality) of the person. This study aspires to further decipher and clarify these relations. The results revealed that personality is variably related to cognitive functioning and cognitive self-representations. Specifically, cognitive ability was significantly but weakly related to only two of the dimensions of personality, namely openness and conscientiousness. On the other hand, there was very high positive correlation between the general self-representation factor and openness to experience, and moderate correlations with extraversion, agreeableness and conscientiousness.

Keywords: cognitive ability, self-evaluation, self-representation, personality, development

::THE MIND

Recent research by Demetriou and colleagues (Demetriou, Christou, Spanoudis, & Platsidou, 2002) suggests that the mind is a three-level hierarchical structure. It involves three functionally distinct levels. The first level interfaces directly with the environment and it includes several specialized capacity systems addressed to the representation and processing of different domains of the environment. The other two levels comprise general-purpose mechanisms and processes, namely *processing potentials* that define representational and processing capacity and *hypercognitive* processes allowing self-awareness and self-regulation (Demetriou, Efklides, & Platsidou, 1993; Demetriou & Kazi, 2001, 2006; Demetriou, Mouyi, & Spanoudis, 2008).

Specialized capacity systems are inferential and problem solving devices that specialize in the representation and processing of different types of information and relations in the environment. As such, they include domain-specific procedures and mental operations which reflect the peculiarities of the elements and the relations that characterize a specific part of reality. Finally, they are symbolically biased in the sense that the symbolic systems used are the most conductive to the representation of its own elements, properties and relations (Demetriou, Mouyi, & Spanoudis, 2008).

Empirical research has identified the following six domains of thought. (1) The *categorical system* deals with similarity-difference relations. (2) The *quantitative system* deals with quantitative variations and relations in the environment. (3) The *causal system* deals with cause-effect relations. (4) The *spatial system* deals with orientation in space and the imaginal representation of the environment. Mental images and operations on them belong to this system. (5) The *propositional system* deals with the truth/falsity and the validity/invalidity of the flow of information in the environment and in systems of representation about the environment. Different types of logical relationships such as implication and conjunction belong to this system. (6) The *social system* deals with the understanding of social relationships and interactions. Mechanisms for monitoring non-verbal communication or skills for manipulating social interactions belong to this system (Demetriou, 2000; Demetriou & Efklides, 1985, 1989; Demetriou et al., 1993; Demetriou & Kazi, 2001).

Processing potentials constrain the complexity and efficiency of information processing at any given moment. They are normally defined in terms of very general processes, such as speed of processing, executive control enabling selective attention and inhibition of task-irrelevant stimuli or responses, and working memory (Demetriou et al., 2002, 2008). In traditional theories of intelligence, these processes are considered to be causally related to individual

differences in general intelligence (Jensen, 1998). In developmental theories, changes with age in any of these processes are considered to be systematically related to changes in the kind and complexity of thought (Case, 1985; Demetriou et al, 1993, 2002, 2008); Halford, 1993; Pascual-Leone, 1993).

Hypercognition includes self-awareness and self-regulation knowledge and strategies which operate as the interface between (a) mind and reality, and (b) any of the various systems and processes of the mind. Hypercognition - concept, very similar to metacognition (Flavel, 1979), involves two central functions, namely *working hypercognition* and *long-term hypercognition*.

Working hypercognition is a strong directive-executive function that is responsible for setting and pursuing mental and behavioral goals until they are attained. This function involves processes enabling the person to (1) set mental and behavioral goals, (2) plan their attainment, (3) evaluate each step's processing demands vis-à-vis the available potentials, knowledge, skills and strategies, (4) monitor planned activities vis-à-vis the goals, and (5) evaluate the outcome attained. These processes operate recursively in such a way that goals and subgoals may be renewed according to the online evaluation of the system's distance from its ultimate objective. These regulatory functions operate under the current structural constraints of the system that define the system's current maximum potentials (Demetriou, 2000; Demetriou & Efklides, 1989; Demetriou & Kazi, 2001).

Consciousness is an integral part of the hypercognitive system. The very process of setting mental goals, planning their attainment, monitoring action vis-à-vis both the goals and the plans, and regulating real or mental action requires a system that can remember and review and therefore know itself. Therefore, conscious awareness and all ensuing functions, such as a self-concept (that is, awareness of one's own mental characteristics, functions, and mental states) and a theory of mind (that is, awareness of others' mental functions and states) are part of the very construction of the system. In fact, long-term hypercognition comprises the models and representations concerning past cognitive experiences that result from the functioning of working hypercognition. These models involve descriptions about the general structural and dynamic characteristics of the mind and prescriptions and rules about the efficient use of the functions.

::Personality

Research in the psychometric tradition has established empirically a five-factor structure of personality (McCrae & Costa, 1997). This structure includes the dimensions of Extraversion, Agreeableness, Conscientiousness,

Emotional Stability (or Neuroticism), and Openness to Experience. Demetriou and Kazi (2001) suggested that the Big Five factors of personality correspond to the domain-specific systems that reside at the environment-oriented level of knowing. That is, the domain-specific systems of understanding channel the functioning of the mind and the Big Five factors channel patterns of action and relationships with the social and cultural environment. Therefore, personality theorists argue that personality provides the framework within which intelligence and mind operate. In other words, the various dimensions of personality may be seen as alternative dispositions to relate and interact with the world in particular ways (Costa & McCrae, 1997; Ferrari & Sternberg, 1998). As such, they constitute alternative formations of temperament which is the dynamic aspect of processing potentials. Thus, the processing potentials constrain the complexity and type of information that can be understood at a given age and temperament constrains how information is to initially be received and reacted to. These constructs are controlled and intertwined by the active processes of self-knowing and self-regulation involved in working hypercognition. Therefore, these processes generate representations about personality dispositions in the same way that they generate representations about cognitive abilities.

In line with this model, several studies have shown that the Big Five factors of personality that emerge from self-rating tests of personality are highly related with measures of self-representation and self-evaluation (Demetriou et al., 2003; Demetriou & Kazi, 2001, 2006). The relations between actual cognitive ability and personality are generally weaker. Specifically, significant correlations have been found between openess and general intelligence (Austin et all., 2002, Kyllonen, 1997 and Moutafi et al., 2003) and significant negative correlations between Neuroticism and intelligence (Ackerman and Heggestad, 1997, Kyllonen, 1997, Moutafi et al., 2003). Findings on the relations between intelligence, on the one hand and extraversion or conscientiousness, on the other hand, have been controversial. Some studies have shown positive and some negative correlations between these variables (Furnham, 2008).

There is always some kind of self-awareness about one´s own cognitive, personality, and behavioral characteristics. However, accuracy in self-awareness varies both within developmental phases and along life-span development (Demetriou and Bakracevic, 2009; Demetriou and Kazi, 2001, 2006). Specifically, self- awareness is inaccurate at the beginning of each developmental phase and it tends to become more accurate by the end of the phase. This indicates that individuals need time and experience to acquire sensitivity about the condition of the cognitive processes that characterize a particular phase. Overall, accuracy in self-awareness and self-representation is first attained for

more easily observable aspects of mental, emotional, and behavioral processes and it then extends to more internal and abstract processes. Moreover, it is assumed that, with age, persons become more reflective and self-aware of their own cognitive processes and abilities (Bakracevic Vukman, 2005; Baltes & Staudinger, 2000; Demetriou, 1990; Demetriou & Kazi, 2001, 2006; Harter, 1999; Kuhn, 2000; Labouvie-Vief, 1992; Moshman, 1990; Nicholls, 1990).

The main aim of this study is to specify how the Big Five factors of personality interrelate with actual cognitive performance and with self-awareness about it as it is reflected in cognitive self-representations and self-evaluations from adolescence to middle adulthood. In the sake of this aim participants were examined by tasks addressing three of the domains specified above, that is spatial, verbal, and social reasoning. They were asked to evaluate the difficulty of the tasks addressed to them, their subjective success on them, and their general self-representations about their performance in the various domains. Personality was examined by the Big Five factors of personality inventory. Based on earlier research, it is expected that personality would be closely associated with hypercognitive processes. Of the Big Five factors, openness to experience and conscientiousness would be more closely associated with actual cognitive performance than the other three factors (Demetriou et al., 2003).

::METHOD

::Participants

The study involved a total of 282 participants, drawn from four different age groups, namely adolescence (13-15 years of age), early adulthood (23-25 years of age), middle adulthood (33-35 years of age), and mature adulthood (43-45 years of age). Specifically, the youngest age group involved 42 adolescents (22 males, 20 females) drawn from the last year of compulsory education. Each of the three adult groups was equally divided between a sub-group of persons with university education and a sub-group of persons who only completed compulsory education or they attended the equivalent of vocational education. Genders were equally represented in all (i.e., there were 20 males and 20 females) but one (there were 18 males and 22 females in the sub-group of the 33-35 yrs-old adults with university education) of the six adult sub-groups.

::Task Batteries and Inventories

All participants were examined by the following tasks and inventories. *Reasoning*. The reasoning battery addressed the three domains of reasoning

mentioned in the introduction, namely spatial, verbal - propositional, and social reasoning. Each domain was addressed by three tasks of increasing difficulty. These tasks are described below.

Spatial reasoning. The tasks addressed to spatial reasoning (see Figure 1) examined mental rotation and the ability to integrate mental images.
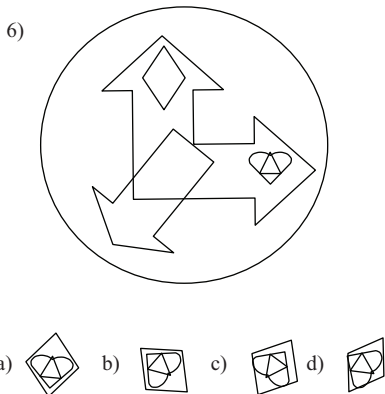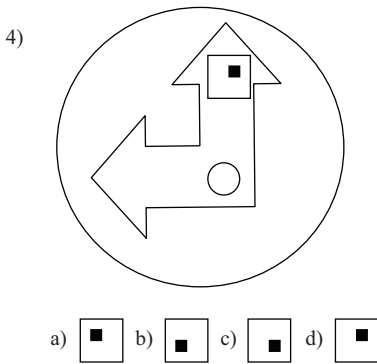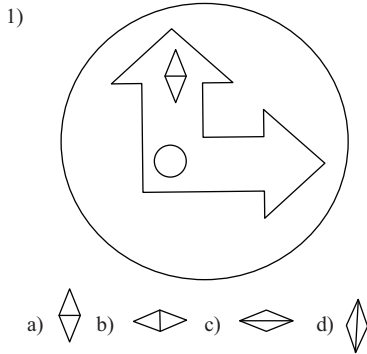

Figure 1. Some items of clocks task
Note: Correct options are b, a, and d for the three Figures, respectively

Difficulty in this task was controlled in reference to the complexity of the figures involved and the effect of rotation on the various components. Specifically, task 2 is more difficult than task 1 because it requires conceiving the effect of rotation on two independent elements (the larger square and the smaller square inside it) whereas task 1 only requires conceiving of the effects of rotation on the orientation of an integrated diamond. Task 3 is considerably more complex than the other two because it requires the mental rotation and integration of several figures.

Verbal- Propositional reasoning. Three series of dialogs (problems) were presented and the participant was to draw the logically valid conclusion suggested by the dialogues by integrating the premises. Specifically, the participants were told that their task was to find where a ring is located from what is said by each of the two girls, Verity (who always tells the truth) and Falsity (who always tells lies).

In logical terms, the first two problems were addressed to modus tollendo ponens and the third to modus tolens. In terms of difficulty, the first problem was the easiest of the three, because the thinker must integrate a disjunctive proposition with a simple affirmative proposition that specifies what of the two alternatives stated by the first proposition is not right. The second problem involved two disjunctive propositions thereby increasing the mental objects to be represented and transformed. Finally, the third problem was more complex than the other two problems because the thinker must integrate a complete syllogism with a statement that defines its truth value.

Social reasoning. Three tasks tapped social reasoning. Specifically, each of these tasks presented a story about a social incidence leading to conflicting views on the basis of moral criteria or criteria of personal or social interest. The participant's task was to evaluate the information presented in the story and take a stance related to the conflicting views presented. Thus, in general, these tasks addressed moral reasoning and social understanding.

Problem 1 was considered to be easiest of the three because it referred to a rather simple and familiar situation. Problem 2 was more difficult and problem 3 was the most difficult of the three because it referred to a complex socio-political situation where correct response required to integrate action of two different collective agents. In term of Kohlberg's (1984) stages of moral development, problem 1, 2 and 3 represent level 4, 5 and 6 of moral reasoning.

Cronbach's alpha for the battery as whole was moderate (.52). However, this is understandable given the small number of items involved and the fact that performance on them was scored on a pass-fail basis.

Self-evaluation of performance. After solving each of the nine tasks, the participants were asked to evaluate their performance and the perceived difficulty

of the task in reference to a seven-point scale. In concern to the evaluation of performance, the participants were asked the following question: "How correct do you think your answer is?" The 7-point scale in regard to this question varied from 1 (it was completely wrong) to 7 (it was absolutely correct). In regard to the evaluation of perceived difficulty, the question was as follows: "How difficult was this problem for you? " The 7-point scale in regard to this question varied from 1 (it was extremely easy) to 7 (it was extremely difficult). Cronbach's alpha was very high for both evaluation of performance (.88) and perceived difficulty (.85).

Cognitive self-representation. A cognitive self-representation inventory was employed that was first used by Demetriou and colleagues (Demetriou & Kazi, 2001; Demetriou et al, 2003). This inventory focuses on the person's self-representation about cognitive abilities. Specifically, this inventory probes one's self-representation about general cognitive processes and characteristics, such as learning, memory, and efficiency of processing, and specialized domains of reasoning, including the three domains addressed by the tasks presented above. The inventory involves a total of 77 statements describing a particular cognitive process or ability, and the participant's task was to specify how much it applies to himself or herself in reference to a five-point scale that varied from 1 (almost not at all) to 5 (very much). These statements addressed the two general levels of the architecture of the mind, that is, the processing and the hypercognitive system, and the six specialized domains, that is, the domains of categorical, quantitative, causal, spatial, verbal, and social reasoning.

For the purposes of the analyses to be described below, only self-ratings about the three domains of interest (i.e., spatial, verbal, and social reasoning) and also about self-monitoring and self-regulation were used.

Cronbach's alpha for this inventory was very high (.93).

Personality. Finally, participants were examined by a test addressed to the Big Five factors of personality that was standardized in Slovenia (Caprara, Barbaranelli, Borgogni, Bucik, Boben, 1997). That is, this test addressed the factors of extraversion, agreeableness, conscientiousness, neuroticism, and openness to experience.

::Procedure

Participants were tested in groups, but they worked individually and interaction between them during testing was not allowed. A booklet was given to each of them, which contained all of the problems and inventories. Within each domain, problems were presented in the same order to all participants, from easy to difficult. Presentation order of domains was counterbalanced

across participants. Evaluation of success and difficulty always followed the solution of each task. Personality test (BFQ) was given to the respondents after the cognitive tests.

::RESULTS

::The Structure of Abilities and Processes

To test our predictions about the structure of the various processes and specify their relations, a complex structural equations model was examined. This model is depicted in Figure 2. It can be seen that this model involved the following factors. First, each set of three tasks addressed to a domain of though, each set of three evaluation scores representing the participants' evaluation of their performance, and each set of three difficulty evaluation scores representing subjective difficulty of the task addressed to the same domain were prescribed to load on a separate factor. Moreover, there were four cognitive self-representation factors, one for each of the three domains of thought and one for self-monitoring and self-regulation. Each of these factors was associated with three mean scores representing self-ascription of ability as given to the statements involved in the self-representation inventory. Therefore, in total, there were three domain-specific performance factors, three domain-specific self-evaluation, and three domain-specific difficulty evaluation factors, three domain-specific self-representation factors, and a general self-monitoring and self-regulation factor. Each of these four sets of first-order factors was regressed a second-order factors. Thus, the four second-order factors stand general cognitive performance, general self-evaluation of performance, general self-evaluation of difficulty, and general cognitive self-representation.

Moreover, the following relations between factors were built into the model. The general self-evaluation, general self-evaluation of difficulty, and general cognitive self-representation were regressed on the general cognitive performance factor. This set of relations reflects the assumption that all kinds of self-evaluation and self-representation somehow reflect the condition of actual abilities. The two self-evaluation factors were also regressed on the general self-representation factor. These relations reflect the assumption that self-evaluation, in addition to the actual condition of ability at a given moment also reflects the persons' general cognitive self-concept. Moreover, each domain-specific self-evaluation factor was regressed on the residual of its corresponding domain-specific performance factor and each domain-specific difficulty evaluation factor was regressed on both the residual of the corresponding performance factor and the residual of the corresponding
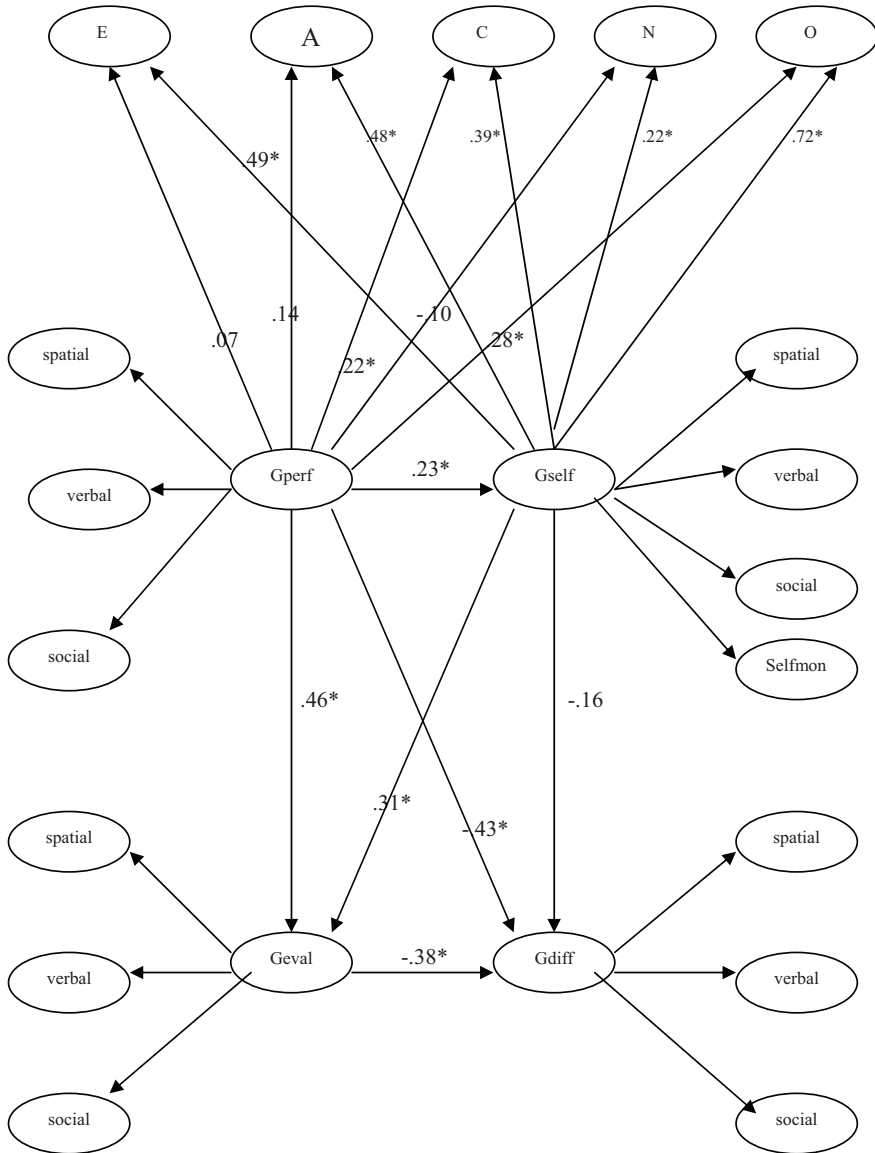
Figure 2. The structural model of the relations between the performance, self-evaluation of success and difficulty, self-representation, and personality factors. Fit: X2(857) = 1327.222, p=.000, CFI=.908, RMSEA=0.044, 90% confidence interval of RMSEA=.039 - .049

self-evaluation of performance factor. This set of relations examines the assumption that self-evaluation of performance and difficulty, in addition to general processes and dynamics is affected by processes and dynamics related to the particular domains, such as possible differences in the perceptibility

of different kinds of mental processes (contrast, for example, mental rotation with syllogistic reasoning).

Finally, the five scores standing for the Big Five factors of personality were regressed on the general performance factor and the residual of the general self-representation factor. These relations aimed to specify how each of the five factors of personality is related to cognitive ability as such and self-representation about it.

The fit of this model is fully acceptable, χ^2 (857) = 1327.222, p = .000, χ^2/df= 1.548, cfi = .908, rmsea = .044, 90% confidence interval for rmsea = .039 - .049). The pattern and size of relations in the model suggest some highly interesting conclusions about the relations between the various processes. First, although of varying magnitude, all of the relations between the second-order factors built into the model were significant. Specifically, self-evaluation of performance was related to both actual performance (.456) and general cognitive self-representation (.310). Evaluation of difficulty was related to all other factors, that is, actual performance (-.434), self-evaluation of performance (-.382), and, to a lesser extent, general self-representation (-.158). General self-representation was moderately related to actual performance (.232). Therefore, it is clear that task-specific subjective evaluations are not arbitrary. They are geared in actual performance and to a considerable extent reflect its status and they are also affected by one's general cognitive self-concept, which actually is the distillation of cognitive experiences and self-evaluations of the past. Likewise, self-evaluation of difficulty reflects actual performance, self-evaluation of it, and general self-representation. Attention is drawn to the fact that of the various relations between the first-order factors only those involving the domain of spatial thought were significant. This finding, which is line with previous research (Demetriou et al. 1993; Demetriou & Bakracevic, 2009; Demetriou & Kazi, 2001, 2006) suggests that spatial processes are more amenable to awareness than other processes, especially social reasoning. Finally, attention is drawn on the relations between cognition and personality. It can be seen that, on the one hand, all five factors were significantly related to the general cognitive self-concept. These relations varied from low (with neuroticism) to very high (openness to experience). On the other hand, the relations between the Big Five factors and actual cognitive ability were much weaker and they reached significance in only two cases (that is, conscientiousness and openness to experience). Thus, it is suggested that all of the Big Five factors but neuroticism involve a strong cognitive self-representation component and one of them is almost commensurate with it. At the same time, only two of these factors are related, to some extent, to the actual condition of cognitive ability. These findings,

corrohorate and extent earlier research on the relation between personality and cognitive processes (Demetriou, et al. 2003).

::DISCUSSION

Traditionally, research on intelligence employs only measures of intellectual abilities. Only rarely these measures are related to self-processes of monitoring, evaluation and regulation of cognitive activity (Demetriou & Kazi, 2001, 2006). Moreover, it is only recently that research focused on the relations between various aspects of cognitive ability and personality. This study included measures addressed to all three types of processes, that is, cognitive abilities, self-processes about them, and personality. The results revealed that personality is variably related to cognitive functioning and cognitive self-representations. Specifically, cognitive ability is significantly but weakly related to only two of the dimensions of personality, namely openness and conscientiousness. Moreover, only openness to experience was significantly related to cognitive ability in all age-groups. This is in line with earlier studies which found that openness is the personality dimension that is most consistently related with intelligence (Zeidner, Matthews, 2000). These results support the assumption (Demetriou et al.,, 2003) that openness to experience may be conceived as the translation of cognitive ability into personality dispositions related to cognitive functioning. Open, curious individuals tend to explore their environment, have wide range of interests and try to find answers to many questions (Furnham, 2008). On the other hand, neuroticism was in two age groups negatively correlated with cognitive performance. This finding is not surprising, because there is negative correlation between intelligence and anxiety, which is one of the sub-factors of Neuroticism (Moutafi et al., 2003). Research has shown that anxiety can influence intellectual performance, especially in test-taking situations. There are also findings which show that state anxiety in cognitive task can to some extent be predicted by self-efficacy (Endler, Speer, Johnson & Flett, 2001).

Thus, it should be stressed that all five personality factors were significantly correlated with self-representations about these cognitive abilities. There was very high positive correlation between the general self-representation factor and openness to experience, and moderate correlations with extraversion, agreeableness and conscientiousness; the relation with neuroticism was low. This is in line with the explanation advanced by Demetriou et al (2003) that cognitive self-representations operate at the same level of the mind as self-reported personality characteristics, because both of them, are self-representations. Thus, self-representations include a branch dedicated to cognition and one dedicated

to personality and these are interrelated and integrated by the self-monitoring, self-representations and self-regulation processes of the hypercognitive system. In other words, hypercognition is the liaison between cognitive and personality functioning. This finding is in line with the construct of "intelligent personality" proposed by Chamorro-Premuzic and Furnham (2006), which includes ability, personality, and self-insight. According to them, all these factors can help to explain the development of abilities and the individual's capacity to acquire knowledge over the life-span.

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