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Mind, Self, and Personality: Dynamic Interactions From Late Childhood to Early Adulthood

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This paper aims to integrate research on mind, personality, and self-development using a general model which hypothesizes that mind and personality are organized in 3 levels. The first level includes environment-oriented, domain-specific systems that specialize in the representation of and interaction with particular types of relationships in the environment in both the cognitive and the social realms. The second level comprises self-oriented monitoring and representation processes that build maps of the environment-oriented systems. Self and identity derive from the interaction between these 2 levels, which is subject to the constraints and the system's processing capacity at the successive ages. These constraints may be taken as the third level of the self. Efficiency in overcoming these constraints is determined by the self-oriented processes, generating feelings and self-representations of self-worth. These feelings are idiosyncratic, and function as a personal constant, which is applied on self-evaluation and self-representations. This constant is rescaled and differentiated with development. Thus, we have simultaneously both modular and transmodular constructs in the mind and the self, which change with relative independence of each other under the constraints of the general processing capabilities and the personal constant. A series of studies are presented to support this model, and its implications for life-span theories of development are discussed.

KEY WORDS: cognitive development; hypercognition; personality; self-awareness; thinking styles.

Intelligence, mind, personality, and self are complementary aspects of the same entity: the individual in interaction with the physical, social, and symbolic worlds. Intelligence refers to the abilities related to knowledge acquisition, understanding, and learning that allow the individual to cope with the changing demands of the world (Demetriou & Kazi, 2001; Jensen, 1998; Sternberg, 1985). Mind refers to exactly the same processes, although the emphasis shifts from the individual's relationships with the environment to those referring to herself or others as thinking agents; thus mind refers to self-awareness about thinking, understanding, and learning (Perner, 1991; Wellman, 1990). Personality refers to dispositions to relate and interact with the world in particular ways, and so provides the framework within which intelligence and mind operate (Costa & McCrae, 1997; Ferrari & Sternberg, 1998). The self refers to all these dimensions together as they are experienced, sensed, understood, and defined by each individual to produce the individual's personal identity (Demetriou & Kazi, 2001; Demetriou, Kazi, & Georgiou, 1999; Harter, 1999). Despite their complementarity, these aspects of the person have been examined separately in psychology, resulting in conceptually and epistemologically very different theories. As a result, the common ground and the dynamic relationships between the dimensions have not been clearly defined.

This paper summarizes a series of studies designed to contribute to the formation of an overarching model that would restore in theory the unity of intelligence, mind, self, and personality that exists in reality. Specifically, the paper attempts to answer questions such as the following: What precisely is involved in self-awareness and self-representation? That is, how are intellectual processes and personality

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dispositions projected onto a person's self-construct? How do the products of self-awareness interrelate to produce an integrated self-system, which includes the domains of cognition and personality? That is, how is it possible that each person has a strong sense of unity and identity while all persons are very differentiated and diversified in their abilities, characteristics, and tendencies? What changes with development in these dimensions and their self-representation? How can the sense of unity be so strongly preserved throughout development despite the fact that abilities, processes, and characteristics change extensively as a result of development?

The various dominant traditions of psychology have focused on a number of these questions, and while valuable work has been produced no model integrating the findings presently exists. It is imperative to move in the direction of constructing such a model (Demetriou & Kazi, 2001; Ferrari & Sternberg, 1998; Jensen, 1998). Thus, in this paper, we will first very briefly summarize the current theorizing and research, in order to pinpoint the similarities and differences between the various traditions. This exercise is useful for the construction of an overarching model that can be tested empirically.

ARCHITECTURES OF THE MIND, PERSONALITY, AND SELF

Psychometric (Carroll, 1993; Jensen, 1998; Thurstone, 1938) and other (Gardner, 1983; Sternberg, 1985) theories of intelligence specify the dimensions and abilities underlying human intelligence and their interrelations. Theories of intellectual development, such as the classic theory of Piaget (1970) or the subsequent neo-Piagetian theories (Case, 1992; Fischer, 1980; Halford, 1993; Pascual-Leone, 1988), describe the nature and interpatterning of cognitive processes underlying intelligence from birth to maturity. Although these theories have influenced our model of the developing mind, the presentation below will focus only on our model because of space limitations. The reader who is interested in a discussion of the relationships of our theory with other theories is referred to other sources (Demetriou, 1998a, 2000; Demetriou & Efklides, 1985; Demetriou, Efklides, & Platsidou, 1993; Demetriou, Kazi, et al., 1999; Demetriou & Kazi, 2001; Demetriou & Raftopoulos, 1999; Demetriou, Raftopoulos, & Kargopoulos, 1999).

Our model points that the mind includes two levels of knowing (the term "level" here refers to architectural layers in the construction of the mind and not to successive stages or tiers in the construction of concepts during development), one oriented to the environment and another oriented to the self. The first level involves representational and understanding processes and functions that specialize in the representation and processing of information from the environment. The second level involves functions and processes oriented to monitoring, representing, understanding, and regulating the environment-oriented functions and processes. Optimum or intelligent performance at any time depends on the interaction between the two levels, because efficient problem-solving or decision-making requires the application of environment-oriented functions and processes under the guidance of representations held about them at the level of self-oriented processes.

The interaction of the two levels occurs under the constraints that stem from the biological condition of the individual at any given point in his life. These constraints may be viewed as an additional content-free level in the architecture of the mind that involves processes operating as the interface between the two knowing levels mentioned above. In information processing terms, this levels refers to the processing capacity available at a given age.

Our research has identified and delineated seven environment-oriented systems (EOS). (1) The *categorical system* deals with similarity–difference relationships. Forming concepts about class relationships is an example of the domain of this system. (2) The *quantitative system* deals with quantitative variations and relationships in the environment; mathematical concepts and operations are examples of this system's domain. (3) The *causal system* deals with cause–effect relationships; operations such as trial-and-error or isolation of variables strategies that enable a person to decipher the causal relationships between things or persons and ensuing causal concepts and attributions belong to this system. (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 truth/falsity and the validity/invalidity of environmental information and in systems of representation. Different types of logical relationships such as implication, compatibility, and incompatibility belong to this system. (6) The *social system* deals with the understanding of social relationships and interactions. Mechanisms for monitoring nonverbal communication and skills for manipulating social interactions belong to this

system. (7) The *pictographic system* underlies the representation of the environment or of thoughts themselves by means of drawings or other kind of signs. Manual skills or skills enabling the translation of a mental image into a picture on paper belong to this system (Case, Demetriou, Platsidou, & Kazi, in press; Demetriou et al., 1993; Demetriou & Efklides, 1985, 1989; Kargopoulos & Demetriou, 1998; Shayer, Demetriou, & Pervez, 1988).

These systems are computationally, procedurally, and symbolically specific and they follow partially autonomous developmental trajectories. Each system includes a characteristic set of operations and processes which are appropriate for the processing of the relationships specific to each domain and is biased to different symbol systems (Demetriou & Efklides, 1988; Demetriou & Raftopoulos, 1999; Kargopoulos & Demetriou, 1998).

The self-oriented level involves processes and functions that guide the monitoring, understanding, and regulation of the processes and functions residing at the other two cognitive levels. Thus, the input to this level is information arising from the functioning of the environment-oriented systems under the current processing constraints (sensations, feelings, and conceptions caused by mental activity). This input is organized into the maps or models of mental functions and the self to be described below. We used the term *hypercognitive* to refer to this level and denote the hierarchical relationship between this and the other two levels of the mind.

The term *hypercognitive* is used rather than the term *metacognitive* because it is a broader and more accurate description of the level of mind that is responsible for self-monitoring, self-representation, and self-control. In Greek, the adverb "hyper" means "higher than" or "on top of" or "going beyond" and when added to the word "cognitive" indicates the supervising and coordinating functions of the hypercognitive system (Demetriou, 1998a, 1998b, 2000; Demetriou et al., 1993). The adverb "meta" means "coming after"; thus, our proposed term is more accurate than the term "metacognitive" because it refers to more of the functions associated with this level of mind. That is, it can denote an autonomous level of the architecture of the mind which exists from the beginning and which operates on the other levels rather than as a by-product of their functioning. In fact, metacognition is only one of the functions of the hypercognitive system.

We have shown that the hypercognitive level involves active self-knowing processes and self-descriptions and concepts. We used the terms *working* and *long-term hypercognition* to refer to these two types of processes, respectively. Working hypercognition includes on-line self-monitoring, self-recording, self-evaluation, and self-regulation processes and skills that enable the individual to efficiently and accurately activate her various cognitive, emotional, or other systems, according to the requirements of the moment. Thus, working hypercognition controls the use of current processing capacity. The functioning of working hypercognition produces knowledge about the mind and the self that is organized into three interrelated systems of concepts or models. These three systems constitute long-term hypercognition. The so-called theory of mind (Flavell, Green, & Flavell, 1995; Perner, 1991; Wellman, 1990), self-regulation rules (Sternberg, 1985), and one's cognitive self-concept belong to long-term hypercognition (Demetriou et al., 1993; Demetriou & Efklides, 1989; Demetriou & Kazi, 2001).

Processing capacity is defined in terms of three parameters: *speed of processing*, *control of processing,* and *storage*. Speed of processing refers to the maximum speed at which a given mental act may be efficiently executed. Control of processing refers to the processes that identify and register goal-relevant information and block out dominant or appealing but actually irrelevant information. Storage refers to the processes which enable a person to hold information in an active state while integrating it with other information until the current problem is solved. Thus, this level is close to the psychometric conception of general intelligence and to other neo-Piagetian conceptions of processing capacity or mental power (Demetriou et al., 1993; Demetriou, Spanoudis, Christou, & Platsidou, in press).

The Organization of Personality

Personality appears to be organized in a way that is formally equivalent to the hierarchical organization of the mind presented above. It can also be described as a hierarchy of three levels: one including different modes of interacting with environment, one referring to constraints operating on these modes, and one involving self-representations about these modes.

Specifically, the so-called Big Five factors of personality (that is, extraversion, agreeableness, conscientiousness, neuroticism, and openness to experience) may be taken as the different modes of relating with the environment. Extroverts are sociable, active,

and uninhibited as contrasted to introverts who are withdrawn, shy, and inhibited. Agreeable individuals are soft-hearted, generous, forgiving, and warm as contrasted to individuals low in agreeableness who are suspicious, headstrong, argumentative, and aggressive. Conscientious individuals are organized, energetic, and reliable as contrasted to individuals low in conscientiousness who are distractible, lazy, careless, and immature. Neurotic individuals are nervous, anxious, tense, and self-centered as contrasted to individuals low in neuroticism who are emotionally stable, confident, alert, and content. Finally, individuals who are open to experience are curious and with wide interests, original, imaginative, and nontraditional whereas individuals who are not open to experience are conservative and cautious (Costa & McCrae, 1997; Kohnstamm & Mervielde, 1998).

Graziano and colleagues (Graziano, Jensen-Campbell, & Finch, 1997; Graziano, Jensen-Campbell, & Sullivan, in press), hypothesize that these five dimensions underlie normal everyday functioning, but are expressed through a number of higher-order constructs. These constructs translate each of the Big Five into self-definitions and self-representations, which lead to particular ways of acting. Moreover, there are also evaluative constructs, such as global or domain-specific self-esteem (e.g., social and academic self-esteem). These higher-order constructs in the structure of personality seem equivalent to the self-representations that reside at the hypercognitive level of the mind.

The constructs included in the two levels of personality analyzed above operate under the constraints of temperament which refers to more or less stable dispositions to receive and react to stimulation in particular ways (Kagan, 1994). Examples of temperamental dispositions include ease as well as intensity of arousal in reaction to stimulation, regulation of arousal states, approach to or avoidance of novelty, irritability, mood, motor activity, and adaptability. To a considerable degree these dispositions are considered as inherited and function as the substrate upon which personality and the self are formed. Thus, from childhood these early tendencies and dispositions gradually develop into the more stable dimensions of personality and style that characterize the individual.

The Organization of the Self

Interestingly, the analysis of the self is formally very similar to the analysis of the mind and personality proposed above. According to the classic theory of James (1892), the self involves two hierarchical levels, the "I-self" and the "Me-self." The I-self is the knower, and includes all self-observation and self-recording processes that generate the knowledge that persons have about their bodily, social, and mental aspects.This knowledge is the Me-self.

James's distinction between a knowing (the I-self) and a known self (the Me-self) is present in modern theories of the self. For example, in Markus's model (Markus & Wurf, 1987) the individual's working self-concept is differentiated from his collection of self-representations. The working self-concept involves any presently accessible self-representations and it is directly involved in the formation and control of behavior at both the intra- and the interpersonal level. Therefore, in this model, the working self-concept assumes the functions of the Jamesian I-self (our working hypercognition), which generates the self-descriptions that belong to the Jamesian Me-self (our cognitive self-image).

Empirical research suggests that the self-construct is indeed hierarchically organized. This research suggests that there is a general self-concept at the apex, a number of major domains at a middle level (such as self-concepts of the academic, social, emotional, and physical domains) and certain more specific domains within each of these major domains (such as maths and science in the academic domain or physical ability and physical appearance in the physical domain). Moreover, each domain includes a descriptive part that specifies what an individual can and cannot do and an evaluative part, which specifies the importance of possibilities and impossibilities for each of the domains. Thus, there is global and domain-specific self-worth or self-esteem (see Bracken, 1996; Harter, 1999; Hattie, 1992).

TOWARD AN OVERARCHING MODEL OF THE DEVELOPING, THINKING PERSON

Draft for an Overall Architecture

We proposed that the three hierarchical architectures summarized above are interrelated (Demetriou, 2000; Demetriou & Kazi, 2001). For instance, we assumed that temperament is to personality what processing potentials are to intelligence and thinking. That is, processing potentials constrain the complexity and type of information that can be understood at a given age, and temperament constrains how information will be initially received and reacted to. Moreover, the Big Five factors of personality may be taken

to correspond to the domain-specific systems that reside at the environment-oriented levels of knowing. In other words, the domain-specific systems of understanding channel the functioning of the mind and the Big Five factors of personality channel patterns of action and relationships with the social and cultural environment. The functioning of these systems is controlled by the active processes of self-knowing implicated in James' I-self or Markus' working self-concept or by the monitoring and control processes involved in our working hypercognition. In turn, the daily functioning of all these systems generates feelings and representations of general cognitive efficiency or global self-worth and general self-esteem, as well as more specialized self-representations about the domain-specific systems of the mind or the particular dimensions of personality. In turn, the interactions between these systems generate different styles of thinking or action, which, in turn, describe different types of actual adaptations and behavior. Figure 1 illustrates this overarching model.

It seems, therefore, that it is possible to construct an overarching model of the thinking and acting individual that simultaneously captures both the dynamic (motivational and emotional) and the meaning-making (representational) components of understanding, experience, and action. Obviously, testing this model in its totality is an enormous undertaking. However, several studies conducted in our laboratory, have provided encouraging evidence that the model justifies further theoretical and empirical scrutiny. Some of these studies will be summarized below.

Developmental Dynamics

All functions, processes, skills, dispositions, and characteristics included in the various levels and systems of the mind as specified in the model above undergo extensive changes from birth to maturity. Different scholars and traditions have focused on different components of this model and have attempted to describe and explain their development. Thus we know, for instance, that the various functions of the processing system, such as speed of processing, inhibition and control of processing, and short-term storage, improve systematically from birth until levelling off at the end of the second or the beginning of the third decade of life. After this age, processing slows down, inhibition and control are effected with more difficulty and less efficiency, and short-term memory declines (see Baltes, 1991; Shaie & Willis, 1991).

The environment-oriented systems, including categorical, analogical, verbal, mathematical, and spatial thought, seem to follow a similar course. That is, they grow and expand until early adulthood and they then also begin to decline, probably a few years later (i.e., in the fifth decade) than information processing, not always at the same time or rate. For instance, spatial reasoning appears to decline earlier than verbal reasoning (Demetriou, 1998a, 1998b; Shaie & Willis, 1991).

Models of personality development are less detailed than those of cognitive development, probably because personality is considered stable from an early age. Although there is strong evidence that the basic Five Factor structure of personality stabilizes in early childhood, if not earlier, we now know that some important personality changes occur. For example, there is evidence that from adolescence to adulthood individuals tend to become more conscientious, more emotionally stable, and more agreeable, but less extroverted and less open to experience (Costa & McCrae, 1997).

It is generally agreed that there are developmental changes in at least three dimensions of the self-system. First, with age self-representations involve more dimensions that are better integrated into increasingly more complex structures. Thus, second, emphasis gradually moves from concrete self-descriptions to more abstract trait- and characteristic-like self-definitions. Third, self-representations become more accurate with regard to the actual characteristics and abilities to which they refer (see Harter, 1999).

Finally, and probably as a result of these changes, self-regulation becomes increasingly more focused, refined, efficient, and strategic. That is, the individual gradually acquires command of his or her information processing capabilities and temperamental dispositions. Practically, this implies that cognitive capabilities and personality dispositions come under increasing a priori control of the person's long-term hypercognitive maps and self-definitions. In fact, capitalizing on these maps by training individuals to use them efficiently enhances and stabilizes the effects of learning experiences and development of the environment-oriented abilities (Demetriou et al., 1993; Kallio, 1998). In Freudian terms, mind and personality come under ego control; in Jamesian terms, they come under the control of the I-self.

Various models that capture the development of mind, personality, or self have been proposed. However, there have been very few and only sketchy

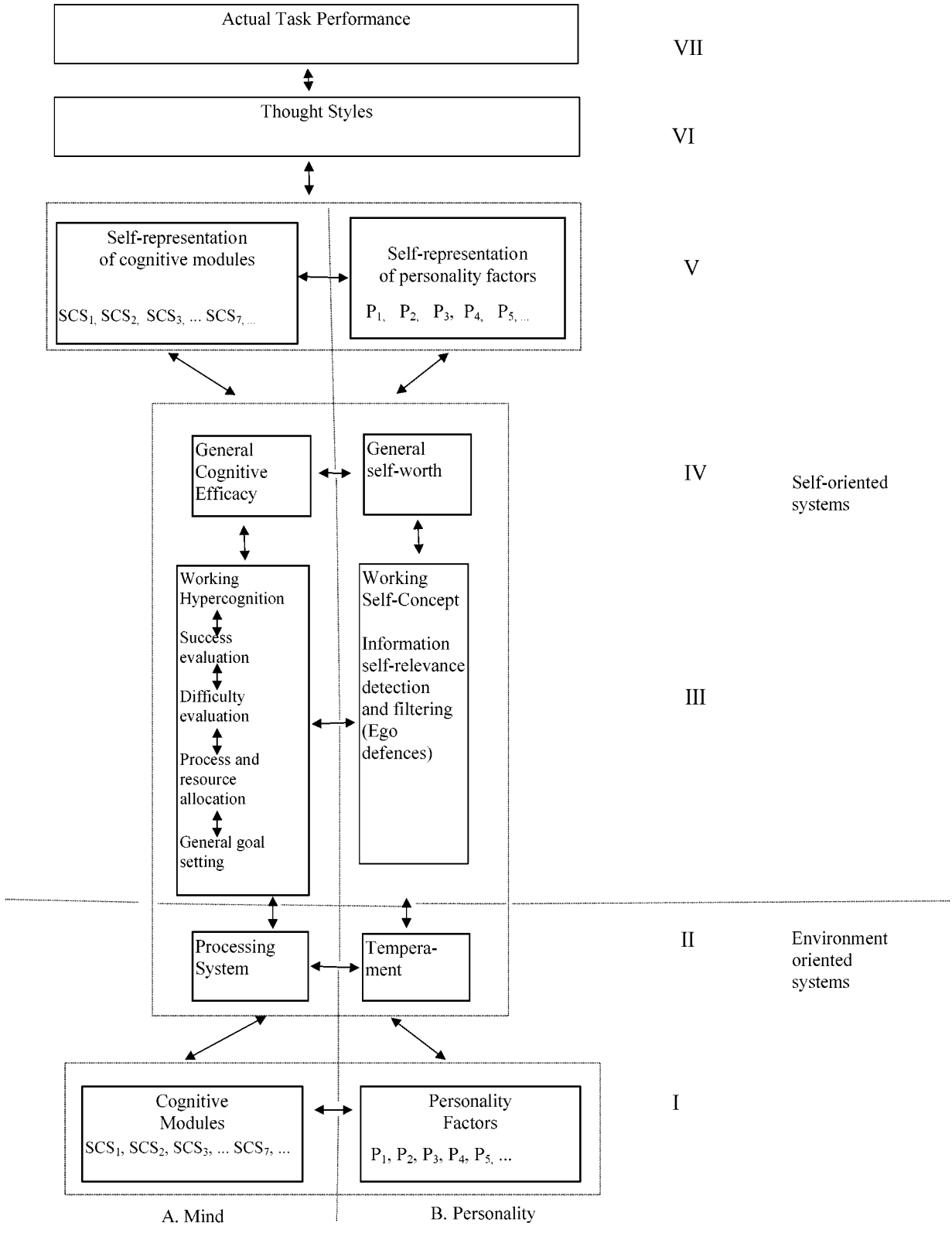


Fig. 1. The general model of the mind and personality. (*Note.* SCS stands for specialized structural system. P stand for personality factor.)

attempts to study and model changes in the relationships among these three realms. Some of our studies to be summarized below are directly addressed to this question. These studies aim to highlight how mind, personality, and self interact from late childhood to early adulthood, and thus contribute to the formation of tendencies and abilities underlying the normal adult's everyday functioning.

STUDY 1: DYNAMIC RELATIONSHIPS AMONG THE LEVELS OF MIND, PERSONALITY, AND SELF

The first study, fully presented in Demetriou and Kazi (2001), aimed to answer the following hypotheses:

1. How are self-representations of cognitive abilities organized? The theory is based on the assumption that the hypercognitive system involves maps of mental abilities that represent the actual organization of abilities; this suggests that self-representations of cognitive abilities must be organized in the same structures as the corresponding actual abilities.
2. How are factors of personality and thinking style related to cognitive factors? We hypothesize that these factors will depend on the actual cognitive performance and self-representation factors, because they reflect adjustments that individuals make to their own cognitive profile so as to maximize efficiency and satisfaction in their personal interaction with the world.
3. During development what changes occur in the relationships between the two main levels of the mind, namely the environment-oriented and the self-oriented level? Our assumption is that large developmental changes, such as those associated with major developmental transitions, necessitate reorganizations in the persons' self-representations about their own abilities aiming to restore, at the level of self-representation, the state of actual cognitive abilities residing at environment-oriented level of the mind.

Participants

This study involved 840 individuals, aged 10.6–15.6 years. Socioeconomic status and gender were fairly equally represented in each age group.

Tasks and Inventories

Participants were examined with the following five types of tasks or inventories.

Cognitive Tasks

A set of tasks addressed seven domains of thought, six of which correspond to the environment-oriented systems specified by our theory. Specifically, a set of mathematical analogies and algebraic reasoning tasks addressed the quantitative system (Cronbach's alpha: .62). A set of hypothesis-testing and experiment-design tasks examined the causal system (Cronbach's alpha: .61). A set of tasks focused on understanding social intentions and dialectical thinking (that is, grasp of the complementarity of different perspectives in regard to issues of social concerns) represented the social thought system (Cronbach's alpha: .58). A set of mental rotation and image manipulation tasks tested the spatial system (Cronbach's alpha: .50). A set of drawing tasks, which required drawing both persons and landscapes, addressed the pictographic system (Cronbach's alpha: .70). Finally, to assess creativity, we used a set of tasks requiring the production of new ideas and symbols about the situation described (Cronbach's alpha: .70). As can be seen, the reliability of these tasks, which are fully described in Demetriou and Kazi (2001), was satisfactory.

Self-Evaluation

Here, participants were asked to evaluate certain aspects of a number of these tasks. Specifically, they were asked to judge the difficulty and success of solution to an easy and a difficult task among the tasks addressed to each environment-oriented system. These evaluations allowed the organisation and interrelationships of cognitive processes at the level of performance to be compared with the organization and interrelationships of these processes at the level of self-awareness; thus the interrelationships between the environment and the self-oriented level of the mind could be more effectively studied.

Self-Representation About Cognitive Abilities

To examine self-representations of the abilities examined by the tasks above, we constructed an inventory asking participants how they represent themselves in regard to various processes involved in

each of the cognitive domains represented in the these tasks. Statements about *quantitative thought* referred to the subject's facility in solving mathematical problems or applying mathematical knowledge to everyday problems (e.g., "I easily solve everyday problems involving numbers" Cronbach's alpha: .83). Statements about *causal thought* referred to the ability to formulate hypothesis and design experiments (Cronbach's alpha: .59), or to construct models that would accommodate experimental findings (e.g., "To find out which of my guesses is correct, I methodically consider only the things my guess proposes"; Cronbach's alpha: .63). Statements about *spatial thought* referred to visual memory (e.g., "I retain a very clear picture of things") and facility in thinking in images ("When I have to arrange things in a certain space, I first visualize what it will be like if I place them in certain way and then I physically arrange them"; Cronbach's alpha: .66). The statements on drawing referred to ability to draw a man, a landscape, and a map (e.g., "I can draw a person very accurately"; " I can paint a building as if it were a photograph"; Cronbach's alpha: .84). Finally, the statements about *social thought* referred to the facility in understanding other's thoughts and feelings (e.g., "I understand easily the intentions of others before they express them"; Cronbach's alpha: .77). As can be seen, this inventory was very reliable. Also, this inventory addressed general cognitive characteristics, such as learning ("I learn easily," "I retain a lot of what I hear"; Cronbach's alpha: .76) and reasoning ability ("I like drawing logical conclusions, which can be justified by the data I have"; Cronbach's alpha: .70).

Personality Characteristics and Thinking Styles

To examine how personality and thinking styles compared to various aspects of the mind addressed by the tasks and inventories above, an inventory assessing various social and personality characteristics was designed. Regarding personality, this inventory addressed ambition and ideal self ("I am an ambitious person," "I want to be the center of attention"; Cronbach's alpha: .76), impulsivity ("I do the first thing that comes to my mind; Cronbach's alpha: .69), and systematicity ("I will deal with various things in a certain order, depending on their importance"; Cronbach's alpha: .59).

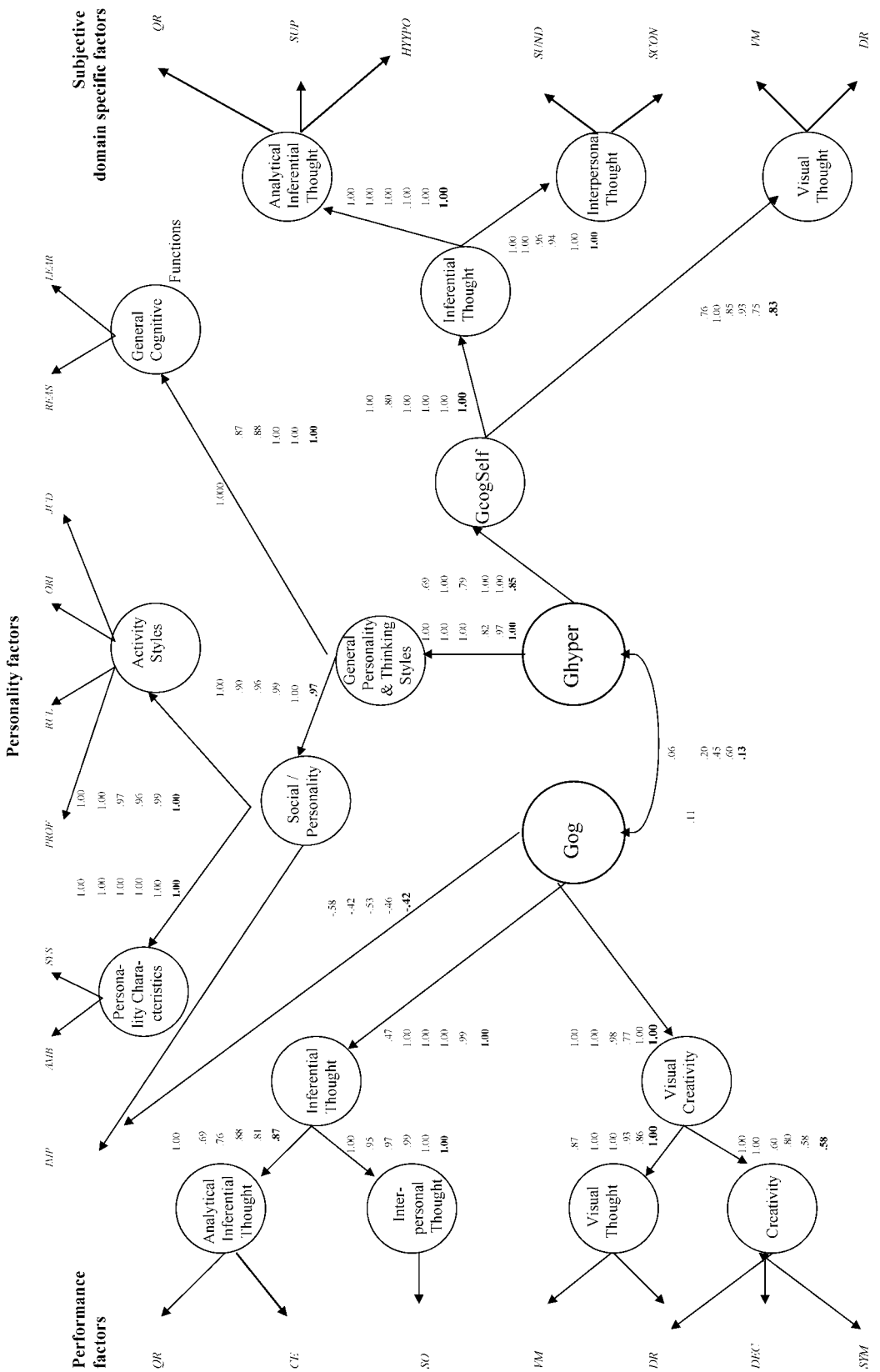
Regarding styles of activity and thought, this inventory addressed the following dimensions: *originality* ("I like working on problems for which there are no pre-prepared solutions"; Cronbach's alpha: .51), an *executive style,* which requires following rules ("When solving a problem, I prefer to follow existing rules") (Cronbach's alpha: .56), or a *judgmental or evaluative style,* which requires evaluating other people ("I like to judge others' choices"; Cronbach's alpha: .59), and *professionalism* ("I like choosing the best of various solutions"; Cronbach's alpha: .62). This inventory was based on Sternberg's theory of self-government (Sternberg, 1988).

Results and Discussion

The data generated by this study was first examined to test the first of our hypotheses (the nature and organization of self-awareness) in regard to various processes. Specifically, a series of confirmatory factor analysis and structural equation models were run to test if the organization of self-representations matches or reflects the organization of performance on the various cognitive tasks. Bentler's EQS programme (Bentler, 1989) was used to run these models. Readers interested in studying all models tested are referred to Demetriou and Kazi (2001). In this paper we present two models that integrate findings on all batteries and inventories described above (see Figs. 2 and 3).

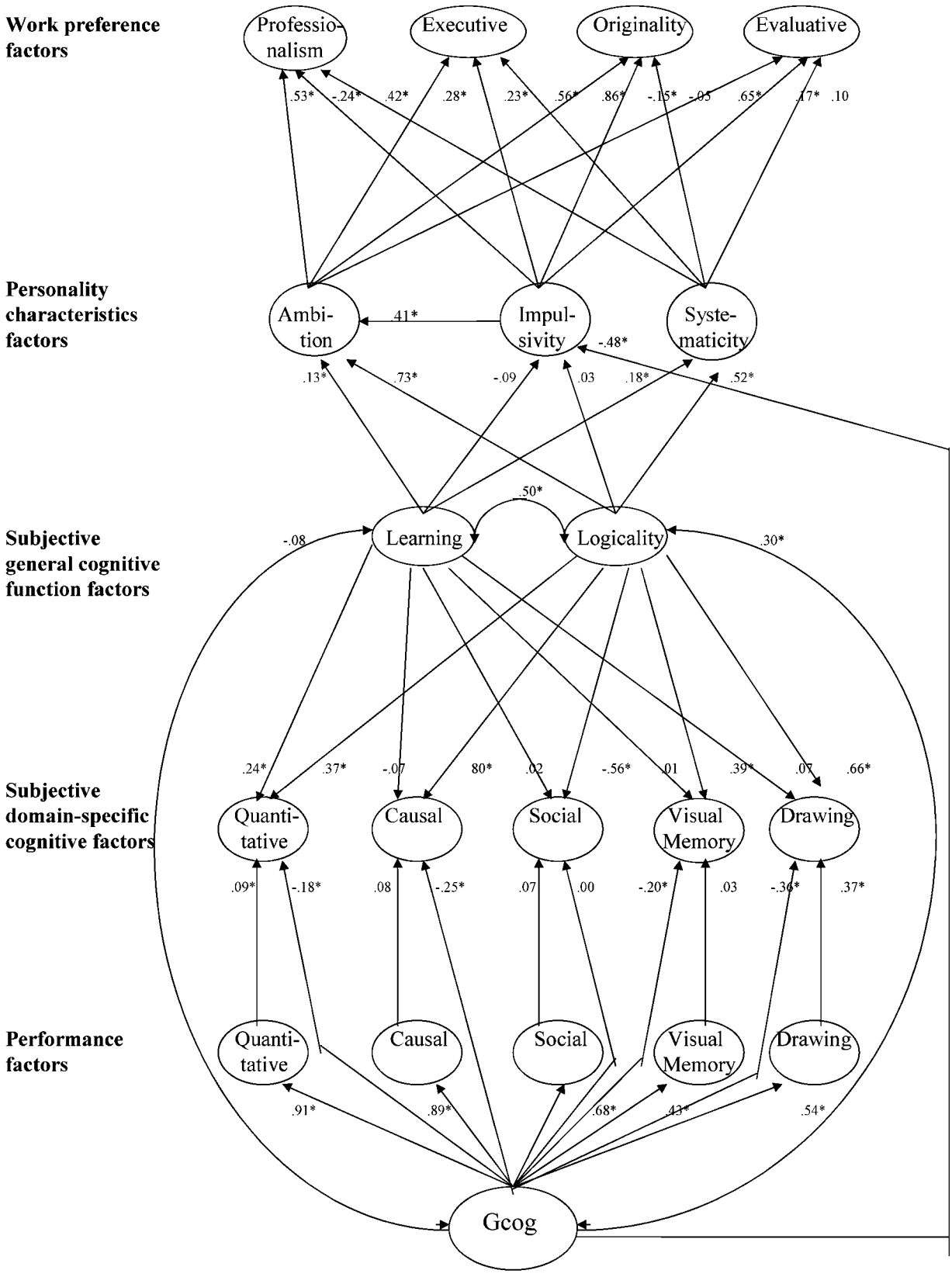
Figure 2 presents a model that includes three sets of factors; that is actual cognitive abilities, self-representations of cognitive abilities, and personality and thinking styles. Moreover, there are several higher-order factors, which represent higher level organizations in each of these three kinds of factors. At the highest level, there are two general factors: a fourth-order factor for general cognitive ability (the G_{cog} factor, which, in psychometric terms represents *g*) and a fifth-order factor, the G_{hyper} factor, for the self-oriented level of the mind. Attention is drawn to the similarity in the organization of the cognitive performance factors and the organization of the corresponding hypercognitive or subjective factors. Thus, this model confirms the first assumption put forward: the subjective architecture of the mind accurately reflects its objective architecture.

This model was also tested separately on each age group in order to test our third hypothesis and found to have a good fit (the parameters of the model found for each age group are also shown in Fig. 2). The consistent good fit strongly suggests that the mental architecture described above is stable from late childhood to middle adolescence despite the fact that during this period the kind of problems that can be solved changes radically. Therefore, it can be concluded that



x2(835)=901.125, p=.06, CFI=.995, GFI=.955, AGFI=.941, SRMR=.04, RMSEA=.01

Fig. 2. The general hierarchical model applied on all tasks and inventories. (*Note.* Numbers in bold in each column refer to the model applied on the whole sample. The other five numbers refer to the model applied on each of the five groups. Form top to bottom, the numbers refer to age groups 11–15, respectively.)



$x^2(614)=1274.580$, p=.001, CFI=.937, GFI=.920, AGFI=.903, SRMR=.048, RMSEA=.003

Fig. 3. The final model of the dynamic relationships between modules across the different levels of the mental architecture.

the major units and levels of the mind as described by our theory do not depend on development.

Our research revealed an especially interesting fact: the correlation between the general cognitive factor representing the environment-oriented level of the mental architecture and the general hypercognitive factor representing the self-oriented level was practically null at the age of 11 years, but increased systematically and became strong at the age of 15 years. That is, the correlation between these two higher order factors was .05, .11, .20, .45, and .60 at ages 11, 12, 13, 14, and 15 years, respectively. This finding suggest that although the constructs and levels of the mind are the same, their relationships may change over the years. Therefore, many changes traditionally associated with the transition from childhood to adolescence seem to primarily affect the communication between the two knowing levels of the mental architecture rather than the modules and actual processes at each level. At the hypercognitive level, therefore, self-monitoring and self-representation of the environment-oriented level become increasingly accurate and detailed (Demetriou & Kazi, 2001).

Interrelationships among cognitive, hypercognitive, personality, and thought styles constructs are delineated in the model shown in Fig. 3. As in our first model (Fig. 2), the cognitive factors here are organised in two levels, one including the performance factors and the other including the self-representations factors that reflect these performance factors. Moreover, there was a second-order general factor related to all the domain-specific performance factors. At the level of self-representation, there were two factors representing general cognitive abilities, logical reasoning and learning ability. One of these factors, logical reasoning, was directly and significantly related to the second-order general cognitive factor and both of them, logicality in particular, appeared to play a very important role in the formation of domain-specific self-representations. That is, the domain-specific self-representation factors appear to depend directly upon the self-representation of logical reasoning and, to a lesser extent, learning. Moreover, the self-representation factors were more related to the second-order cognitive performance factor than to the corresponding domain-specific performance factor. An exception to this pattern is quantitative thought and drawing, which seem to be more transparent to awareness than the other domains studied here (negative relationships between cognitive performance and self-representation indicate that, with cognitive development, self-attribution of abilities becomes more conservative; Demetriou & Kazi, 2001). These relationships suggest that domain-specific self-representations derive directly from self-representations of more general or dynamic cognitive functions rather than from domain-specific factors. It seems that domain-specific experiences of problem solving, especially when they are not easily amenable to self-monitoring and objective evaluation, such as causal or social understanding, first contribute to the formation of a sense of general cognitive efficiency. This is then translated back into domain-specific representations, if needed.

We note here that another study (Demetriou & Kazi, 2001), which cannot be presented because of space limitations, provided further support to the assumptions about the relationships between the various levels of the mind. This study showed that skill in processing and analogical reasoning tasks directly corresponded to individual's self-representations of reasoning and learning abilities. This finding suggests clearly that the hypercognitive system directly registers and represents the condition of the processing system and general inferential processes. Therefore, one might say that the famous *g* construct of psychometric theories of intelligence (Jensen, 1998), and the recently revitalised constructs of global self-worth (Harter, 1999) and self efficacy (Bandura, 1989) of personality psychology may be two sides of the same coin.

Regarding the organization of personality and the self, it can be seen that ambition and systematicity were highly related to the two factors representing general cognitive efficiency in self-representation, that is, learning and logical reasoning. The factor for impulsivity was closely and negatively related to the second-order general cognitive ability factor, but was not related to either of the two cognitive self-image factors. Thus, it seems clear that both the self-representation of logical reasoning and impulsivity play pivotal but rather independent roles in the organization of the self-image at both the cognitive and the personality level. For instance, they both contribute strongly to the formation of the ideal self. However, systematicity is formed in relation to logicality but independently of impulsivity.

The relationships between personality dimensions and thinking styles are equally interesting, and suggest the following conclusions. First, the factor standing for the ideal self exhibited the strongest effect on three of the four thinking styles factors, suggesting that this dimension is as important in the formation of a person's choices and style as logical

reasoning is in the organization of the more cognitive aspects of one's self-image. Second, the pattern of relationships between personality and thinking styles offers insight into how personality characteristics affect thinking styles. Specifically, the factor representing the executive style was more closely related to systematicity than to ideal self or impulsivity. Originality was positively and highly correlated to ideal self, negatively to implulsivity and it was not related to systematicity. The evaluative style was related highly to ambition, much lower but positively to impulsivity, and low to systematicity. It seems, therefore, that nonimpulsive individuals with high ambitions are oriented to activities requiring originality; impulsive and ambitious individuals tend toward evaluative activities; impulsive and systematic individuals orient themselves to the rule-abiding activities.

Development and Individual Differences

It is well known that individual attitudes to self-evaluation and self-representation differ; for example some people are systematically lenient in the evaluation of their own performance while others are systematically strict. How can this obvious fact be reconciled with the findings indicating that self-representations actually reflect the organization of cognitive abilities?

To investigate this question, we extended the study described above, further testing subjects who varied systematically in their accuracy and attitude to self-evaluation. By combining cognitive performance and self-evaluation of this performance we formulated the following four groups of subjects: (1) low performance–low success evaluation, (2) low performance–high success evaluation, (3) high performance–low success evaluation, and (4) high performance–high success evaluation. Obviously, subjects in groups 1 (low-accurates) and 4 (high-accurates) are accurate in their self-evaluation, because their evaluations are consistent with their performance; while those in groups 2 and 3 are not accurate. In other words, group 2 subjects (law inaccurates) are lenient in their self-assessment whereas group 3 subjects (high inaccurates) are strict with themselves. These subjects were tested on all tasks and batteries described above once a year for 2 more years, (3 consecutive years in total). The effects of interest here are concerned with the condition of self-evaluation in these four person categories along with time. That is, are the differences between the four groups preserved across the three testing waves?

To answer this question, a 5 (the five age groups) $\times$ 4 (the four person categories) $\times$ 3 (the three testing waves) $\times$ 5 (the five SCSs, i.e., quantitative, causal, imaginal, social, and drawing) ANOVA, with repeated measures on the last two factors, was applied on postperformance success evaluation provided at each of the three testing waves for each of the five SCSs. Results are summarized in Fig. 4, which shows performance averaged across the five SCSs as a function of person category, testing wave, and age. The person category exerted a highly significant effect, $F(3, 210) = 49.27$, $p = .0001$, indicating clearly that the expected differences between the four groups remained stable across the three testing waves. Age exerted a marginally significant effect, $F(4, 210) = 3.16$, $p = .02$, indicating a tendency for self-evaluation scores to increase with age. However, the interaction between age and person category was nonsignificant, $F(12, 210) = 0.86$, $p = .592$, indicating that differences among the four person categories remained stable across the five age groups.

The effect of testing wave was also highly significant, $F(2, 420) = 65.18$, $p = .0001$, indicating that self-evaluation scores increased from one wave to the next, particularly from the first to the second wave. This increase seems to reflect the performance improvements, which occur during this phase of life. The significant Person category $\times$ Wave, $F(6, 420) = 25.72$, $p = .0001$, and Person category $\times$ Age interaction, $F(8, 420) = 2.76$, $p = .006$, indicated that the differences among the four person categories tended to diminish from one wave to the next or with increasing age, respectively.

These findings suggest that self-evaluation and self-representation remain generally consistent through time. Individuals tend to be consistently accurate, lenient, or strict in their self-evaluation of cognitive functioning and other dispositions. This suggests a kind of internal transformer, which adjusts evaluations and representations, related to particular behaviours or events to remain consistent with one's self-definitions regardless of environmental or developmental changes. This transformer seems to be "driven" by a factor that may be termed *personal constant,* meaning that the individual adopts a particular attitude to his or her performance and ability and consistently applies it across different domains. This constant will adjust any signals regarding the individual's functioning to a level that is personally characteristic.

This personal constant undergoes major redefinitions or rescalings at crucial points in development when cognitive potentials are transformed. For

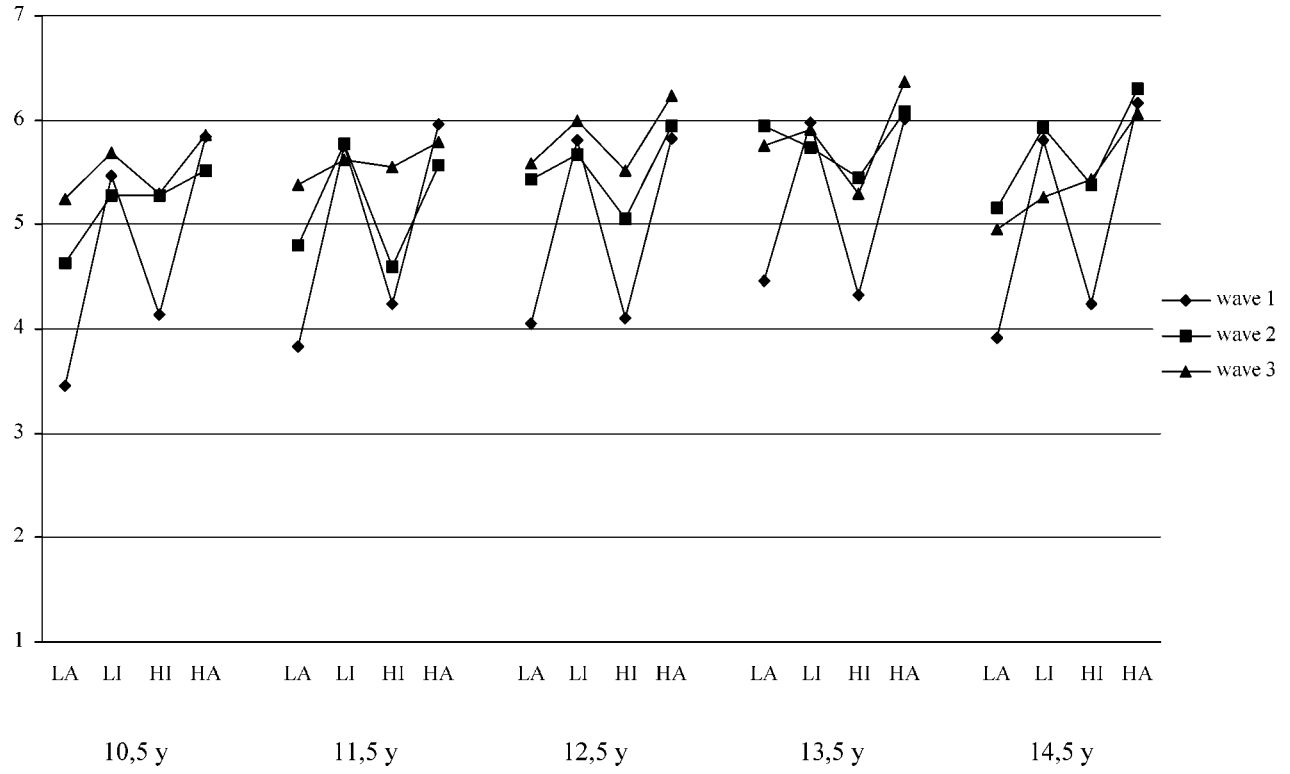


Fig. 4. Postperformance success evaluation averaged across SCSs as a function of age, person category, and testing wave.

instance, during the transition from childhood to adolescence, self-evaluation scores first decrease but are then restored to previous levels. After this change, self-evaluations become much more accurate (Harter, 1999).

These interpretations imply, therefore, that hypercognitive maps may accurately represent the architecture of an individual's mind and self and yet may be accurate or inaccurate in the evaluation of personal performance and behavior. Thus, the hypercognitive maps accurately reflect relative differences between cognitive and personality functions and abilities *within* the individual. The personal constant, however, is consistently applied across all cognitive and personality functions and abilities, thereby explaining differences in self-evaluation and self-representation among individuals. The personal constant can therefore explain why the two differences are generally stable, both the relative differences between abilities and tendencies within persons and the relative differences in self-evaluation and self-representation across persons vis-à-vis each of the abilities and tendencies. In other words, it explains why hypercognition can simultaneously preserve an accurate structure of cognitive processes in the mental maps it constructs and also involve a strong personal element in terms of how these processes are effected (or are thought to be effected) in the real world.

STUDY 2: COGNITIVE DEVELOPMENT, SELF-REPRESENTATION, AND THE BIG FIVE FACTORS OF PERSONALITY

The studies thus far presented have focussed on cognitive performance, self-representations about cognitive performance, thinking styles, and personality. However, our tests did not directly address those dimensions of personality considered dominant by current personality theory (see Costa & McCrae, 1997; Graziano et al., 1997), nor did our inventory of cognitive self-image examine some important dimensions of the mind as specified by our theory. To remedy this limitation, a series of new studies were designed to examine in detail the various dimensions of cognitive self-representation and thinking styles in relation to the Big Five factors of personality (that is, extraversion, agreeableness, conscientiousness, neuroticism, and openness to experience). The study's

aim was to specify how the Big Five factors interrelate with both cognitive self-representation and thinking styles.

Participants

Three hundred and twenty two students (265 female and 57 male) from the faculties of humanities and social sciences of the University of Cyprus participated in this study. The mean age of this group was 19.3 years. These students came from all over Cyprus and from varying socioeconomic groups. However, because admission to the University of Cyprus is highly selective, these students represent the top 10–15% of the population, in relation to academic performance is concerned.

Inventories

Three inventories were used in the study. Personality was examined with the Greek version of an inventory addressed to the "Big Five" factors (Besevegis, Pavlopoulos, & Mourousaki, 1996), and proved highly reliable, as Cronbach's alpha ranged from .86 to .90 for the set of items addressed to each of the five factors and .92 for the whole test.

The second inventory focussed on self-representation and addressed the same dimensions tested in the first study as well as a series of new additional items. The new items examined self-image in regard to various aspects of (i) speed of processing, (ii) working memory, (iii) self-monitoring and self-regulation, and (iv) deductive and inductive reasoning. Thus, in this study, the cognitive self-image inventory considered most dimensions of each of the three levels of the mind (i.e., the processing system, the environment-oriented systems, and the hypercognitive system). The reliability of this inventory was again very high: it ranged between .72 and .87 for the items addressed to each of the various dimensions of cognitive self-representation and .85 for the whole test.

Thinking styles were evaluated with a shortened version of the inventory used in the first study (described earlier), and reliability of this inventory was also satisfactory (.60).

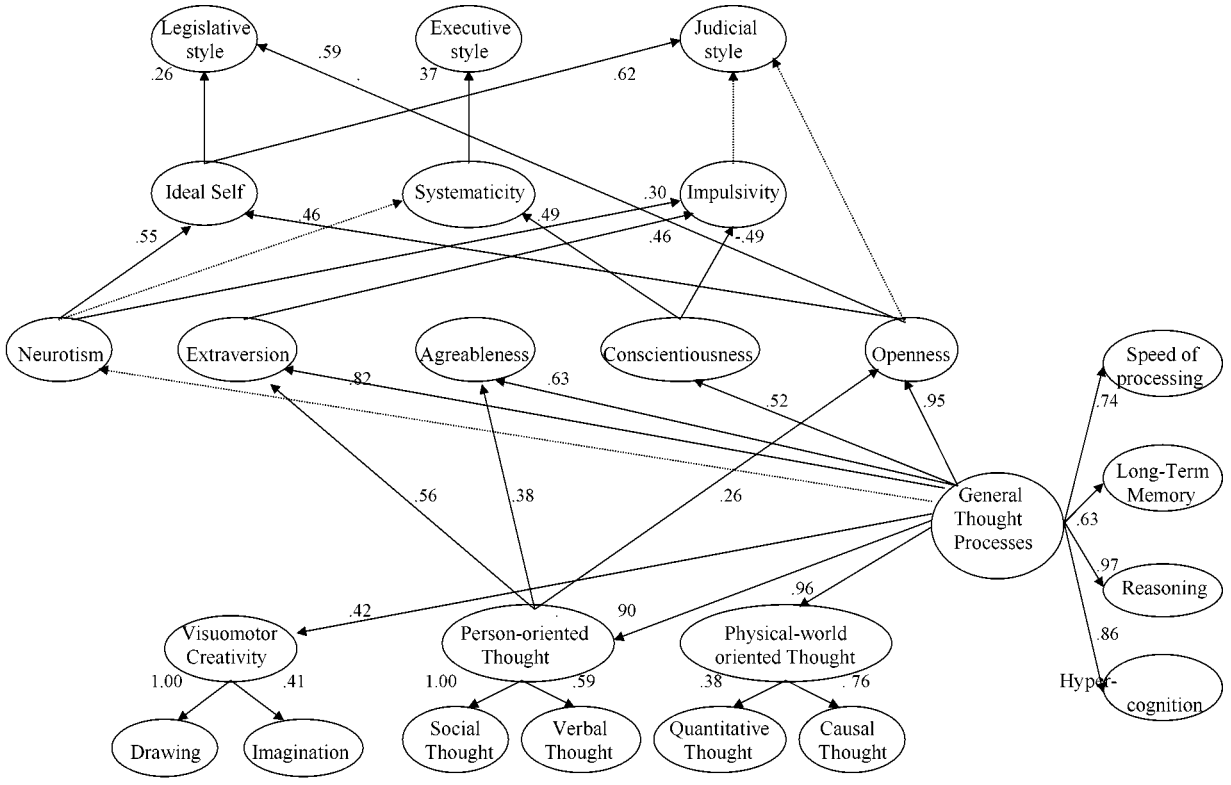
Results and Discussion

Exploratory factor analysis was first applied to all three inventories together to verify that all dimensions of cognitive self-representation, personality, and thinking styles were actually present. The analysis revealed that all dimensions appeared as distinct factors, thus justifying their use in the structural equation model to be described below (see Demetriou & Kazi, 2001).

To specify the relationships among the various kinds of factors, a complex structural equation model was built (see Fig. 5). The model assumed that the factors are organised in several tiers: the cognitive factors are located at the lower layer of this architecture, personality factors are placed in the middle, and thinking styles at the top. Locating personality factors in the middle does not imply that they are considered less basic than the cognitive factors in determining behaviour; rather, this architecture simply indicates that cognitive factors influence derivative factors (such as thinking styles), and actual behaviour through the interface of the personality factors.

The pattern of relationships is highly interesting. Specifically, it can be seen that four of the five dimensions of personality are closely related to those of cognitive self-representation, for instance, individuals who have a strong sense of cognitive efficiency are also open to experience. In fact, the relationship between the factors of perceived general cognitive efficiency and openness to experience is so high (.95) that they may be considered as two sides of the same coin. Also notably high were the relationships between extraversion (.82) , agreeableness (.63), and conscientiousness (.52) and perceived cognitive efficiency. Only neuroticism was found to be completely unrelated to cognitive efficiency.

Different combinations of personality characteristics appear to result in different thinking styles. The model suggests that individuals who are open to experience and emotionally stable tend to score high on the ideal self factor; in other words, they think highly of themselves and want to be the centre of social attention. This is suggested by the rather strong relationships between these two personality dimensions with the factor representing ideal self. In turn, thinking highly of oneself together with being open to experience orients the individual to activities requiring originality. Those who think highly of themselves but are not open to experience tend to have an evaluative style of thought, which orients them to activities requiring evaluation. Interestingly, a combination of emotional stability with extraversion seems to lead to impulsivity; impulsivity itself is negatively related to conscientiousness, which is, however, related to systematicity. In turn, systematic personalities tend to



$x^2(859)=926.525$, p=.054, CFI=.981, GFI=.819, AGFI=.763, RMSEA=.023

Fig. 5. The model of the relations between cognitive self-image factors, personality factors, and thinking styles factors.

have an executive style, which leads them to activities with predefined rules. We believe that these findings are a first step in the direction of integrating the psychology of the mind with the psychology of personality. The study presented below provides more evidence in this direction.

STUDY 3: COGNITIVE DEVELOPMENT, SELF-REPRESENTATION, AND THE BIG FIVE FACTORS OF PERSONALITY

All measures generated by the second study summarized above stand for self-representations or self-characterizations. Thus, while this study addresses the relationships between the various dimensions of the self-oriented level of the mind and the self, it cannot directly clarify correlations among abilities residing at the environment-oriented level, the various dimensions of self-representation, and personality. A series of studies currently under way in our laboratory aim to remedy this weakness by including both measures of actual performance and also various measures of self-representation and personality. One of these studies is summarized below.

Participants

This study included a total of 891 participants, distributed by age as follows: 80 (mean age 10.5 years) and 83 (mean age 11.5 years) primary school children drawn from grades 5 and 6, respectively; 67 (mean age 12.5 years), 73 (mean age 13.5 years), and 74 (mean age 14.5 years) young adolescents drawn respectively from grades 1, 2, and 3 of junior high school; 147 (mean age 15.5 years), 131 (mean age 16.5 years), and 137 (mean age 17.5 years), older adolescents drawn from grades 1, 2, 3, of senior high school, respectively; finally, 99 (mean age 21 years) university students. The genders and three socioeconomic classes (rural, working class, and middle class) were about equally represented in each age group. Moreover, the participants from senior high school were about equally drawn

from the two main directions in Cypriot secondary schools, namely humanities and sciences.

Task Batteries and Inventories

Participants were examined with a cognitive development test, which included batteries addressed to five of the SCSs specified by our theory, (quantitative, causal, spatial, qualitative, and propositional). The quantitative thought battery addressed skills in numerical operations, numerical analogies, and algebraic reasoning (Cronbach's alpha .86). The causal thought battery focused on the ability to formulate and test hypotheses by designing experiments and the ability to understand various types of casual relationships, such as necessary and sufficient, necessary and insufficient, unnecessary and insufficient, etc. (Cronbach's alpha .55). The spatial thought battery included items addressed to formation of mental images, mental rotation, and coordination of perspectives and frames of reference (Cronbach's alpha .85). The qualitative thought battery tested class inclusion, Raven-like reasoning, and verbal analogies (Cronbach's alpha .77). Finally, the propositional thought battery examined class reasoning, propositional reasoning, and reasoning in a pragmatic context (Cronbach's alpha .62). As a whole, this test was highly reliable (Cronbach's alpha for the entire test is .90).

Moreover, the participants were examined by the cognitive self-representation inventory used in Study 2 described above (Cronbach's alpha .91). The Big Five Factors of personality were addressed by 50 of items drawn from the personality inventory used in Study 2. Specifically, the 10 items with the highest loading for each of the five factors were selected to address personality in this study (Cronbach's alpha .83). Thus, this study provides the data required to examine the precise relationships among the various SCSs, as well as those among cognitive self-representation and personality from late childhood to early adulthood.

Results and Discussion

A complex model was fit to the data for both the entire sample of 891 participants and for the four important phases of development, namely late childhood, early adolescence, late adolescence, and early adulthood. Primary school children, junior high school participants, senior high school participants, and university students were pulled together to form each of these four groups. This manipulation allowed the various factors and relationships over the whole sample to be specified, as well as how these factors and relationships change, if at all, across these four crucial phases of development. Fitting the model to each age group was not possible because of the limited number of subjects.

The model included both first- and second-order factors (see Fig. 6). Each of the five SCSs, which represent performance on the corresponding task battery, was assigned a first-order factor that was specified in reference to three mean scores representing performance on the items addressed to a domain. These factors were then regressed on a second-order factor. In terms of our theory, this factor represents the environment-oriented level of the mind and it corresponds to the general cognitive factor specified by the first of the studies presented here.

There was also one first-order factor for self-representation of each of the five SCSs based on the self-attribution of ability scores given to the respective items on the self-representation inventory. Again, each of these factors was specified in reference to three scores representing self-attribution of ability in regard to a domain. All five self-representation factors were regressed on a second-order factor, representing the self-oriented or, in our terms, the hypercognitive level of the mind. This factor corresponds to the general hypercognitive factor of the first study. The five SCS-specific self-representation factors were also regressed on the residual of the corresponding performance factor. This manipulation enables us to specify how (if at all) the domain-specific self-representation factors depend on their corresponding ability-specific factor, as well as their dependence on forces regarding self-representation.

The Big Five factors of personality were also assigned a first-order factor, specified in reference to three scores representing self-attribution of personality characteristics related to a personality dimension. Each factor was regressed on both the general cognitive performance and the general cognitive self-representation factor. This manipulation allows the relations among the personality factors and both the cognitive and the hypercognitive levels of the mind to be specified.

Finally, the two second-order factors were allowed to correlate in the fashion of the model shown in Fig. 2.

The fit of the model, applied on the whole sample was good, $\chi^2(830) = 1627.812$, $\chi^2/df = 1.961$, $p = .001$, CFI = .919, GFI = .920, AGFI = .909,

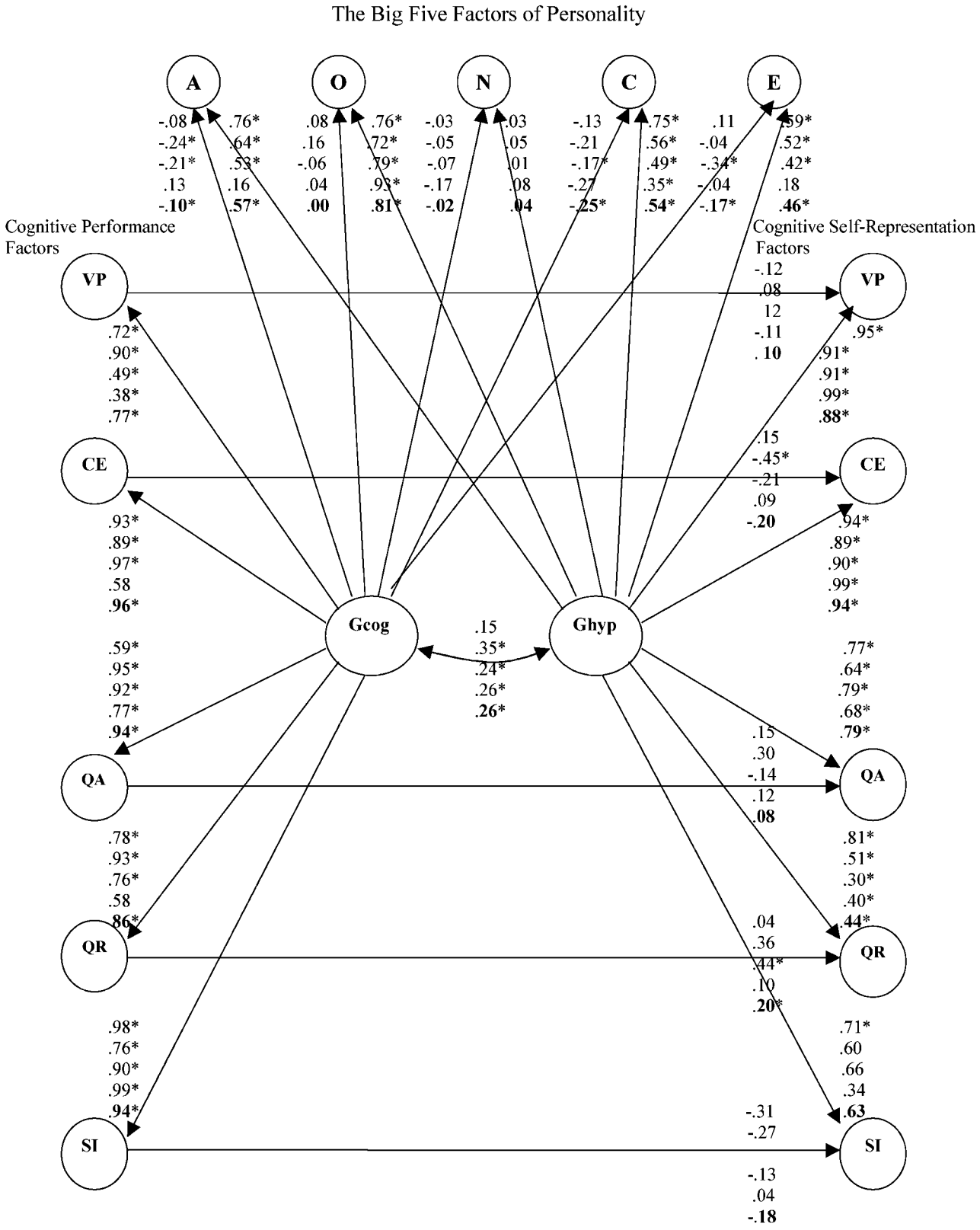


Fig. 6. The model captures the organization of cognitive abilites, self-representation about cognitive abilites, and the Big Five Factors of personality. VP, CE, QA, QR, and SI stand for the verbal–proportional, the causal–experimental, the qualitative–analytic, the quantitative–relational, and the spatial–imaginal system, respectively. A, O, N, C, and E stand for agreeableness, openness to experience, neuroticism, conscientiousness, and extroversion, respectively. Asterisks indicate significance of parameters. Asterisks indicate significant loadings.

RMSR = .053. The model was further tested with a multiple group analysis, involving the four age groups; no equality constraint was imposed in this model. This analysis allowed the model parameters to be specified separately for each age group so that they would be compared for possible differences. The fit of this model was also satisfactory, especially considering the complexity of the model and the presence of multiple groups $\chi^2(3279) = 4658.809$, $\chi^2/df = 1.420$, $p = .001$, CFI = .844.

We note first the parameters of the model tested on the entire sample, because this sample's size (891 subjects) and variability (in terms of age and origin of subjects) lend considerable robustness to this model. The parameters of foremost importance in this model are those concerned with the relationships among both the personality factors and the cognitive factors. Inspection of the model reveals first, that the effects of the general self-representation factor on the personality factors were very similar to the corresponding effects revealed by Study 2. Thus, there was a very strong effect of self-representation on openness to experience (.81), lower but still significant and substantial effects on agreeableness (.57), conscientiousness (.54), and extraversion (.46), and no effect on neuroticism (.04).

Second, the effects of the cognitive performance factor on the personality factors were much weaker in all cases. Moreover, it is noticeable that, whenever significant, these effects were negative, (agreeableness: −.10; conscientiousness: −.25; extraversion: −.17). We interpret these results to indicate something broader than a direct relationship between cognitive ability and personality or between intellectual development and personality development. That is, we suggest that the size and the direction of these relationships does not justify assuming a direct relationship between cognition and personality. Rather, this pattern of relationships reflects a broader phenomenon regarding the relationships between development of cognitive abilities and the development of self-representation. That is, the cognitive changes, which occur at some phases of development, make the persons conservative in their self-attribution of ability or characteristics. As a result, increases in cognitive performance scores are associated with a general decrease in self-attribution scores (Demetriou & Kazi, 2001). In terms of the findings of our Study 1, this pattern of relationships may reflect the rescaling of the personal constant that occurs from early adolescence to early adulthood.

Third, the intercorrelation of the two general factors was significant, indicating that the two levels of the mind do in fact interact. This confirms the findings of Study 1.

Fourth, the direct effects of the domain-specific factors on their corresponding self-representation factors were generally very low. In fact, this effect was significant only in the case of quantitative thought (.20); this supports the assumption that self-representations about specific domains are primarily derived from a general self-representation of cognitive efficiency. Nevertheless some domains (e.g., mathematics), are more transparent to awareness than others, and contribute directly to both the formation of self-representation and general cognitive efficiency.

The parameters of the model tested on the four age groups were generally the same as those of the model tested on the whole sample. However, if taken in relation to each other, the four age-specific models do reveal some interesting developmental trends. First, the effect of the self-representation factor on three personality factors (agreeableness, conscientiousness, extraversion) diminished systematically from the younger to the older age group. This developmental trend was not observed for openness, where the effect of self-representation remained always very strong, nor for neuroticism, where the effect was always negligible. Second, the effect of the general cognitive performance on the general self-representation factor was nonsignificant at primary school but became significant thereafter. This finding, which concurs with the model shown in Fig. 2, further supports our assumption that a relatively accurate communication between the two levels of the mind (in regard to the processes studied here) is not established until early adolescence.

In sum, it appears that the relationships between personality and actual cognitive abilities are indirect rather than direct; more specifically, are mediated by the hypercognitive level of the mind. Our findings reveal that the dimensions of personality are not closely related to cognitive performance itself but rather are closely related to cognitive self-representation. These relationships are so close that it may be accurate to assume that personality as examined by self-report inventories is part of the general self-representation system. Alternatively, it may be concluded that all but one (neuroticism) of the Big Five dimensions of personality have a strong reflected cognitive component. We, however, note that, apart from openness to experience, the dependence of personality dimensions on

the dimensions of cognitive self-representation tend to weaken with age. This process of differentiation evolves throughout adolescence, becoming clear in early adulthood.

CONCLUSIONS

The studies summarized here suggest that the mind is simultaneously hierarchical, modular, and transmodular. It is hierarchical because it involves systems that are organised at different levels, according to orientation and functioning. By definition, self-oriented systems stand on a level higher than the environment-oriented systems because they are applied on them in order to monitor and regulate their functioning. Processing potentials stand in-between as a dynamic field that interlocks the two knowing levels, thus constraining their functioning and interactions. Moreover, the mind is modular at both the level of environment-oriented cognitive processes and personality dispositions and the level of their self-representation. In fact, modularity at both levels is very strong for good reasons: it enables specialized and therefore efficient interaction with the domain concerned.

However, the mind is also unified or transmodular, insofar as the very ability to oversee, record, and differentiate modules is by definition a transmodular function. Moreover, the personal constant identified here is a transmodular mechanism because it operates on all modules to allow systematic adjustments to both performance and subjectivity. This constant integrates the effects of general processing efficiency and temperament. Thus, this constant represents processes that directly interconnect mind and personality. All three studies presented here showed clearly that self-representations about cognitive functions and personality dimensions are considerably cohesive, although direct relationships between cognitive abilities and personality were very weak and negative.

Therefore, it may be said that humans have mind because there are environment-oriented systems and internal dispositions of which to become mindful. The self is the personalized aspect of this system and it may refer to cognitive abilities and processes (e.g., I am good in reasoning, learning, mathematics, drawing, social interaction, etc.) or to personality traits or dispositions (e.g., I enjoy being with people; I am stable; I am irritable, etc.). These traits and dispositions determine individual idiosyncratic functioning. At the same time, everything is embedded in a social context where minds, selves, and personalities interpret, interact, and interrelate (Demetriou & Kazi, 2001). In fact, observing and interacting with others may be a good platform for testing assumptions about one's own self and mind. These assumptions are consistent with modern evolutionary theory, which argues that mindfulness emerged as a result of self-observation, self-evaluation, and self-mapping as well as the human capacity for observation and manipulation (Bogdan, 2000; Mithen, 1996).

Development appears to exert two seemingly contradictory kinds of influences. First, it seems to strengthen the tuning between the two basic knowing levels of the mind. The reader is reminded that there is a structural change in the relationship between the hypercognitive and the other levels of the mental architecture, which begins at the age 11–12 years. It is widely accepted that cognitive abilities are transformed extensively at this age, and our studies have shown that at this age the personal constant is rescaled, obviously to tune the person's self-representations with his or her new cognitive abilities and potentials. This interlevel tuning improves until the end of adolescence. In turn, this results in increasing communication between the environment-oriented and the self-oriented level of the mind. As a side effect of this increasing communication, self-attribution of abilities and characteristics tend to become stricter and more accurate with either age or improvement in cognitive performance.

Second, the findings of Study 3 suggest that this increasing communication between the levels of mind coevolves with an increasing differentiation between self-attributions related to personality and those related to cognition. The reader is reminded that during the transition from adolescence to adulthood correlations between the cognitive and the personality aspects of the self seem to decline. Taken together, these findings suggest that from late childhood to early adulthood humans become more accurate self-observers and, probably as a result of this, more able to clarify and articulate various abilities and attributes.

This conclusion implies that the transition to adulthood is associated with a kind of multifurgation of the personal constant. That is, the two principal realms of the self (cognitive and the personality), and possibly certain subrealms acquire their own constant which is then used to calibrate domain-specific performance. Extensive study is needed to map the processes that cause this multifurgation, and to specify the new domain-specific constants, their possible interrelationships, and of course, their relationships to the original and a general personal constant. It may

be noted that these findings agree with other research which indicates that young adults begin to operate as systematic self-theorists who are concerned with both their own and others' profile of abilities and characteristics (Fischer & Ayoub, 1994; Harter, 1999).

It would be interesting to extend this model to accommodate development in the years of maturity and late adulthood. It has been mentioned in the introduction that the various aspects of the environment-oriented systems show positive changes until about the age of 50 years when they begin to show negative changes. For instance, speed and control of processing decrease, working memory declines, and reasoning and problem solving loose some of their efficiency and flexibility. There are also personality changes, particularly in those dimensions most closely related to cognition, as individuals become less open to experience and less extroverted with age. Two of our studies (Studies 2 and 3) showed clearly that self-representation of cognitive efficiency is closely related to both actual cognitive performance, and these two dimensions of personality. These links justify studying whether these personality changes in the latter years are caused by coexistent cognitive changes. Further research is needed to provide a direct answer to this question.

A number of scholars have argued that losses at the more fundamental levels of the mind are compensated by gains in the many functions and skills associated with self-understanding, self-management, and management of complex social and interpersonal issues, at least until the end of middle age. These authors have argued that the mind becomes *dialectical* after a certain phase (Labouvie-Vief, 1990; Pascual-Leone, 1983; Riegel, 1973). Dialectical thought enables individuals to envisage and accept alternative conceptions of the same aspect of reality to attain a higher order synthesis. In this synthesis alternative conceptions are recognized for whatever unique or valuable contribution they make to the process of understanding. All these theorists believe that dialectical thought requires explicit reflection and self-awareness.

Dialectical thought is also implicated in the acquisition of wisdom, which is supposed to come with age. According to Baltes and Smith (1990), wisdom is "exceptional insight into human development and life matters, exceptionally good judgement, advice, and commentary about difficult life problems" (p. 95). Wise judgement integrates factual knowledge of the events and pragmatics of life, strategies for dealing with them, knowledge which considers uncertainties, and a relativist attitude toward life values and goals. In fact, wisdom is possible because minds interact with each other. The attainment of wisdom is highly useful for both the individual and the social group, since it can integrate the best interests of both into balanced decisions and policies. Moreover, wisdom enables the individual to accept the negative changes that aging brings, such as the cognitive changes noted above and the decline in general physical fitness and health (Baltes, 1991; Baltes & Staudinger, 1996).

However, there is no evidence on how these changes are related to possible changes in the relationships between personality and the mind. It could be assumed, for instance, that the weakened relationships between personality and cognition discussed above make the person more sensitive to the various combinations of personality, cognitive talents, and abilities. In turn, this may make the person more tolerant of alternative ways of interpreting the world and acting in it. By implication, increasing tolerance may lead to a dialectical approach to problems and to wisdom in judgement. Thus, the changes discussed above in the relationships between the levels of the mind and the personal constant may lie at the background of the acquisition of dialectical thought and wisdom. Obviously, there is no evidence directly related to these assumptions. It is hoped that the model and the studies presented here indicate the directions we would have to follow, in order to highlight these phenomena.

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