INTELLIGENCE AS A SUBSYSTEM OF PERSONALITY:

FROM SPEARMAN'S G TO CONTEMPORARY MODELS OF HOT PROCESSING

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INTRODUCTION

Wechsler wrote that "general intelligence ... must be regarded as a manifestation of the personality as a whole" (Wechsler, 1950/1974, p. 47). According to Wechsler and others, personality and intelligence are so closely connected that one cannot be considered without the other (see Sternberg & Ruzgis, 1994, for a collection of such opinions). Such different definitions of personality and intelligence are employed in the field, however, that it is difficult to integrate such conceptions. In this chapter, we employ a common definition of personality constructed from reviews of diverse theoretical perspectives within the field of personality (Mayer, 1993-1994, 1995, in press); this common conception of personality arises from what is elsewhere termed a *system-topics approach.* To match this common conception of personality, we sought a common conception of intelligence. Accord-

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ingly, we conducted a pan-theoretical review of major intelligence theories, so as to identify the major components of intelligence that were fairly consensual across such perspectives. The consensual descriptions we developed of personality and intelligence will potentially clarify how the two system interact.

The system-topics approach to personality rests on the assumption that there are several core topics by which any complex system is defined (Mayer, 1993-1994, 1995, in press). Three core topics of personality are: (1) its components, (2) the organization of those components, and (3) the change and stability of the components and their organization over time. The personality system is composed of multiple components—subsystems—including consciousness, cognition, affect, and conation, and their subsidiary subsystems that carry out basic mental functions. It further includes those components that represent knowledge of the self and surrounding world, as well as those thematically unified components that direct thought and action in coherent, dynamic, patterns, such as the traits of extraversion and sensation-seeking. Personality is supported through its neurobiological underpinnings and is itself a part of larger social systems. The personality system also exists within the individual organism and is bounded by the individual's sensory-motor contact with the outside world (Mayer, 1995). (Its influence may extend past that sensory-motor boundary through its various actions.) In system-topics language, intelligence may be viewed as a subsystem which overlaps with several personality subsystems. The exact nature and scope of intelligence will depend upon how it is conceptualized (i.e., as abstract reasoning, or as all of cognition, or as intelligent behavior), but virtually all definitions of personality and intelligence view intelligence in a part-whole relation to personality.

The purpose of the present chapter is to develop a systems description of the components shared in common by personality and intelligence, to apply that description to several standard models of intelligence, and then to describe our own research on emotional (or *hot*) processing within the framework. After this introduction, the "Background" section briefly examines the historical development of several frameworks commonly employed for the exposition of personality and intelligence. The "Systems Model of Intelligence" section develops a systems model of intelligence from a review of several major theories of intelligence, by focusing on the component parts of intelligence. The next section, "Hot Processing," discusses our own research and that of allied laboratories within this systems model. The final section, "General Discussion and Conclusion," examines the merits of such a systems model and more generally the organization of intelligence within personality.

BACKGROUND

In the present section, we examine three earlier fieldwide frameworks—outlines, really—that had been used for integrating intelligence within personality. These three, in rough historical order of appearance, include: (1) the differen-

tial psychology framework, (2) the theory-by-theory framework, and (3) the research-topics framework. Each of the three has been only partly successful in representing the personality-intelligence relation; it is for that reason that we promote the system-topics alternative at the conclusion of this section.

The Differential Psychology Approach

Differential-psychology frameworks emerged in the 1930s during a time when great strides were being made in intelligence testing but before a coherent field of personality psychology had developed. At that time, personality psychology was divided among the clinical approaches of Freud, Jung, Adler, and others, as well as a correlational/testing orientation that focused on the study of individual differences. Differential psychology was defined as the study of individual and group differences and emphasized both intelligence and personality testing. Anastasi and Foley's authoritative textbook stated:

> differential psychology is presented, not as a separate field of psychology, but as one approach to the *understanding of behavior.* Its fundamental questions are not so different from those of general psychology. It is apparent that if we can explain why individuals react differently from one another, we shall understand why each individual reacts as he does (Anastasi & Foley, 1949, p. viii).

Fifty years ago, much of individual differences research focused on typologies of people in addition to the dimensions along which they varied. Some of the later chapters of Anastasi and Foley examine such types as *degenerate families*, the *endomorph*, *mesomorph*, and *ectomorph*, the *subnormal*, the *genius*, the *male*, the *female*, and various racial and cultural differences. In the typologies of that time, personality and intelligence were viewed as interacting together to produce different sorts of individuals. Thus, according to one theory, the *genius* was a genius not only because of superior mental ability but also because of various psychopathological abnormalities. Whatever theory of genius a person accepted, it was a given that personality and intelligence worked together to create the behavioral outcome.

The differential psychology framework, through its focus on psychological testing, integrated studies of personality and intelligence and indicated how their features might interact to produce various types of people (i.e., the genius). Because the framework predated the advent of much of personality psychology, however, it remained vague in hypothesizing specific interactions between personality and intelligence. It was more successful in showing *that* people differed on various traits than it was in explaining how or why they differed. Moreover, it possessed no means by which to include a study of mental universals as opposed to individual differences. For instance, Freud's universal id/ego/superego model of human personality could not be adequately discussed within this approach or compared to other models. All that could be examined was the quite different issue of individual differences.

Theory-By-Theory Approaches

If one abandoned the differential psychological approach, however, one was left to choose among hotly contested personality theories. Personality psychology between 1900 to 1950 consisted almost entirely of books that espoused a particular theory such as Freud's psychodynamics or Roger's client-centered approaches, often to the exclusion of any other theory. This period ended with Hall and Lindzey's (1957) theory-by-theory framework, which presented a fair-minded cross-section of expositions of personality conceived by Freud, Jung, Adler, Rogers, Maslow, and others.

Despite the fact that some major personality theorists, notably Jung and Cattell, had much to say about intelligence, the theory-by-theory approach to personality made little contact with intelligence research. Even if such coverage had been added, however, it might not have contributed much to examining intelligence's place within personality. Most theory-by-theory volumes made little or no effort to arrive at integrations across contradictory theories (Maddi, 1989; Mayer, 1993-1994, 1995, in press). Limited by such eclecticism and far removed from contemporary research, the theory-by-theory framework has begun to lose its general acceptance among personality psychologists (e.g., Mendelsohn, 1993).

Research Topics Approaches

To compensate for the weaknesses of the theory-by-theory approach, a newer framework in personality psychology has emerged: a research topic-by-topic approach. The research topic approach covers a series of areas of empirical investigation defined by contemporary psychologists working in the field. A typical volume might have chapters on such substantive areas as *the unconscious*, *gender and sexuality*, *traits*, *personality stability*, *cognition and affect*, *motivation*, and so forth, as well as introductory chapters on history and methodology.

Interestingly, chapters on intelligence do not regularly appear in research volumes on personality, although there is no good reason for their omission. But this may ultimately make little difference because such volumes on research topics have not yet gained much popularity (Mendelsohn, 1993). Like the theory-by-theory approach, the research topics possess little or no integration across chapters and thus fail to construct a coherent sense of personality as a whole, let alone its interaction with subsystems such as intelligence. Given this lack of integration across topics in personality, the topic-by-topic approach does not lend itself to the exposition of intelligence and personality.

Summary Thus Far

The three traditional frameworks for examining the relation between personality and intelligence (differential psychology, theory-by-theory, and research topic-by-topic approaches) have failed to yield an adequate integration of personality

and intelligence. The frameworks themselves contribute to this state of affairs. Differential psychology cannot organize common, universal connections between personality and intelligence. The theory-by-theory and research topic-by-topic approaches are meant to be exhaustive but possess no intrinsic method for integrating across theories or research areas. As a consequence, they present a disjointed view of personality itself and fail to integrate intelligence within it. A systems approach solves this problem by identifying components common to personality and intelligence and treating them in an interrelated fashion.

The Potential Advantage of a System-Topics Approach

One can conceive of personality as a complex system which organizes a person's experience of, understanding of, and interaction with, the world. Any complex system must be differentiated into distinct features and integrated such that these features cooperate in general functioning (Csikszentmihalyi, 1993). Because personality is so complex, perhaps the most responsible way of understanding it is through a systems perspective, which examines differentiated components in such an integrated structure.

Recall that the system-topics approach focuses on components and their organization. As it turns out, most personality components, including intelligence, can be clearly described outside of the theory in which they were proposed (Mayer, in press). As a consequence, the system-topics treatment enables the scientist to escape the context of competing theories by focusing attention at the level of components. This pan-theoretical language of components can be used to subsume earlier theoretical writings concerning the nature of intelligence and intelligence-personality interactions. By understanding the precise components that intelligence and personality share in common, the relation between the two systems can be better understood.

In the present case, we employ a systems approach and identify several components that are commonly employed across intelligence theories. Those components are then employed to summarize a variety of earlier-developed theories. Once this more universalized language for describing intelligence theories is developed, the language can then be used for characterizing current theories and better understanding personality-intelligence relations.

CONSTRUCTING A SYSTEMS MODEL OF INTELLIGENCE

In the present section, we outline and describe several components that appear and reappear throughout the intelligence literature. Next, we organize some touchstone intelligence theories according to these several universalized components. To identify these basic components, we first carefully examined eight commonly discussed theories of intelligence. The group was selected as a whole to represent theories of importance to both intelligence and personality researchers. Among

intelligence theories, Spearman's theory of general intelligence and Thurstone's theory of primary mental abilities were selected because of their continued influence on the field. Wechsler's theory of intelligence represented a practitioner-developed model of intelligence par excellence. Personality theories relevant to intelligence were represented by Carl Jung's concepts of intellectual functions, which he employed as the basis of his psychological types, and Cattell's theory of *fluid* and *crystallized* intelligence. Hans Eysenck's work also derives from a personality perspective—but one that is particularly focused on biological concerns. Two more recent theories of intelligence cross disciplinary boundaries. Baron's work on personal *prudence*—the idea that prudent behavior represents an intelligent style of life—joins personality processes in an intelligence framework. Finally, Gardner's theory of multiple intelligences was included for its important statements about personality organization—although it originally stemmed from an educational tradition. Later, we will discuss our own theory of *hot processing*, which is concerned with the processing of emotional information from this component-based model.

An in-depth examination of the above theories suggested that eight components are regularly employed across them to describe intelligence and its relation to personality. These include: (1) a concept of raw *input*, or raw information, that enters the system; (2) *mental energy*, which "powers" intelligence; (3) an *intellectual processor* that transforms raw information into usable products of processing; (4) an *arena*, which is the location within personality where intelligence operates; (5) an *expert knowledge base* that consists of operations and rules that are stored by the system so as to make subsequent processing more efficient and/or accurate; (6) *output* such as new or transformed ideas that emerge from the intellectual processor; (7) *enhancers*, which are nonintellective features hypothesized to enhance intellectual functioning; and (8) *constraints*, which are nonintellective features that inhibit such intellectual functioning.

We took each of our original theories and recast them within an outline based on these eight components. The results appear in Table 1. Each section of the table systematizes each theory by dividing its statements concerning intelligence according to the eight components. We will refer to the various theories and their divisions, as shown in Table 1, throughout the next section.

Inputs

The *inputs* are the raw information upon which intelligence operates. Input information is transformed by intelligence to be of use to the person in a particular problem-solving situation. Inputs may derive from sources outside the personality system (e.g., symbolic communication from others) or may be self-generated. For example, Spearman's inputs consist of "fundaments"—building blocks such as individual words, numbers, or ideas. From these fundaments are abstracted their

Table 1. Sample Classification of Intelligence Models According to Characteristic Features

Input and Mental Energy	*Processor and Arena*	*Knowledge Base and Output*	*Enhancers and Constraints*
		Spearman (1927, 1930)	
Input. Unprocessed percepts and ideas enter into processing as "fundaments" of a relation (Spearman, 1930, p. 18). *Mental Energy.* A common "mental energy," g, fuels specific processors— "mental engines," comprised of "different neural systems" (Spearman, 1927, p. 133).	*Processor(s).* A series of specific processors, *s*'s, govern processing through (1) educing relations, (2) educing correlates, and (3) self-apprehension. The term "noegenesis" referred to the collective effect of each form of processing (see Spearman, 1930, pp. 34-35). *Processing Arena* Processing takes place by groups of neurons within various portions of the cerebral cortex (see Spearman, 1927, p. 134).	*Expert Knowledge Base.* Spearman's atomistic approach to intelligence did not incorporate a knowledge base. *Output.* The products of "noegenesis"—the relations, correlates, and meta-cognition— are simply referred to as new mental contents.	*Enhancers.* Greater intelligence is determined by a greater amount of mental energy and greater "efficiency of the engines involved [in processing]" (Spearman, 1927, p. 220). *Constraints.* Mental fatigue, mental inertia, oscillation, and self-control constrain the quantity and efficiency of processing (see Spearman, 1930, chs. XVII-XX).

(*continued*)

Table 1 (Continued)

Input and Mental Energy	Processor and Arena	Knowledge Base and Output	Enchancers and Constraints
	Jung (1921/1946, 1925/1989)		
Input. Both objective and subjective information enter into processing by the four functions. *Mental Energy.* A limited amount of energy is allocated to a particular input (i.e., internal subjective feelings or external experience), which becomes more highly processed.	*Processor(s).* Four distinct processors exist, each of which "brings to the subject a special aspect of reality" (Jung, 1925/1989, p. 122). Although the four psychic functions employ different symbols, each operates through abstraction— "a form of mental activity which releases the essential content or fact from its connection with irrelevant elements" (Jung, 1921/1946, p. 520). *Processing Arena.* The major arena of processing is the psyche (both conscious and unconscious), which contains "a subjective constellation of concepts" (Jung, 1921/1946, p. 521) by which persons abstract the value of subjectively conceived objects.	*Expert Knowledge Base.* The collective unconscious provides a preexisting source of archetypes—universal stereotypes—of the world from which intelligence could draw. *Output.* The different functions produce different mental products: intuition produces new possibilities, feeling produces values, sensation produces percepts, and thinking produces ideas.	*Enhancers.* Although Jung (1921/1946) was not explicit about the capacity of intelligence, greater intelligence probably depends upon: (1) a greater ability to abstract only the essential features of an object, (2) the ability to consider both objective and subjective data (p. 496), and (3) the ability to coordinate the processing of all four functions.

Thurstone (1924/1960, 1938)

Input. Ill-defined impulses (motives), concepts, or ideas represent "unfinished acts" (Thurstone, 1924/1960, p. 34) which must further define themselves before realized as behavior.

Mental Energy. The [energy] sources of conduct are the physiological, mental, and social conditions of satiety or satisfaction which every normal person seeks.

Processor(s). There are seven primary abilities: *S*: "spatial and visual imagery"; *P*: "perceiving detail ... imbedded in irrelevant material"; *N*: "numerical calculation"; *V*: "verbal relations," dealing with "ideas and meanings"; *W*: "dealing with [the structure of] words"; *M*: "memory"; and I: "induct[ion]" (Thurstone, 1938, pp. 80-87). Each primary ability operates through abstraction (Thurstone, 1938, p. 11).

Processing Arena. Processing proceeds from the preconscious arena, in which ideas are formed, to the conscious arena, where imagination of possible consequences takes place.

Expert Knowledge Base. As a person matures, he/she develops a system of symbols which enable the person to "represent expected experiences" in a very abstract form (Thurstone, 1924/1960, p. 162).

Output. With increasing definition, an impulse is translated into a well-specified, uncontested "idea ... concept, ... [or] proposed general line of conduct" (Thurstone, 1960, p. 48)—all of which occurs beyond rational control. For all persons, rational control is limited to "the acceptance and rejection of the ideas that occur to us" (p. 48).

Enhancers. "Mental power and intelligence consist in the capacity for allowing the rough, vague, loose, almost intangible impulses to clash before they have become particularized into percepts or definitely specified ideas" (Thurstone, 1960, p. 50). "The more intelligent the actor, the earlier will the dissatisfaction tend to become [conscious]" (p. 99).

Constraints. The major constraint on intelligence is "urgency." Urgency forces the motive toward expression before it is consciously elaborated by being selected from among universal ideas (Thurstone, 1960, p. 99).

(continued)

Table 1 (Continued)

Input and Mental Energy	*Processor and Arena*	*Knowledge Base and Output*	*Enhancers and Constraints*
	Wechsler (1939, 1943, 1960, 1963, 1971, 1974)		
Input. Intelligence invariably processes different environmental "challenge[s]" (Wechsler, 1971, p. 52), including "propositions ... the meaning of words ... mathematical problems [etc.]" (Wechsler, 1939, p. 4). *Mental Energy.* "General intelligence, like electricity, may be regarded as a kind of energy. We do not know what the ultimate nature of this energy is ... we know it by the things it does" (Wechsler, 1939, p. 4).	*Processor(s).* A sequence of neural "resonances" lead to purposeful or practical behavior (Wechsler, 1960, p. 264). The major attribute of intellectual processing is "the ability to perceive, to understand, and to educe rational relationships" (Wechsler, 1974, p. 81). *Processing Arena.* The major processing arena is "the human brain ... a complex neural network whose main function is to serve as a vast clearing house of incoming and outgoing messages" (Wechsler, 1960, p. 260).	*Expert Knowledge Base.* "an organism ... combine[s] past data into meaningful configurations," (Wechsler, 1974, p. 176). Knowledge represents a set of modified links between facts (see Wechsler, 1963). *Output.* The result of intelligent processing are various "mental products" (Wechsler, 1939, p. 4) —associations, inferences, and other solutions to the problems presented to the individual.	*Enhancers.* In terms of brain activity, "an intelligent person may ... be defined as one who has been endowed with more or better resonators" (Wechsler, 1960, p. 264). *Constraints.* Fundamental to general intelligence are certain "non-intellective factors" (Wechsler, 1943, p. 101), such as persistence, drive, and temperament.

Cattell (1940, Cattell & Butcher, 1968)

Input. For fluid intelligence, the major objects processed are aspects of problem-solving situations. For crystallized intelligence, the major objects processed are "former judgments" (Cattell & Butcher, 1968, p. 19).

Mental Energy. Ergs and metaergs are general sources of instinctual energy; these are not, however, integrated within the theory of intelligence.

Processor(s). There may be separate processors for fluid and crystallized intelligence (Cattell, 1940). The fluid processor(s) (more fundamental and physiologically based) operate through various problem-solving strategies in entirely novel situations. Crystallized processor(s) operate on the expert knowledge base, recapitulaing previously learned knowledge from various areas (e.g., verbal, numerical, spatial).

Processing Arena. Cattell is not explicit about the arena in which problem-solving occurs.

Expert Knowledge Base. In addition to being a processor, crystallized intelligence constitutes a body of knowledge that is accumulated by the individual and useful for future intellectual processing.

Output. The products of both fluid and crystallized intelligence are new judgments.

Enhancers. Certain temperament traits may have weak influences in some school settings (Cattell & Butcher, 1968, p. 21).

Constraints. As stated above, certain temperament traits may influence intellectual processing in some school settings.

(continued)

Table 1 (Continued)

Input and Mental Energy	*Processor and Arena*	*Knowledge Base and Output*	*Enhancers and Constraints*
	Eysenck (1953, 1979, 1994)		
Input. The objects processed are different forms of information (e.g., verbal, numerical, and spatial; Eysenck, 1953). *Mental Energy.* Concept not addressed.	*Processor(s).* Both a general intelligence processor and specific mental processors govern processing. Some neurological structure or feature, such as a "comparator," serves as the major processing agent. The comparator "looks at ... repeated [neurological] messages to see whether they are identical (and hence acceptable as representations of reality) or not" (Eysenck, 1979, p. 27). The general processor operates through the acceptance or rejection of mental representations as valid, and the subsequent neural transmission of these representations. The specific processors operate through "reasoning, memory, perception, etc" (Eysenck, 1979, p. 192). *Processing Arena.* The arena of processing is the nervous system (mainly the cerebral cortex).	*Expert Knowledge Base.* Eysenck postulates an Intelligence "B" which denotes the application of intelligence to the environment. Aspects of Intelligence B related to the Expert Knowledge Base include strategies and adaptation to the environment (Eysenck, 1986, p. 25, Fig. 1.9). *Output.* The products of processing are AEPs (averaged evoked potentials, which are probably neural coded information in-transit).	*Enhancers.* Greater intelligence reflects the capacity of the comparator to quickly recognize correct solutions to problems. A less capable comparator takes longer to make correct judgments, which increases the amount of time spent on problem-solving—particularly on complex tasks. Intelligence can be divided into three separate enhancers—speed, persistence, and error-checking (Eysenck, 1979; 1994). *Constraints.* Anything which interferes speed, persistence, and error-checking (e.g., impulsiveness) represents a constraint on intelligence.

Baron (1982, 1985, 1988; Haslom & Baron, 1994)

Input. The major objects processed are possible behavioral options and evidence for or against options (including "temporally remote consequences," Haslom & Baron, 1994, p. 52).

Mental Energy. Concept not addressed.

Processor(s). The main processor is "goal-directed thinking" which "[consists of the] search for possibilities, evidence, and goals, and the use of evidence to change the strengths of possibilities" (Baron, 1985, p. 128). Such thinking is supported by general intelligence (Baron, 1988, p. 122).

Processing Arena. [implied to be] a clearinghouse for weighing, evaluating, and revising behavior options.

Expert Knowledge Base. Critical knowledge includes information relevant to "the evaluation of consequences, the assessment of likelihoods ... and the ... temporal dimension of delay and behavioral allocation" as it influences the future (Haslom & Baron, 1994, p. 50).

Output. The major outputs are decisions about goals, including their addition, removal, strengthening or weakening. (see Haslom & Baron, 1994, p. 35).

Enhancers. "Intelligence ... can be taken to include the virtues of good thinking. In particular, good thinking is 'actively open-minded'" (Haslom & Baron, 1994, p. 42).

Constraints. Impulsiveness is the most salient motivational constraint against good thinking: "Poor thinking...would be caused by a general tendency to neglect the future relative to the immediate present" (Haslom & Baron, 1994).

(*continued*)

Table 1 (Continued)

Input and Mental Energy	*Processor and Arena*	*Knowledge Base and Output*	*Enhancers and Constraints*
		Gardner (1983/1993a, 1993b)	
Input. "the mind has the potential to deal with several different kinds of content" (p. xi). "human beings have particular intelligences because of informational contents that exist in the world—numerical information, spatial information, information about other people" (p. xxi). Each intelligence processes its own type of information. For instance, musical intelligence processes pitch, rhythm, and timbre (p. 104). *Mental Energy.* Concept not addressed in any significant way.	*Processor(s).* Specific processors include the linguistic, musical, logical-mathematical, spatial, bodily-kinesthetic, and the personal self and other. Intelligences are "broader than ... specific computational mechanisms (like line detection) while narrower than ... general capacities, like analysis, synthesis, or a sense of self" (Gardner, 1983/1993, p. 68). *Processing Arena.* "The brain can be divided into specific regions, with each emerging as relatively more important for certain tasks, relatively less important for others" (Gardner, 1983/1993, p. 54).	*Expert Knowledge Base.* "Intelligence begins with *raw patterning ability*.... In the subsequent stage, the intelligence is encountered through a *symbol system*.... As development progresses, each intelligence together with its accompany symbol system is represented in a *notational system*" (Gardner, 1993, p. 28). *Output.* For each of the intelligences, the products of processing are solutions to problems or "original symbolic products" (p. 303).	*Enhancers.* The capacity of each intelligence is determined by the ease with which domain-specific tasks are carried, and by the personality's sensitivity to the relevant aspects of different symbols. Prior learning and social support in the area can increase such intelligence (Gardner, 1983/1993, p. 77). *Constraints.* "each intelligence has its own strengths and constraints," (Gardner, 1983/1993, p. xix). Most notable among the constraints are previously learned "naive" theories about a particular domain and lack of social support for learning in it (see p. 316).

interrelations—new mental ideas, through the process of educing (drawing out) relations, correlates, and self-involvements. Thurstone's inputs were impulses or concepts which require transformation into well-defined ideas; these inputs originate from inside the person in the unconscious mind. Perhaps Howard Gardner had the most differentiated set of inputs, plainly distinguishing among logical, spatial, social, and other forms of information that are embedded in the outside world.

Mental Energy

Mental energy refers to a psychic resource which must be allocated to specific intellectual processors in order for them to function. Mental energy may represent anything from chemical energy transmitted along neurons to a metaphorical description of attentional resources. As a precursor to his discussion of *g*, Spearman (1927) summarized a number of conceptions about mental energy, including Aristotle's notion of the energy realized in an act of knowing; Immanuel Fitche's notion of *facts* as a redistribution of conscious and unconscious force; and McDougall's conceptualization of the nervous system as a "vast system of channels in all parts of which potential chemical energy is constantly being transformed, in virtue of the normal vital activity of the neurones, into a particular form of active energy" (cited in Spearman, 1927, pp. 123-124). Spearman (1927) regarded *g* as a form of mental energy which fuels different intellectual processors. Because processing depends upon such fuel, the amount of processing depends upon the amount of energy available to the mind. The greater the energy, the greater the mind's capacity to educe relations and solve problems. Wechsler seemed to generalize the energy metaphor still further, describing all of intelligence as an energy and comparing it to electricity (Wechsler, 1939). This is perhaps the most controversial component of the set, and one that it is not used by all theorists.

The Processor(s)

The intellectual processor(s) are those which compute or "think" intelligently. Processors clarify or purify input, connect it with newly generated or previously stored knowledge, and evaluate the output of various transformations. Spearman's processors were an array of specific processing engines that abstract information from specific domains—such as imagery, language, and similar domains—and that reason with such information. These separate engines each follow a single, general process: that of *educing* relations, or abstracting from the inputed material general principles or relationships. Carl Jung termed his four processors *functions*. Each one carries out a specific form of abstraction which enabled the person to appreciate a particular aspect of reality. For example, artists commonly use the sensation function, which involves classifying external objects according to their

power over the senses. Inputs relevant to this processor include external objects that release strong sensory reactions. Representations of these sense-eliciting objects are then abstracted and operated upon on the basis of their potential utility in creating paintings, music, and other artwork. In Gardner's (1993a) theory, there exist at least seven specific processors, corresponding to specific areas of the brain, such as *linguistic* or *musical* processors, each of which engage in different problem-solving operations.

The Arena

The nature of the processor is further clarified by a consideration of the arena. The *arena* is a special memory location within which symbols are manipulated by one or more processors. Baddely (1986) gives a particularly good example of an arena (although he is not one of our theorists) when he describes a visuo-spatial sketchpad in which working memory (and intelligence, from our perspective) operates; a similar concept is Jung's idea of intelligence arranging and rearranging archetypes in the unconscious. Both Baddely's visuo-spatial sketchpad and Jung's constellation of archetypes embedded in the collective unconscious, are examples of arenas. The formal qualities of the arena include whether it is conscious, the nature of symbols within it, and the degree to which symbols are differentiated from or integrated with one another; these qualities collectively assist in specifying an intelligence by describing the immediate symbolic environment in which it operates.

Spearman had little to say about the arena in which the intellectual processor operates. For Jung, an intellectual function (*thinking, feeling, sensing, intuiting)* may operate on unconscious archetypes, as noted above, or on conscious thoughts, or on some division between the two. Thurstone viewed processing as progression from unconscious to conscious arenas, and, other things being equal, the quicker the transition across arenas, the more intelligent the processing. Gardner's (1993a) approach, based as it is on brain function, suggests yet an alternative perspective on arenas. He placed his intelligences within certain brain locations. Thus, verbal intelligence might be located within the language and speech areas. Spatial intelligence might be located in the imagistic theater of the mind, and each of these areas can be thought of as the processor's arena.

The Expert Knowledge Base

The expert knowledge base is a collection of information that, on the one hand, includes heuristics for the self-management of intellectual processing and, on the other hand, includes important world knowledge, both of which are of long-term, reusable value to the processor. Cattell's distinction between fluid and crystallized intelligence revealed the potential importance of the expert knowledge base. Whereas fluid intelligence can be characterized as a processor that quickly

abstracts and adapts to inputs from an arena of novel information, crystallized intelligence involves a processor that operates on previously learned knowledge, skills, and heuristics that can be said to constitute an expert knowledge base. Thus, the expert knowledge base for mathematics contains previously established rules, concepts, and information which facilitate future thinking. Haslam and Baron's equation between intelligence and wise behavior suggests that considerable world knowledge is necessary because such knowledge underlies wisdom. For Gardner, symbol systems such as language, mathematics, and so forth each constitute a form of expert knowledge.

The Output

The outputs of the intellectual processor are variously described within the different theoretical models of intelligence. Frequently, the output represents meaningful, usable information in response to a problem. The output often represents an abstracted or purified essence of the input which has been connected in some way to an expert knowledge base (see below). For Wechsler, the major outputs involve associations, inferences, and other solutions to problems. Eysenck employs a highly biological definition involving averaged-evoked potentials which he claims represent neurally-coded information in transit. For Baron, the major outputs of intelligence are far more social in nature and involve the construction and weighing of particular life goals.

Enhancers and Constraints

The final two concepts are *enhancers* and *constraints*. These are entities related to, but typically outside of intelligence, that may enhance or restrict the intellectual processor. For example, Spearman saw several factors as potentially constraining intellectual performance, including mental fatigue and mental inertia. Spearman's *g*, which we have referred to as an energy source, could alternatively be considered an enhancer. For Jung, mental attitudes, by which he meant any of a number of mental tendencies (including the four functions of thinking, feeling, sensing, and intuiting), could influence intellectual processing by biasing perception. For example, a person who anticipates regularly being oppressed might be less able to recognize information that he is in control than would a person who is commonly an oppressor. David Wechsler (1974/1950) was well-known for his interests in personality factors that enhanced or constrained intelligence. He was particularly attentive to such factors as perseverance,"p," moral and conative propensity,"W," the individual's interests and concerns,"X," and general issues of temperament rather than ability,"Z." He also was quite sensitive to issues of anxiety during test-taking as well as other factors.

Summary of the Systems Extension into Intelligence and Personality

The systems approach developed here has focused attention on several specific components of intelligence: *input*, *energy*, *processor(s)*, *arena*, *expert knowledge base*, *output*, *enhancers*, and *constraints*. This concludes our general application of the systems approach to determining the subcomponents of intelligence. Further systematization could speak to the aims of intelligence (and, hence, part of personality) by describing the transformation that takes place between inputs entering the system and the final outputs, but such an exposition is beyond the stated aims of the present chapter. Instead, we will next employ the framework as developed so far to discuss work on intelligence from our own laboratory. Our work has been focused on emotional, or *hot*, processing. The framework provides us with an opportunity to examine some of the places in which emotional processing takes place.

MODELS OF HOT PROCESSING

Historically, the majority of intelligence theories concerned logical, propositional thinking. This can be verified from an examination of Table 1. For example, most inputs to intelligence involve nonaffective symbolic systems. Hot processing refers to the role of emotion or affect within the intelligence model: be it an input, a special processor, or a constraint on the model. We define affect as any general feeling state or feeling-relevant information. Emotion refers more specifically to an emotional response such as happiness, anger, fear, or sadness, but it is not limited to these. The study of *hot processing* is concerned with what happens when emotional information is processed by the intellectual system. Hot processing is important for several reasons: (1) information is often emotional (hot) rather than unemotional, (2) there is evidence that such information may be processed differently than non-emotional information, and (3) such processing may be particularly vulnerable to pressures from the rest of personality. Consequently, hot processing can tell us about the intelligence system itself as well as reveal more about its relation to personality.

In the present section, we illustrate a model of hot processing by discussing it in relation to the eight intelligence components common to intelligence theories. Table 2 summarizes this discussion. Over the last several years, discussion has grown around the specific concept of emotional intelligence. Those with interests in that topic may wish to examine current reviews of that model of hot processing. Emotional intelligence appears promising as an alternative model of intelligence that has been omitted from standard tests of intelligence (e.g., Mayer & Geher, 1996; Mayer & Salovey, 1997; Mayer, Salovey, & Caruso, in press). In the remainder of this chapter, however, a more general approach will be taken to hot processing. (This approach will, however, partly overlap with emotional intelligence).

Table 2. An Intelligence Model for the Processing of Hot Information

Input and Mental Energy	*Processor and Arena*	*Knowledge Base and Output*	*Enhancers and Constraints*
Input. The theory makes a distinction between hot and cold information. Hot information is that which involves survival of the self (generally conceived) including any information that affects status, reproduction or other areas primarily or secondarily related to well-being. Although all information can be construed as hot, cold information is generally less centrally or less clearly related to such issues. Both hot and cold information may be input into the system through virtually any modality: through images, propositions, or some combination of such inputs. There is also a specialized channel—emotions—which produces hot information almost exclusively. *Mental Energy.* Emotions are frequently described as raising or lowering arousal. For example, depression has often been viewed as lowering mental energy, whereas a moderate amount of happiness can be viewed as raising mental energy. Each emotion may also "spread activation" from itself in memory, priming related information in the memory network.	*Processor(s).* A number of processors are viewed as operating in parallel with one another. Most of these partly-independently-operating processors can be viewed as operating in a modality-specific mode. For example, some processors will be focussed on imagery, others on propositions, others on verbal fluency. *One specific processor hypothesized to exist in this model is an emotional processor which specifically manipulates affective information.* In addition, there exist general-purpose processors which educe information from the more specific processors, connect such information, integrate it, and identify general laws or abstractions. *Processing Arena.* The arena for hot processing consists of unconscious, conscious, and reflective subarenas. Consciousness and reflective consciousness, however, will typically be necessary for truly innovative, new conceptual relationships to be discovered and employed.	*Expert Knowledge Base.* Various ethical, religious, aesthetic, and specifically emotional knowledge is employed as part of the knowledge base for hot processing. *Output.* Both short-term and long-term models and representations of the self, the self-in-the-world and the world. A special emphasis is given to the accuracy of the models, which will require abstraction, general laws, and expert knowledge, applied as needed.	*Enhancers and Constraints.* The likelihood for cold information to be processed will be a direct product of how pleasurable it is for the system to be "turned on." (This can itself be thought of as a hot process). That is, the more pleasurable the individual finds the intellectual system as a whole, the more likely he or she will be to process cold (and hot) information, and to construct situations in which such processing of cold information will be self-relevant. Hot information, will also be readily processed the more the system is on. Hot processing will also be boosted, however, by an openness, and even pain-tolerance for emotionally charged information to enter into consciousness and unconsciousness. The constraints are the reverse of the enhancers. To the extent intellectual activity is unpleasant, it will be carried out less, and fewer situations that promote it will be sought. To the extent the person defends against emotions and affective material, the less hot information will be processed.

Inputs and Hot Processing

There appears to be an appraisal process which may assess ostensibly cold information and convert it, where appropriate, to hot information. For example, the knowledge that a stock has declined involves fairly cold information—unless one owns the stock and was planning to sell it to pay for a medical emergency. Other inputs may be more directly hot. For instance, the sight of blood or emotional facial expressions may require little higher-order processing before the information is recognized as hot and emotionally processed. For such input, the major task of emotionally intelligent processing is not to interpret the input but to decide how and when to react to the input.

Inputs can be conceptualized at an atomistic or holistic level. At a more atomistic level, Zajonc (1980) coined the term *preferenda* to refer to interactions between internal feeling states and general features of objects. As emotionally relevant features of objects are processed, the emotional context in which these objects are processed changes, resulting in different evaluations of the objects; the understood features of the objects do not change, but the influence of these objects upon the individual does change. At a more holistic level, the person must understand the implications of an entire situation or context in order to evaluate the emotional ramifications of a given instance of information.

Mental Energy and Hot Processing

One of the more interesting issues concerning hot processing is its relation to mental energy. Many depressed states are characterized by low mental energy, whereas mania involves high mental energy. Moreover, there exist links between such levels of mental energy and intellectual processing, with depression potentially impeding processing (Ellis & Ashbrook, 1991). A given emotion may also release energy in such a way as to "align" processing with emotion-relevant information. This is described in Gordon Bower's (1981) spreading activation model of mood and memory. Within this model, memory is conceived of as a vast network of associations among concepts. The concepts are called nodes, and mental energy, termed activation, spreads from one node to the next. In this model, moods are central nodes able to spread energy. Thus, as a person enters an increasingly positive mood, energy is spread from such nodes to positive-associated concepts which become activated (likewise with negative moods). The most consistent empirical findings related to this are that memory retrieval, and also judgment, are mood-congruent. That is, a person in a happy mood will learn and recall more positive things, judge positive events as more likely, judge positive examples of categories as more typical, and so forth. Similarly, a person in a sad mood will learn and recall more negative things, judge negative events as more likely, judge negative examples of categories as more typical, and so forth (see Fiske & Taylor, 1991, for a general review; for more recent work, see Mayer, Gaschke, Braverman, & Evans, 1992; Mayer & Hanson, 1995;

Mayer, McCormick, & Strong, 1995). Such mood changes within the memory and related arenas may have additional effects as well on reasoning (Palfai & Salovey, 1993), creativity (Isen, 1984), and other cognitive functions.

Hot Processor

A number of theorists have commented on the likely existence of a partially independent emotion processor. Thurstone (1924/1960, p. 163) wrote, "the highest possible form of intelligence is one in which the alternatives are essentially nothing but affective states." And Gardner, speaking of the personal intelligence, wrote:

> The core capacity at work here is *access to one's own feeling life*—one's range of affects or emotions: the capacity instantly to effect discriminations among these feelings and, eventually, to label them, to enmesh them in symbolic codes, to draw upon them as a means of understanding and guiding one's behavior. In its most primitive form, the intrapersonal intelligence amounts to little more than the capacity to distinguish a feeling of pleasure from one of pain....At its most advanced level, intrapersonal knowledge allows one to detect and to symbolize complex and highly differentiated sets of feelings ... to attain a deep knowledge of ... feeling life (Gardner, 1993a, p. 239).

A certain amount of research has examined the basic ability to recognize emotion in external stimuli such as faces or body language. Identification of the emotional content of stimuli (using group consensus as the criterion) is generally correlated with self-reported empathy (see Salovey & Mayer, 1990, for a review). For example, in one study, people viewed a series of abstract designs, colors, and faces and attempted to gauge the emotional content of each. Such skill was reliable, unifactorial across the various stimuli types, and correlated with self-report measures of empathy (Mayer, DiPaolo, & Salovey, 1990). Other studies (e.g., Mayer & Geher, 1995; Mayer & Kirkpatrick, 1995; Mitchell & Mayer, 1998) have examined emotional recognition for characters in short written passages; this skill similarly correlates with self-reported empathy. Mayer and Mitchell (1995) found that one component of emotion-recognition skill correlates with general intelligence, as indicated by self-reported SAT scores.

Emotional processing is likely to be more elaborate than simple emotional recognition, including, for example, emotional problem-solving and fluency. Averill and Thomas-Knowles (1991) asked people to write stories that integrated three typically incongruent emotions into a single, unified experience. People high in such skill show remarkable ability to synthesize diverse feelings. One high-emotional-fluency participant, upon being assigned the three emotions of serene/bewildered/impulsive wrote:

> The clouds are few, the sky is clear. I'm at the top of the cliff. It's real peaceful up here. Suddenly, I want to jump, I don't know why, I just want to. Calmly, I look down at what would be my unquestioned doom. It looks so peaceful; warm and friendly. But why, why do I want to

> dive into the hands of the grim reaper?... I hesitate, then motion to jump, something strange pulls me back. It is the peacefulness of the cliff (Averill & Thomas-Knowles, 1991, p. 280).

Ability at such tasks correlates both with intelligence and creativity, but also correlates independently with similar emotion tasks, suggesting the presence of some emotion processor. Averill's work, and the research (discussed above) on emotional recognition in stories, indicates that emotional processing almost invariably involves abstractions of a more general nature. The above cliff scene, written by a high-emotional-fluency participant, also require substantial verbal fluency. Thus, the emotion processor seems to act in parallel with other processors.

The Arena and Hot Processing

The emotional processor performs its actions within arenas that may be unconscious, conscious, or relatively conscious. Processing in the unconscious arena is interesting in that certain emotional/behavioral patterns can be taught unconsciously without the person ever recognizing that they have been learned. A child brought up within an abusive family may learn early that it is necessary to be especially and consistently well-behaved, so as to avert physical punishment, and this may occur without any awareness, or at least labeling, of the abuse as abuse (Mayer, Rapp, & Williams, 1992). Such learning is behavioral but ultimately must become consciously recognized to be overcome. Hot processing develops partially within the unconscious arena and so differentiates itself from intentional and logical processing characteristic of the conscious arena, such as that involved in learning matrix algebra. If a person learns a number of maladaptive generalizations from his or her parents or caretakers, special efforts will be required to overcome them precisely because they are learned with little awareness or symbolization (see Gardner, 1993a, p. xviii). A person seeking to develop expertise at hot processing, therefore, may first need to understand any atypical or nonconsensual reactions he or she has experienced from early learning.

Normal waking consciousness, in contrast to unconscious processing, is highly synthesized, often containing complete images and propositions rather than communications from fragmented sources. Consciousness is capable of the connected, extended processing required for logical responses to significant problems and complex environments (Greenwald, 1992). The conscious portion of the arena also possesses some qualities that are unique to hot information. Clinical and experimental research have both indicated that some people more than others divert consciousness toward or away from emotional information—especially painful information (see Mayer & Salovey, 1995, for a partial review). The conscious arena, therefore, may be more or less able to include hot information, dependent upon various enhancers and constraints on its function (described below).

One final arena within which hot processing takes place is a reflective or meta-experiential realm of consciousness, in which consciousness turns back on itself and evaluates its own products (Mayer & Gaschke, 1988; Mayer & Stevens, 1994). For example, if someone finds various emotional reactions unacceptable in him- or herself—say, anger—then that emotion may be rejected as a possible feeling, even if it is fleetingly experienced consciously. Such limits on experience are, as Freud aptly put it, the internal analog to a dictatorship that suppresses information it finds unpleasant to itself. Like the dictatorship, such a reflective-conscious style may unduly restrict emotional-intellectual possibilities and thereby restrict the individual's range of potential emotional problem solving. Concretely, a person with an alcoholic spouse may become incapable of feeling sustained anger at the spouse's drinking. The person's anger might never be sensed because it is never input into the processor. Or, in the case where the anger is input, it may be processed only within an unconscious arena.

The Hot Expert Knowledge Base

Over time, a person will develop various expert rules for understanding the emotional environment and traversing it. Expert hot processing probably requires the establishment of a number of hot intellectual frameworks—including aesthetic, religious, and ethical/moral frameworks—to fully manifest itself, just as mathematical ability requires some knowledge of algebra and geometry to manifest itself. Partly emotion-based rule systems, such as ethics, aesthetics, and religion, provide the context within which one reasons about a current problem as well as the criteria against which various solutions are evaluated. Thus, handling a conflict with a friend will require both a moral framework and empathic knowledge of that individual: these provide a reliable starting point for the possible solutions one might employ. A number of books are devoted to developing such a knowledge base in this area, including popular psychological writings on managing interpersonal relations, to movie criticisms which instruct a person as to how to emotionally respond to a movie (i.e., "the movie is unnecessarily violent"), to sophisticated religious teachings on feeling repentance (i.e., Peli, 1984) or the awe of God (Otto, 1950).

Outputs and Hot Processing

Perhaps the two purest outputs of the emotional processing system are affective evaluations and emotions. Affective evaluations may be relatively simple registers of how pleasant or unpleasant one feels about a particular object, situation, or event. At times, however, evaluations may combine emotional responses in complex patterns and take on all the complexity of emotions themselves. Basic emotions, such as happiness, anger, fear, or sadness, frequently occur automatically; but hot processing can also produce more cognitively laden emotions that contain

complex blends of cognition and affect together: challenge, pity, shame, repentance, and so forth, do not always emerge spontaneously but are generally taught and refined by moral and religious bodies of thought (for a review, see Mayer & Salovey, in press). As already noted, emotional processing also may be combined with outputs from parallel processors such as verbal and spatial processors. Thus, emotional, linguistic, and spatial outputs might be combined in a poem. Similar combinations of parallel processors might produce mathematics, music, ethics, and so on. The emotional processor ensures that mental thoughts and behavioral acts each possess appropriate and intended emotional content. Repeated failures at such integrated processing may produce hot mental contents or "action tendencies" (Arnold, 1960, p. 177) which are in conflict with cold behavior prescriptions—such as the urge to exonerate an attractive but guilty defendant.

Hot Enhancers and Constraints

"Turning On" the System

It is an interesting feature of hot processing that the intelligence system itself can become an object of hot processing—enjoyed by those who find thinking pleasurable or disliked by those who find intellectual pursuits frustrating. In a factor-analytic study of self-reported intellectual experience, Mayer, Caruso, Zigler, & Dreyden (1989) found three factors: (1) intellectual absorption or flow, (2) intellectual pleasure, and (3) intellectual apathy that collectively predicted membership in a group of highly gifted children (selected from a southern U.S. regional sample) above and beyond mental age or intelligence quotient. The Need for Cognition Scale (Cacioppo & Petty, 1982) may provide yet another indication of the use of the intelligence system. As intellectual absorption or flow helps turn on the intelligence system, there are other enhancers and constraints that operate within that system once it is turned on. Particularly relevant to hot processing are emotional openness and closedness.

Openness versus Closedness

Perhaps the most important hot processing takes place within the conscious arena. But it is also known that some people divert attention away from conscious information because it is too painful or threatening. This also occurs unconsciously through the operation of defense mechanisms (see Mayer & Salovey, 1995, for a more complete review). Research in our laboratory has concentrated on conscious and reflective-conscious shepherding of information in and out of the arena. Direct conscious openness, for example, can be examined while people are labeling their own moods on mood scales. Most contemporary mood scales instruct participants to report their moods by indicating to what degree they feel each of a number of emotions, such as *happiness*, *fear*, or *sadness*. In one study,

we added to such scales additional items such as *feeling this feeling* or *blocking the feeling out*. In the present conceptualization, mental redirection of feelings (e.g., blocking the feeling out) can be viewed as constricting the processing arena and, therefore, impeding hot processing. Results indicated that people who consistently constrain information flow within the arena by blocking out feelings show small but significant decrements in the ability to perceive emotion in prose passages (Mayer & Kirkpatrick, 1995).

The conscious arena may also be affected by more sustained reflective attention to mood. These meta-, or reflective, experiences arise as consciousness turns back on itself to examine its own processing. For example, a meta-experience might be: "a sad feeling makes sense given that my cousin is dying." Such a reflective experience represents yet another level of potential emotional processing that is dependent on a highly conscious arena. Meta-experiences are complex and plastic; there exist seven or more common factors of meta-experience. A number of meta-experiential patterns have been proposed that may enhance hot processing, but these are, as yet, untested (Mayer & Stevens, 1994).

We have proposed that processing in this system framework involves a separate, hot processor that operates in partial independence from other processors, in unconscious, conscious, and meta-conscious arenas. Within the conscious and meta-conscious arenas, the ability to focus on emotional material has been found to enhance hot processing. Conversely, a person who shuts out such emotional information will be unable to complete adequate hot processing under some circumstances. When the system operates well, it extracts emotional information from the environment, either directly and automatically, or through appraisal processes, and generates appropriate evaluative and emotional responses in return. It also operates in conjunction with other intellectual processors to produce mental products that synthesize emotional and non-emotional symbol systems, as happens when words, images, and emotions are integrated within a poem. Sometimes, the intelligence system becomes an object of hot processing itself, and if the person enjoys thinking, he or she may keep the system more turned on, and use it more often.

GENERAL DISCUSSION

Recapitulation

We have discussed several frameworks that have been employed to connect personality and intelligence. These included a differential psychology approach, a theory-by-theory approach, and a research-topics approach. None of these approaches seem well suited to a comprehensive integration of personality and intelligence systems. For that reason, we chose to apply a systems framework to the problem, especially concentrating on the components of intel-

ligence. We suggested that several components are commonly described across intelligence theories. These included *input*, *energy*, the *intellectual processor*, the *arena* in which processing takes place, the *expert knowledge base*, the *output* from the system, and the *enhancers* and *constraints* on the system. We then organized descriptions of eight intelligence theories in this component-by-component manner in Table 1. We described how the model can be applied to a nonintellective aspect of personality—hot, or emotional, processing. As we did so, we included some of the research from our laboratory, as well as related research from other laboratories.

Purpose and Evaluation of the Systems (and System-Topics) Approach

Our overarching goal for this present chapter was to provide a language for describing the internal relationship between personality and intelligence. The systems approach developed here employs eight components to represent intelligence. Each of these components address concepts which have been traditionally considered meaningful by a subsample of important intelligence researchers. Concepts such as processors, inputs and outputs, arenas, and constraints are part of the current language of cognitive science and information processing. Additionally, this systems language was useful in organizing research from our own and other laboratories.

Possible Alternatives to the Model

The systems approach employed here is just one of many possible models. The eight components we employed here are organizational structures rather than necessary statements about the intelligence system and its relation to personality. At the same time, the component-by-component description of any of the theories uniquely identifies each such theory and portrays its essentials in some detail. This suggests that the components are sufficient to portray the core elements of most intelligence theories.

Clarification of Hot Processing

The present framework has also permitted the integration of a number of findings concerning hot processing within a more unified framework. For example, prior to this application, there existed a great deal of research on hot processing. This work has included everything from such basic cognition-and-affect work as mood-congruent memory and judgment to more complex issues such as the interaction between emotional openness and emotional perception. In addition, we suggested that hot processing involves the pleasure that one takes in thinking. The use of the present set of components has enabled us to discuss these diverse lines

of research and pull them together in a reasonable way in depicting a whole and unified intelligence system.

Using the System Approach to Relate Intelligence to Personality

Our final goal was to employ this component-by-component approach to better understand intelligence's relation to personality. The eight components of the intelligence system are also eight components of the personality system; as such, they provide a means by which to describe how the two systems intersect. This intelligence-personality intersection occurs at each of the eight components. These relations are discussed next.

Inputs and Personality

Inputs to intelligence are also inputs to personality more generally. The specific meanings of such inputs are interpreted in part from the context of the individual's psychology. Many people appear to process numerous symbols in a "conflict-free" sphere, easily applying intelligence to algebra, political science, or other fields. For other people, however, such encounters may be more complex. Some may perceive numbers as boring or intimidating. Others may not be able to process issues in political science without being overwhelmed by feelings of injustice, and so on. Most intelligence tests sample inputs from bland and diverse domains to circumvent such issues, but this is not to say that actual living people do not encounter conflict-ridden information.

Mental Energy and Personality

The concept of mental energy was a very popular metaphor employed by both personality and intelligence theorists of the early part of the twentieth century. In psychoanalytic notions of personality, the concept of energy was central. For example, Freud's (1923) libido represented general energy that motivates the personality. Pervin (1984) described the psychoanalytic concept of personality as:

> a system in which energy flows, gets sidetracked, or becomes dammed-up. In all, there is a limited amount of energy, and if it gets used in one way, there is that much less energy to be used in another way. . . . Human behavior may take many forms, but basically all behavior is reducible to common forms of energy. The goal of all behavior is *pleasure*, that is, the reduction of tension or the release of energy (p. 67).

Parallel to the idea of motivational energy was the suggestion that emotion is a form of energy. Hillman (1960) reviewed the concept of emotion and noted that many psychologists employed mechanical, spiritual, and thermodynamic metaphors in describing it. Hillman himself connected emotion to energy by concluding that "emotion is the way energy appears to the consciousness" (Hillman, 1960, p. 261).

Recall that Spearman conceived of mental energy as a common fuel for different intellectual processes. If intelligence, motivation and emotion were fueled by the same energy, then mental energy might represent a fundamental intersection between intellective and nonintellective personality processes. Although few correlations exist between general motivation and IQ (see, for example, Eysenck, 1994; Mayer et al., 1989), the case is different with emotion. When a person enters a sad mood, the mood may reflect depleted energy from both personality and intelligence, as a sad person will perform more poorly on tests of memory (e.g., Ellis & Ashbrook, 1991). Chiu, Hong, and Dweck (1994, p. 110-111) suggest along these lines that, "Cognitive processes cannot invigorate themselves. They need some kind of motivational/affective processes to fuel them, and even 'goal-less' thought would need affect to sustain it." From a different perspective, mental energy could be reinterpreted as a property of nerve potentials, and these may correlate with intelligence quotients (see Eysenck, 1986). Few (if any) studies, however, have been done to date correlating intelligence- and personality-related brain activity.

Processors and Personality

Although intellectual processors are a part of personality, their capacity for processing seems relatively independent of personality. Once again, this is indicated by low correlations between IQ and most other personality traits (see Eysenck, 1994, for a review). Baron (1982) has noted that one possible reason for these low correlations is that IQ represents an *optimal* performance by the intelligence system while personality traits represent *normative* manifestations of personality. Normative (as opposed to optimal) performance by the intelligence system may be more clearly related to normative measures of personality (Baron, 1982). Another aspect of these processors of considerable contemporary interest is their distribution across the personality system. Some theorists contend that intelligence is centralized within the cognitive system, with perhaps some employment of conscious attention. Others, however, view the processors as distributed across personality—for example, with one processor in the language center, another accompanying the emotions, and so on. If the latter is the case, then it may well be that various specific intelligences (i.e., Spearman's *s*'s) do correlate with personality in ways that *g* does not. For example, someone with a highly developed emotional processor may appear more emotionally sensitive and socially adroit than other people (cf., Salovey & Mayer, 1989-1990).

Arena and Personality

The arena, too, serves as a potential link between intelligence and personality. One common way of dividing the processing arena is into conscious and

unconscious segments. Little, however, is truly known about intelligence in the unconscious sphere. Are operationalized concepts such as (factor-analytic) *g* detectable in unconscious processing? Certain reaction time studies would seem to indicate that reactions so quick they are not governed by consciousness do correlate with *g* (Detterman, et al., 1992). No experiment we can think of has examined this possibility with more extensive tests of unconscious processing. At the same time, personality, cognitive, and social psychologists have become increasingly adept at creating procedures for studying unconscious cognitive activity (see Seger, 1994, for a review). This, certainly, is an area ripe for further study.

Expert Knowledge Base(s) and Personality

It is a truism that although intellectual level may not be related to many aspects of personality, what a person chooses to learn influences and is influenced by personality. Although this may be of secondary interest to intelligence researchers, it should be of primary interest to the personologist. Knowing the content of a person's knowledge base (vs. his or her level of intelligence) has perhaps been an under-valued aspect of personality assessment. Indeed, Chiu, Hong, and Dweck (1994) suggest that beliefs, values, standards, and similar constructs traditionally assigned to nonintellective personality are also used by intelligence and may therefore be understood as part of its knowledge base. A person who values cooking and knows all about the interchangeability of cooking wines with vegetable oils as flavor enhancers in cooking will be different from the person who values football and knows all about the partial free agency rule and its interaction with coaching in the building of a winning team. Knowledge base assessment techniques could be readily constructed (e.g., as are the content categories in the games of *Jeopardy* or *Trivial Pursuit*) and would serve as replacements for self-report of interests.

Outputs and Personality

The quality of the output of the intelligence system will shape a great deal of personality and life patterns. Fundamentally, intellective outputs direct goal-congruent behavior and summarize one's understanding of the world and one's experiences. Moreover, a given set of intellectual outputs, to the extent that they successfully address a personal problem or satisfy a personal need, will set the stage in a particular fashion for a new set of problems or needs to be addressed (Cantor, 1994).

Enhancers, Constraints, and Personality

Enhancers and constraints may be regarded as nonintellective personality's diffuse influence on intelligence, and vice versa. Brody (1992) summarized evidence

that personality characteristics such as impulsivity and other temperaments (constraints, in our system) influence a person's specific intellectual skills, performance on intelligence tests, and success in academics, and found a few modest relations. From our own observations, the most promising set of enhancers seem to involve the pleasantness, flow, or need associated with "turning on" the intelligence system. A second group of constraints such as anxiety interfere with processing by capturing and limiting attention. A third group, pertaining especially to hot processing, involves the degree of openness or closedness to emotional information that is input into the intelligence system. Finally, we suggest that one's intelligence may enhance or constrain various nonintellective personality and processes and structures within the meta-cognitive arena. Undoubtedly, awareness of one's intellectual capabilities influences one's goals and expectations in life as well as one's general self-concept.

Concluding Comments

At the outset, we chose a systems approach to describe the relation between intelligence and personality. From this perspective, intelligence is a complex subsystem, itself composed of further subsystems, operating within the context of the larger personality system. We centered our discussion of intelligence on eight components, each of which is also a part of the larger personality system. This approach may hold more promise for integrating personality and intelligence than a theory-by-theory, a research topics, or a traditional differential psychology approach. The systems approach suggests several points of intersection between intellective and non-intellective personality systems. General personality function is viewed as influencing the more specific manifestations of intelligence—how many products are evaluated and organized within the processing arena, the degree to which thinking occurs prior to and beyond the attainment of processing goals, the sorts of materials that are favored in processing, the kinds of expert knowledge that the individual develops, and the patterns of enhancement or constraint on intellectual processing. As personologists develop better means of differentiating and integrating various components of intellective and non-intellective information processing, the structure of the personality system—and intelligence within personality—will be better understood.

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