

# Cognitive Styles in the Context of Modern Psychology: Toward an Integrated Framework of Cognitive Style

Maria Kozhevnikov  
George Mason University

The goals of this article are to elucidate trends and perspectives in the field of cognitive style research and to propose an integrated framework to guide future research. This is accomplished by means of a comprehensive literature review of the major advances and the theoretical and experimental problems that have accumulated over the years and by a discussion of the promising theoretical models that can be further developed, in part, with modern neuroscience techniques and with research from different psychological fields. On the basis of the research reviewed in this article, the author suggests that cognitive styles represent heuristics that individuals use to process information about their environment. These heuristics can be identified at multiple levels of information processing, from perceptual to metacognitive, and they can be grouped according to the type of regulatory function they exert on processes ranging from automatic data encoding to conscious executive allocation of cognitive resources.

*Keywords:* cognitive style, individual differences, information processing, metacognition

*Cognitive style* historically has referred to a psychological dimension representing consistencies in an individual's manner of cognitive functioning, particularly with respect to acquiring and processing information (Ausburn & Ausburn, 1978). Messick (1976) defined cognitive styles as stable attitudes, preferences, or habitual strategies that determine individuals' modes of perceiving, remembering, thinking, and problem solving. Witkin, Moore, Goodenough, and Cox (1977) characterized cognitive styles as individual differences in the way people perceive, think, solve problems, learn, and relate to others.

The development of cognitive style research is an interesting and paradoxical topic in the history of psychology. Starting in the early 1950s, a tremendous number of studies on style types appeared in both the theoretical and applied literature, all aimed at identifying individual differences in cognition that are stable, value free, and related to personality and social relationships. In 1954, Gardner Murphy assessed cognitive style studies as "a huge forward step in the understanding of the relations of personalities to their environment . . . a new step toward the maturity of American psychological science" (in Witkin et al., 1954, p. xx). Nevertheless, in the 1970s, cognitive style research began to lose its appeal. The field was left fragmented and incomplete, without a coherent and

practically useful theory and with no understanding of how cognitive styles were related to other psychological constructs and to cognitive science theories.

At the present time, many cognitive scientists would agree that research on cognitive styles has reached an impasse. In their view, although individual differences in cognitive functioning do exist, their effects are often overwhelmed by other factors, such as general abilities and cognitive constraints that all human minds have in common. The paradox of the current situation is that interest in building a coherent theory of cognitive styles remains at a low level among researchers in the cognitive sciences; however, investigators in numerous applied fields have found that cognitive style can be a better predictor of an individual's success in a particular situation than general intelligence or situational factors. In the field of industrial and organizational psychology, cognitive style is considered a fundamental factor determining both individual and organizational behavior (e.g., Streufert & Nogami, 1989; Sadler-Smith & Badger, 1998; Talbot, 1989) and a critical variable in personnel selection, internal communications, career guidance, counseling, and conflict management (Hayes & Allinson, 1994). In the field of education, researchers have argued that cognitive styles have predictive power for academic achievement beyond general abilities (e.g., Sternberg & Zhang, 2001).

The intent of this article is to review the major advances as well as the significant theoretical and experimental problems that have accumulated in the field. First, I describe "basic" research on cognitive style, which focuses on individual differences in the cognitive processes involved in simple perceptual and sorting tasks. Second, I review cognitive styles related to more complex tasks (e.g., problem solving, decision making, and judgment), described by researchers in applied fields such as management, psychotherapy, and education. Third, I explore trends in cognitive style research that have emerged to examine superordinate cognitive styles (metastyles), defining the extent to which individuals exhibit flexibility and self-monitoring in their choice of styles. Fourth, I describe studies aimed at integrating different cognitive

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Correspondence concerning this article should be addressed to Maria Kozhevnikov, George Mason University, Psychology Department, David King Hall, MSN 3F5, 4400 University Drive, Fairfax, VA 22030-4444. E-mail: mkozhevn@gmu.edu

style dimensions into unified multilevel models and at attempting to relate cognitive style to other psychological constructs. I also examine recent attempts to explore the cognitive and neural underpinnings of cognitive styles from cognitive science and neuroscience perspectives. Finally, I propose a new framework to study cognitive style and outline possible perspectives for the development of the field.

### Basic Research on Cognitive Styles

In this section, I describe basic research on cognitive styles, which peaked between the late 1940s and early 1970s, the most active period in terms of experimental work on styles. I designate this line of research on cognitive style as basic for two reasons. First, the term *cognitive style* was traditionally used more with respect to this line of research than to some of the other lines of research described in the following sections, in which other terminology (e.g., learning styles, personal styles) was more common. Second, this line of research focused on examining individual differences operating at basic or early stages of information processing, including perception, concept formation, sorting, and categorization.

#### *Introduction of the Cognitive Style Concept*

The first experimental studies revealing the existence of individual differences in simple cognitive tasks involving perception and categorization were conducted in the 1940s and early 1950s (Hanfmann, 1941; Klein, 1951; Klein & Schlesinger, 1951; Witkin, 1950; Witkin & Ash, 1948). Hanfmann (1941) showed that some individuals used a perceptual approach when grouping blocks whereas others used a more conceptual approach, trying first to formulate hypotheses about possible groupings. Witkin and Ash (1948) reported significant individual differences in the way people perceive the “upright” orientation of a rod in different surrounding fields in a task called the Rod-and-Frame Test. Witkin and Ash found that some subjects perceived the rod as upright only when it was aligned with the axes of the field whereas other subjects were not influenced by the field characteristics. Klein (1951) studied how accurately people made judgments about changes in perceptual stimuli. Subjects received projected squares that constantly changed in size. Klein identified two types of individuals: *sharpeners*, who noticed contrasts and maintained a high degree of stimulus differentiation; and *levelers*, who noticed similarities among stimuli and ignored differences. The main contribution of these early studies was to identify robust individual differences in the performance of simple cognitive tasks and to demonstrate that people differed in their overall success and in the ways in which they perceived and solved the tasks. At that time, there was no established label for these individual differences; they were called perceptual attitudes, patterns, predispositions, cognitive attitudes, modes of responses, or cognitive system principles (see Holzman & Klein, 1954; Gardner, Holzman, Klein, Linton, & Spence, 1959, for a review).<sup>1</sup>

The notion of cognitive style was introduced by Klein and Schlesinger (1951) and Klein (1951), who were interested in possible relations between individual differences in perception and personality. Klein (1951) was the first to consider cognitive styles (he called them “perceptual attitudes”) as patterns of adaptation to the external world

that regulate an individual’s cognitive functioning. “Perceptual attitudes are special ways, distinctive for the person, for coming to grips with reality” (p. 349). According to Klein, the process of adaptation requires balancing inner needs with the outer requirements of the environment. To achieve this equilibrium, an individual develops special mechanisms that constitute his or her “ego control system” (Klein, 1951, p. 330). Cognitive style expresses “a central or executive directive of the ego-control system . . . and it acts very much as ‘a selective valve’ which regulates intake – i.e. what is or not to be ignored” (Klein, 1951, p. 333). Klein considered both poles of the leveling–sharpening dimension as equally functional (i.e., each pole is a means for individuals to achieve a satisfactory equilibrium between their inner needs and outer requirements). In leveling, the purpose is the obliteration of differences; in sharpening, it is a heightened sensitivity to them. Several years later, Holzman and Klein (1954) defined cognitive styles as “generic regulatory principles” or “preferred forms of cognitive regulation” in the sense that they are an “organism’s typical means of resolving adaptive requirements posed by certain types of cognitive problems” (p. 105).

Witkin et al. (1954) conducted a large experimental study that played a crucial role in the further development of cognitive style research. The goal of Witkin’s study was to investigate individual differences in perception and to associate these differences with particular personality tendencies. In Witkin’s study, subjects received a number of orientation tests aimed at examining their perceptual skills, such as the Rod-and-Frame Test, in which subjects determined the upright position of a rod; the Body Adjustment Test, in which subjects judged their body position in different fields (e.g., defining their body position in rooms with tilted walls and chairs); and the Rotating Room Test, in which subjects adjusted a room to the true vertical position. In addition, subjects received the Embedded Figure Test, in which they identified simple figures in a complex one. Witkin et al. used a broad spectrum of methods to examine the personality characteristics of their subjects, including autobiographical reports, clinical interviews, projective tests, and personality questionnaires. Witkin et al.’s main finding was that individual differences in how people performed the perceptual tasks were stable over time and across tasks. Two groups of subjects were identified: *field dependent* (FD)—those who exhibited high dependency on the surrounding field; and *field independent* (FI)—those who exhibited low dependency on the field. It is worth mentioning that they found a large intermediate group of subjects who did not fall into either category. There were also significant relations among subjects’ performance on perceptual tests, their personality characteristics, and their social behavior. The FD group made greater use of external social referents in ambiguous situations than did the FI group and were more attentive to social cues. In contrast, the FI group had a more impersonal orientation than the FD group, exhibiting psychological and physical distancing from other people (see also Witkin & Goodenough, 1981, for a review).

Witkin et al. (1962) explained individual differences in perception as the outcome of different modes of adjustment to the world, concluding that both FD and FI groups have specific components

<sup>1</sup> Although the term *cognitive style* had already been introduced by Allport (1937) in relation to central personality traits, it was not actually used in the early studies of cognitive style.

that are adaptive in particular situations. According to Witkin, Dyk, Faterson, Goodenough, and Karp (1962), field dependence reflects an early and relatively undifferentiated mode of adjustment to the world, whereas field independence reflects a later and more differentiated mode. Although field independence is generally related to higher performance on perceptual tasks as well as higher growth in psychological organization, it is the integration of a psychological system, not differentiation, that reflects the effectiveness of the system's adjustment to the world.<sup>2</sup> That is, a highly differentiated FI individual may be very efficient in perceptual and cognitive tasks; however, she or he may exhibit inappropriate responses to certain situational requirements and be in disharmony with his or her surroundings.

Both Klein (1951) and Witkin et al. (1962) viewed cognitive styles as patterns or modes of adjustment to the world that appear to be equally useful but rely on different cognitive strategies and can result in different perceptions of the world. Furthermore, Klein clearly emphasized the control aspect of cognitive styles and their guiding function in an individual's activity, coming close to the concept of cognitive executive functions, which determine when, where, and in what manner an individual uses particular cognitive strategies or skills. Although Witkin's position regarding integration and adjustment is similar to Klein's, Witkin and his colleagues did not fully elaborate their theory, and this resulted in much confusion in the field. As we will see, this confusion permeated subsequent research, causing arguments about whether opposite poles of style dimensions are equally valuable or whether some, such as field independence, sharpening, narrow categorization, and others, are indicators of relatively high levels of intelligence.

### *Identification of the Main Features of Cognitive Style*

In the late 1950s, Klein's and Witkin's ideas of bipolarity (i.e., value-equal poles of style dimensions) spawned a great deal of interest. Psychological pervasiveness (i.e., cutting across boundaries between intelligence and personality) was the second appealing feature of the construct. Witkin et al.'s (1954) and Klein's (1951) studies showed a close connection between intelligence and personality, leading psychologists to hope that the "artificial dissociation" between the two fields (a distinctive characteristic of psychology during the last century) could be surmounted with the notion of cognitive style. The long-standing hope of describing an individual as a "holistic entity" (Witkin et al., 1977, p.15) seemed close to fulfillment. As a result, a tremendous number of studies on style types started to appear in the literature, all of them aimed at identifying individual differences in cognition that were stable over time, value free, and related to personality and social relationships.

Along with field dependence–independence and leveling–sharpening, dozens of other style dimensions were proposed. One such dimension was impulsivity–reflectivity (called also "conceptual tempo"), representing a preference for making responses quickly versus pausing to decrease the number of errors in problem-solving situations (Kagan, 1958, 1966). The instrument most often used to measure impulsivity–reflectivity was the Matching Familiar Figures Test (MFFT; Kagan, Rosman, Day, Albert, & Phillips, 1964). This test involves selecting the figure from among six similar variants that is identical to an original figure. Response times and error rates are measured, and a median

split criterion is used to classify individuals as *reflective*, if they make few errors and exhibit long response times, and *impulsive*, if they make more errors but respond faster. Consistent with findings on field dependence–independence and leveling–sharpening styles, the impulsivity–reflectivity dimension was moderately stable over time and across different contexts. Attempts to relate this dimension to personality and social variables were only partially successful. Researchers did find, however, that impulsive children displayed more aggression than reflective children and also that reflective children exhibited more advanced moral judgment than impulsive ones (see Messer, 1976, for a review).

Other commonly studied cognitive styles of this period are described in Table 1. These include tolerance for instability (Klein & Schlesinger, 1951), breadth of categorization (Gardner, 1953; Pettigrew, 1958), field articulation (Messick & Fritsky, 1963), conceptual articulation (Bieri, 1955; Messick, 1976), conceptual complexity (Harvey, Hunt, & Schroder, 1961), range of scanning (Gardner et al., 1959), constricted–flexible controls (Gardner et al., 1959), holist–serialist (Pask, 1972; Pask & Scott, 1972), verbalizer–visualizer (Paivio, 1971; A. Richardson, 1977), and locus of control (Rotter, 1966). Messick (1976) attempted to organize these numerous dimensions and proposed a list of 19 cognitive styles; Keefe (1988) synthesized a list of 40 separate styles.

Despite the numerous proposed cognitive style dimensions, no attempt was made to integrate them, and the main experimental paradigm was as follows: A simple task with two or more possible ways of solving it was offered to a subject. In situations of uncertainty about the "right way" of performing the task, the subject would choose his or her preferred way. Because all ways of solving the task were considered to have equal value, it was assumed that the subject's choice revealed a preference, not an ability. A group of subjects was then divided on the basis of their performance via a median split, forming two opposing poles of a particular style. This approach led to a situation in which as many different cognitive styles were described as there were researchers who could design different tasks. Not surprisingly, this situation was problematic. The first problem lay in the fact that although the main "motto" of research on cognitive styles was that bipolar dimensions represented two equally efficient ways of solving a task, in reality, one strategy was usually more effective than the other. Ironically, this fact appears especially clear in the most commonly used instruments to measure cognitive styles, such as Witkin's Embedded Figure Test (Witkin et al., 1954) to measure field dependence–independence and Kagan's MFFT (Kagan et al., 1964) to measure the impulsivity–reflectivity dimension. Riding and Cheema (1991) noted that a fundamental weakness of the Embedded Figure Test is that low scoring individuals are assumed to be FD, although low scores can be due to other factors (e.g., low

<sup>2</sup> According to Witkin et al. (1962), *integration* is an essential property of any system, including psychological systems, and it refers to the development of functional relationships among system components as well as between the system (self) and its surroundings (nonself). In contrast, *differentiation* refers to the degree of segregation of self from nonself, in the sense that boundaries have been formed between the system and its surroundings and that attributes are identified as one's own and recognized as distinct from those of others.

Table 1  
*Conventional Cognitive Styles*

Name of style	Concept of style	Method of measurement
Tolerance for instability/tolerance for unrealistic experience (Klein & Schlesinger, 1951)	Readiness to accept compromise solutions (apparent movement) if perceptual data conflict with the knowledge that stimuli are really stationary. <i>Tolerance</i> is easiness and <i>intolerance</i> is difficulty in experiencing apparent movement when viewing two figures exposed alternately.	The subjects were presented with pairs of stimuli exposed briefly one after another. Ease or difficulty in seeing movement was measured as the rate of alternation during which the effect of movement was experienced by a subject.
Equivalence range/breadth of conceptualization/category width: broad/narrow	Degree to which people are impelled to act on or ignore an awareness of differences. Equivalence range refers to preferred narrow or broad categorization of certain aspects of experience (Gardner et al., 1959). Category width "may be thought of as measuring subjects' typical equivalence range for classifying objects" (Pettigrew, 1958, p. 532)	Object Sorting Test: The test measures preferences for many groupings, each containing a few objects, or for few groupings, each with a large number of objects (Gardner, 1953). Modifications of the test included sorting the names of objects, descriptions of people, photographs of human faces, and others. Category Width Scale: subjects are asked to estimate the extremes of a number of diverse categories, from the length of whales to annual rainfall in Washington, DC. Tendency to overestimate (broad category width) or underestimate (narrow category width) is measured (Pettigrew, 1958).
Constricted/flexible control (Gardner et al., 1959)	Refers to the extent of differences in reactions to stimulus fields containing contradictory cues. <i>Constricted control</i> subjects resort to counteractive measures in their attempts to overcome the disruptive effect of intrusive cues and respond to the most obvious aspects of a field. <i>Flexible control</i> subjects are not over-impressed with a dominant stimulus organization if the instructions render another part of the field to be more relevant, and they are capable of differential responses to specified aspects of a field in the face of explicitly interfering cues.	<i>Color-Word Test (Stroop, 1935)</i> : Subjects were required to name the color of a word and ignore its content. Ease or difficulty in coping with distracting perceptual cues was measured.
Field articulation: element/form articulation (Messick & Fritzkly, 1963)	<i>Field articulation</i> refers to modes of perceiving complex stimuli. <i>Element articulation</i> involves the articulation of discrete elements from a background pattern. <i>Form articulation</i> highlights large figural forms against a patterned background.	Design Variations Test: Subjects were required to memorize a series of complex designs along with nonsense labels. Ease of identification of elements of a design in terms of learned labels was considered a measure of element articulation (Messick & Fritzkly, 1963).
Range of scanning (Gardner et al., 1959)	Refers to individual consistency in attentional strategies such as extensiveness of scanning. <i>Extensive scanners</i> differ from <i>limited scanners</i> in the amount of information sampled before commitment to a response.	Extensiveness of eye movements of a subject performing the Size Estimation Test (Gardner et al., 1959) was measured. Subjects were required to adjust a variable circle of light to the sizes of disks held in their left hands.
Conceptual articulation: complexity/simplicity (Bieri, 1955; Messick, 1976)	Conceptual articulation is generally recognized as a preference for complex conceptions over simple ones. Refers to individual differences in the extent to which instances of a concept are discriminated from one another in a number of categories within the concept's range of reference.	Modification of Kelly's Role Construct Repertoire Test (Kelly, 1955): Subjects are asked to sort known persons; during each sorting, subjects must state in what ways two of the persons are alike and different from a third in a particular respect. Total number of constructs used was measured.
Conceptual complexity: abstract/concrete (Harvey, Hunt, & Schroder, 1961)	Refers to continuum from concrete to abstract. All people can be ordered along this continuum, depending on their ability to differentiate and integrate information. Individuals low in differentiation and integration are considered <i>concrete</i> . Individuals high in differentiation and integration are considered to be <i>abstract</i> .	Sentence Completion Test: Subjects were required to complete a number of sentence stems. Sentences are scored on a 5-point concrete-abstract scale.
Holist-serialist (Pask, 1972; Pask & Scott, 1972)	Refers to an individual tendency to respond to a problem-solving task with either a holistic or a focused ("step-by-step") strategy. <i>Serialists</i> operate with a step-by-step approach to problem solving, choosing to deal only with small amounts of material at a time, before linking these steps. <i>Holists</i> utilize a significant amount of information from the start, looking to achieve understanding by identifying and focusing on major patterns or trends in the data.	A series of problem-solving tasks was designed to allow individuals to adopt either a step-by-step or a global approach to solving the problems (Pask & Scott, 1972).

(table continues)

Table 1 (continued)

Name of style	Concept of style	Method of measurement
Visualizer (imager)–verbalizer dimension (Paivio, 1971; Richardson, 1977)	Refers to an individual preference to process information by verbal versus imagery means.	Individual Differences Questionnaire (Paivio, 1971) and Verbalizer–Visualizer Questionnaire (Richardson, 1977): Participants were asked to evaluate the extent to which they habitually use imagery versus verbal thinking. The items on these questionnaires asked participants to indicate whether or not each of a list of statements, such as “I often use mental pictures to solve the problems,” described their habitual method of thinking.
Locus of control: external–internal (Rotter, 1966)	Refers to the extent to which an individual possesses generalized expectancies for internal versus external control of reinforcement. People with an external locus of control believe that their own actions do not determine their lives; people with an internal locus of control believe that their actions matter and that they can control their lives.	Locus of Control Test: The items in the test ask people to evaluate their generalized expectancies for internal versus external control of reinforcement (Rotter, 1966).

motivation, inability to follow the instructions, or visual defects). This may explain why FI subjects usually perform better than FD subjects on many types of tasks. It is not surprising then that many researchers who have investigated the correlation between intelligence tests and conventional measures of field dependence such as the Rod-and-Frame or Embedded Figure Tests (e.g., Cooperman, 1980; Goodenough & Karp, 1961; MacLeod, Jackson, & Palmer, 1986; McKenna, 1984) consistently report higher intelligence among individuals with an FI style than among those with an FD style.

A second problem was using the median split criterion to distinguish between the groups representing opposing poles of a cognitive style dimension (see reviews by Kholodnaya, 2002; Messer, 1976; Walker, 1986). Walker (1986) reviewed data on the impulsivity–reflectivity dimension and reported that norms were used in only 8% of all studies, making it difficult to be sure that one researcher’s reflectives were not another’s impulsives. A third problem, as noted in many reviews (e.g., Kogan & Saarni, 1990; Sternberg & Grigorenko, 1997), was the lack of a theoretical foundation for identifying cognitive style dimensions. Most studies of cognitive styles were descriptive, did not attempt to elucidate the underlying nature of the construct or relate styles to information processing theories, and were designed according to the assumption that styles are limited to only very basic information processing operations. As a consequence, much of this work suffered from arbitrary distinctions and overlapping dimensions. All of the problems above led to a situation in which the promising benefits of studying individual cognitive styles were lost among the chaos. Thus, the amount of work devoted to the cognitive style construct declined dramatically by the end of the 1970s.

Although a large number of theoretical and methodological problems accumulated in the field, research on basic cognitive styles clearly established robust differences in the way that individuals approached cognitive tasks. The main message of this research is that styles represent relatively stable individual differences in preferred ways of organizing and processing information that cut across the personality and cognitive characteristics of an individual. Messick (1976) reviewed the literature of that period and came to the conclusion that cognitive styles represent

consistent individual differences in preferred ways of organizing and processing information and experience . . . . They are not simple habits . . . they develop slowly and experientially and do not appear to be easily modified by specific tuition or training . . . . The stability and pervasiveness of cognitive styles across diverse spheres of behavior suggest deeper roots in personality structure than might at first glance be implied by the concept of characteristic modes of cognition. (pp. 4–6)

Furthermore, Messick (1976) distinguished between styles and abilities, coming close to Klein’s (1951) conception of the regulatory function of cognitive styles. Cognitive styles “appear to serve as high level heuristics that organize lower-level strategies, operations, and propensities – often including abilities – in such complex sequential processes as problem solving and learning” (Messick, 1976, p. 9).

### Research in Applied Fields: Styles Related to Complex Cognitive Tasks

Despite declining interest in styles among cognitive scientists by the end of the 1970s, the number of publications on styles in applied fields increased rapidly, reflecting the practical necessity of understanding individual differences in mechanisms of cognitive functioning. The main feature of these studies has been their focus on styles related to complex cognitive tasks, such as problem solving, decision making, learning, and individuals’ causal explanations of life events. This is in contrast to basic research on cognitive styles, which focused primarily on individual differences in perception and basic cognitive functions.

#### Decision-Making Styles

One example of cognitive style research in managerial fields is decision-making styles. Kirton (1976, 1977, 1989) examined managerial styles in decision making and introduced an *adaptors–innovators* dimension, which he defined as “a preferred mode of tackling problems at all stages” (Kirton, 1989, p. 5). Kirton (1989) defined adaptors as those preferring to accept generally recognized policies while proposing ways of “doing things better” and inno-

vators as those who question the problem itself, take it out of context, and propose ways for “doing things differently.” Kirton (1989) showed that adaptation–innovation is a relatively stable dimension (the test–retest reliability of the instrument measuring this dimension on a sample of college students, with time intervals from 4 to 17 months, ranged from 0.82 to 0.86) and argued that styles develop early in life and remain more or less stable over time and across situations. In addition, Kirton (1989) investigated the adaptation–innovation dimension in organizational settings—widening the concept of cognitive style to characterize not only individuals but also the prevailing group style (called *organizational cognitive climate*). Kirton (1989) argued that the overall cognitive climate stems from a work group sharing a similar style, that is, with all members within one half of a standard deviation around the mean for the group.

Another line of studies on decision-making styles was conducted by Agor (1984, 1989), who introduced three broad types of management styles: the intuitive, the analytical, and the integrated. People with an analytical style prefer to solve problems by breaking them into manageable parts by using analytical and quantitative techniques. People with an intuitive style, in contrast, rely more on feelings to make decisions, prefer unstructured situations, and solve problems holistically. A third, integrated, style uses both analytical and intuitive decision making interchangeably as the situation demands. Reviewing findings from national testing, Agor (1989) found that the dominant styles of executives varied with their management level, level of government service, gender, occupational specialty, and to some degree, with ethnic background. Agor (1989) noted that one’s style of decision making includes stable individual characteristics, applies to interpersonal relationships, and spreads throughout whole organizations.

Rowe and Mason (1987) proposed a model of decision-making styles based on dimensions of cognitive complexity (i.e., an individual’s tolerance for ambiguity) and environmental complexity (i.e., people-oriented vs. task-oriented work environments). The four styles derived from this model are directive (practical, power-oriented), analytic (logical, task-oriented), conceptual (creative, insightful, and intuitive), and behavioral (people-oriented, supportive, and receptive). Rowe and Mason stressed the importance of cognitive style in career success. To be successful, an executive must know his or her style to focus on achieving objectives in a frequently changing environment. Similarly, more recent studies on styles in managerial fields have supported similar ideas. First, cognitive style is a key “determinant of individual and organizational behavior, which manifests itself in both individual workplace actions and in organizational systems, processes, and routines” (Sadler-Smith & Badger, 1998, p. 247). Second, cognitive styles interact with the external environment and can be modified in response to changing situational demands as well as be influenced by life experiences (Hayes & Allinson, 1994; Hayes & Allinson, 1998; Leonard & Straus, 1997). Individuals “often stretch outside the borders of . . . preferred operating modes if the conditions are right and the stakes are high enough” (Leonard & Straus, 1997, p. 112).

### Personal Styles

By the end of the 1970s, a large number of new “personal cognitive styles” were proposed in psychotherapy, such as

optimistic–pessimistic, explanatory, anxiety prone, and others (Alloy et al., 1999; Haefel et al., 2003; C. Peterson et al., 1982; Seligman, Abramson, Semmel, & von Baeyer, 1979; Uhlenhuth et al., 2002). One of the first and most elaborated personality-related styles used widely in psychotherapy was the explanatory (attributional) style. Explanatory style reflects differences among people in the manner in which they habitually explain the causes of uncontrollable events (i.e., attributing the cause to internal vs. external circumstances). Furthermore, attribution theory suggests that styles are not always an inherent part of one’s personality and intelligence. Although relatively stable, styles can be acquired via an individual’s interaction with the external environment. For instance, a person acquires an *external* attributional style “when repeated experience with uncontrollable events leads to the expectation that future events will elude control . . . and an individual expects that nothing she does matters” (C. Peterson, Maier, & Seligman, 1993, p. 4). That is, it requires some repetition of life events or observing other people’s behavior to reinforce or inhibit certain styles.

Other personal styles have been identified with an instrument called the Myers–Briggs Type Indicator (MBTI; Bayne, 1995; Myers, 1976; Myers & McCaulley, 1985). The MBTI is a self-report instrument, which was developed on the basis of four of Jung’s (1923) personality types, extraversion–introversion (EI), sensing–intuition (SI), thinking–feeling (TF), and judging–perceiving (JP). Combinations of preferences form 16 psychological types. Similar to other applied styles, the MBTI assumes close connections between one’s style and professional specialization and is currently one of the most popular instruments for describing personality type in the field of career and job counseling (Stilwell, Wallick, Thal, & Burleson, 1998). Despite its commercial success, evidence supporting the MBTI as a valid measurement of style is inconclusive (see Coffield, Moseley, Hall, & Ecclestone, 2004, for a review). There has been considerable controversy regarding the MBTI’s measurement characteristics (Carlson, 1989; Doyle, Radzicki, Rose, & Trees, 1997; Healy, 1989; McCaulley, 1991; Merenda, 1991; Pittenger, 1993), and its construct validity has been repeatedly questioned, particularly in relation to whether the constructs are best represented as opposing pairs (e.g., Bess & Harvey, 2002; Girelli & Stake, 1993).

### Learning Styles

The field that has generated the largest number of applied studies on cognitive styles is education. In education, research has aimed at understanding individual differences (preferences) in learning processes, called *learning styles*. Gregorc (1979, 1982, 1984) built a model of learning styles by using a phenomenological approach, cataloguing the overt behavior of “good learners” to identify basic learning styles. He proposed two dimensions, perception (i.e., the means by which people grasp information), which could be concrete or abstract; and ordering (i.e., the ways in which people arrange, systematize, and use information), which could be sequential or random. These two axes were the foundation for basic learning styles, forming four different channels that mediate ways of receiving and expressing information: concrete–sequential (hardworking, conventional, and accurate), abstract–sequential (analytic, objective, logical), abstract–random (sensitive, compassionate, imaginative), and concrete–random (quick, intuitive, and

instinctive). On the basis of interviews with high school students and adults, Gregorc and Ward (1977) concluded that style characteristics are related to the whole system of thought and that “these characteristics are integrally tied to deep psychological constructs” (Gregorc, 1982, p. 51).

Contrary to Gregorc’s phenomenological approach, Kolb (1974, 1976, 1984) proposed a model of learning styles based on theories of experiential learning proposed by John Dewey, Kurt Lewin, and Jean Piaget (see also Kolb, Boyatzis, & Mainemelis, 2001). Kolb (1984) viewed learning as a holistic and continuous process of adaptation to the world, a continual modification of concepts by experience. It requires not only a “specialized realm of human functioning such as cognition or perception, but involves the integrated functioning of the whole organism – thinking, feeling, perceiving, and behaving” (Kolb, 1984, p. 31). His proposed “cycle of learning” involves four adaptive learning modes: two opposing modes of grasping experience, concrete experience (CE) and abstract conceptualization (AC); and two opposing modes of transforming experience, reflective observation (RO) and active experimentation (AE). The *diverging style* is a preference for CE and RO; *assimilating* is a preference for AC and RO; *converging* is a preference for AC and AE; and *accommodating* is a preference for CE and AE. Kolb (1984) presented evidence regarding relations among the learning styles and educational or professional specialization, showing that different job requirements might cause changes in learning styles.<sup>3</sup>

It should be noted that several researchers noticed a close similarity between Kolb’s and Gregorc’s characterizations of learning styles and the MBTI personality styles. For instance, Garner (2000) criticized Kolb, claiming that his learning styles were synonymous with Jung’s personality types. Drummond and Stoddard (1992) commented that “the Gregorc measures the same dimensions as the Myers–Briggs but uses different labels” (p. 103). Indeed, there are resemblances among Gregorc’s (1982) sequential–random processing, Kolb’s (1976) convergent–divergent, and the MBTI thinking–feeling styles as well as between Gregorc’s and Kolb’s concrete–abstract dimensions. However, what is most interesting about all these approaches is that they introduce two-level models of cognitive style, designating styles that operate both at the level of perception and at the level of complex cognitive activities, such as decision making, judgment, and problem solving (see Table 2).

Other research on learning styles has focused on the development of psychological instruments to assess individual differences in complex classroom situations (e.g., Dunn, Dunn, & Price, 1989; Entwistle, 1981; Schmeck, 1988; see also Cassidy, 2004, and Rayner & Riding, 1997, for reviews). For instance, Entwistle, Hanley, and Hounsell (1979) developed an instrument for assessing learning styles that focused on the depth of processing applied during learning. Entwistle et al. (1979) identified four learning styles: deep (intention to understand), surface (intention to reproduce), strategic (study organization, time management, etc.), and apathetic (lack of direction). Dunn et al. (1989) composed the Learning Style Inventory, a 100-item self-report questionnaire asking subjects to respond to statements relating to their preferences regarding the following factors: environmental (e.g., light, sound, temperature), emotional (e.g., persistence, motivation), sociological (e.g., working alone or with peers), physical (modality preferences), and psychological (e.g., global–analytical,

impulsive–reflective). Similar to the basic cognitive style researchers, the education researchers also defined styles in terms of both pervasiveness and stability.

In summary, the most significant contribution of applied studies was the expansion of the cognitive style concept to include constructs that operate in relation to complex cognitive activities. As a consequence, one distinguishing characteristic of these studies is the use of self-report questionnaires as a method of style assessment, reflecting a new tendency in cognitive style research to study conscious preferences in organizing and processing information. Another significant contribution of these studies is the examination of external factors that affect the formation of an individual’s style. The studies converged on the conclusion that cognitive styles, although relatively stable, are malleable, can be adapted to changing environmental and situational demands, and can be modified by life experiences. Furthermore, evidence accumulated regarding the connection between an individual’s style and the requirements of different social groups—from parent–child relationships<sup>4</sup> to professional societies. Thus, the general definition of cognitive styles as patterns of adjustment to the world, suggested by Klein (1951) and Witkin et al. (1954), was further specified to include descriptions of requirements that are imposed by social and professional groups. Cognitive styles became related to social interactions regulating people’s beliefs and value systems.

The main problem with these studies is the same as I discussed earlier—the explosion of style dimensions: The number of styles was defined by the number of applied fields in which styles were studied. As a consequence, the cognitive style construct multiplied to include decision-making styles, learning styles, and personal styles, without clear definitions of what they were or how they differed from the “basic” cognitive styles identified previously. The set of theoretical questions regarding the mechanisms of cognitive styles, their origins, and their relation to other psychological constructs remained open.

### Recent Trends in Cognitive Style Research: Toward Hierarchical Multilevel Models

Starting in the early 1970s, new trends in cognitive style research started to emerge; these can be roughly divided into three categories. The first includes studies identifying styles (e.g., mobility–fixity) that can operate on a metacognitive level (e.g., Keller & Ripoll, 2001; Kholodnaya, 2002; Niaz, 1987). The second comprises studies that attempt to unite existing models of style into a unifying theory with a limited number of central dimensions (e.g., Allinson & Hayes, 1996; Curry, 1983; Hayes & Allinson, 1994; Riding, 1991; Riding & Cheema, 1991) as well as to build an entirely new theory (e.g., Sternberg, 1997). The third includes

<sup>3</sup> However, Hickcox (1991), when reviewing research on Kolb’s experiential learning theory (1974, 1976, 1984), reported that among 81 studies on the social service professions, medical professions, education, higher education, accounting, and business, the results from only 50 studies supported Kolb’s approach versus 31 studies that showed partial or no support.

<sup>4</sup> According to Witkin (1964), early relationships between mother and child play a substantial role in the formation of a child’s patterns of adjustment and, thus, in the development of certain cognitive styles, for instance, field dependence or field independence.

Table 2  
*Similarities Between the Myers–Briggs Type Indicator (MBTI) and Gregorc’s and Kolb’s Approaches*

Level	MBTI	Gregorc	Kolb
Perception Decision-making	Sensing–Intuitive Thinking–Feeling	Concrete–Abstract Sequential–Random	Concrete–Abstract Convergent–Divergent

a few studies that aim to build multilevel hierarchical models of styles and relate cognitive style to other psychological constructs and processes (e.g., Miller, 1987, 1991; Nosal, 1990). These trends will be discussed in detail in the following sections.

### *The Mobility–Fixity Dimension: “Metastyle”*

Studies of the mobility–fixity (also called rigidity–flexibility) dimension originated to question the bipolar description of cognitive styles, suggesting that further divisions would better explain much of the accumulated data. In particular, these studies attempted to address one of the most contradictory results from previous research, specifically the mobility of cognitive style. That is, under certain circumstances, some subjects switch their style from one pole to another. Of interest, Witkin was the first to note that there might be individuals who possess both FD and FI characteristics and can exhibit one or another depending on the situation (Witkin, 1965; Witkin et al., 1962). According to Witkin et al. (1962), whereas FI individuals are creative, FI individuals who are also mobile are often even more creative because mobility signifies greater diversity in functioning and is more adaptive than fixity.

Eska and Black (1971) were the first to identify the existence of two different groups on each pole of the impulsivity–reflectivity dimension. After classifying elementary-school children as *reflective* if they scored below the mean in errors and above the median in latency on the MFFT and *impulsive* if they scored above the mean in errors and below the median in latency on the MFFT, Eska and Black identified two more groups: *quick*, who performed below the mean in errors and below the median in latency; and *slow*, who scored above the mean in errors and above the median in latency. Similarly, Keller and Ripoll (2001) studied 5–9-year-old children on impulsivity–reflectivity in a gross motor task (i.e., hitting a ball with racquet) and found that some children did not fit the dichotomy of impulsive versus reflective. Two other groups emerged, the *fast–accurate* and the *slow–inaccurate*. Keller and Ripoll concluded that reflective individuals might better be viewed as those who can adapt their response time to the context and thus be more efficient (i.e., fast and accurate) in problem solving.

Similar results showing the existence of mobile individuals were obtained in studies by Niaz (1987). The Embedded Figure Test and Raven’s (1938) Standard Progressive Matrices Test were administered to a group of freshman college students to assess their field dependence–independence and intelligence level, respectively. In addition, Niaz administered the Figural Intersection Test.<sup>5</sup> On the basis of the median split procedure, subjects were categorized into four groups according to their results on the Embedded Figure and Figural Intersection Tests: mobile FI, mobile FD, fixed FI, and fixed FD. Although Niaz did not provide strong evidence that the Figural Intersection Test does, in fact, measure the mobility–fixity

dimension, her results revealed an interesting pattern. Specifically, the fixed FI group of students received the highest scores on the Raven’s Matrices Test. Mobile individuals (both FI and FD) performed significantly better than all other groups in three college courses: chemistry, mathematics, and biology. Niaz (1987) concluded that “mobile subjects are those who have available to them both a developmentally advanced mode of functioning (field-independence) and a developmentally earlier mode (field-dependence)” (p. 755). She concluded that, in mature individuals, fixed functioning would imply a certain degree of inflexibility and inability to regress to earlier perceptual modes.

One more study illustrates the mobility–fixity trend. Kholodnaya (2002) hypothesized a quadripolar structure of field dependence–independence, wide–narrow categorization, constricted–flexible cognitive control, and impulsivity–reflectivity. Kholodnaya (2002) administered several basic cognitive style and intelligence tests (e.g., Witkin’s Embedded Figure Test, the MFFT, Raven’s Matrices, a Stroop task (1935), and a word-sorting task). By using cluster analysis, she identified four clusters in the field-dependence–independence dimension. One represented fixed FI individuals. These individuals demonstrated high speed in restructuring the visual field (as measured by the Embedded Figure Test); however, they showed high interference and relatively long response times in the Stroop task as well as relatively poor ability in concept formation (as measured by the word-sorting task). Another cluster, which Kholodnaya designated as mobile FI, included individuals who, along with high speed on the Embedded Figure Test, showed relatively high performance on the word-sorting task, relatively low conflict on the Stroop task, and relatively high ability to integrate sensory information with context. The other two clusters, fixed FD and mobile FD, were similar in their relatively long response times on the Embedded Figure Test. However, in contrast to fixed FI, mobile FD individuals exhibited low cognitive conflict in the Stroop task and better ability to coordinate their verbal responses with sensory information. Furthermore, Kholodnaya found similar patterns for each of the following dimensions: constricted–flexible cognitive control, impulsivity–reflectivity, and narrow–wide range of equivalence; that is, each of these styles could be split further across mobile and fixed individuals. Kholodnaya concluded that mobile individuals

<sup>5</sup> The Figural Intersection Test was originally designed to measure “mental attentional energy” (Johnson, 1982, in Niaz, 1987), and in Niaz’s (1987) article, it is considered a measure of the mobility–fixity dimension. Each item of the Figural Intersection Test consisted of two sets of figures: a presentation set, in which single geometric figures were presented separately; and an intersecting set, in which the same figures were presented overlapping, with one area of common intersection. The task was to identify the areas of intersection.

can spontaneously regulate their intellectual activities and effectively resolve cognitive conflicts. In contrast, fixed individuals are unable to adapt their strategies to the situation and will exhibit difficulties in monitoring their intellectual activity. Thus, according to Kholodnaya, cognitive style represents the extent to which the metacognitive mechanisms of self-monitoring and self-control are formed in a particular individual, and in the case of a fixed individual, it is more appropriate to talk about a cognitive deficit than a cognitive style.

An important contribution of Kholodnaya's (2002) research is that she introduced the notion of metacognition into the field and defined cognitive style as a psychological mechanism that regulates and controls an individual's cognitive functioning. However, there is little support for her conclusion that fixed individuals exhibit cognitive deficits. Often, expertise in a particular field involves the development of a strongly fixed cognitive style. For instance, professional linguists and philosophers exhibit a fixed verbal style, whereas professional visual artists exhibit rigid visual styles in a variety of situations (Blajenkova & Kozhevnikov, 2002). Also, there is no support for her claim that cognitive styles are represented as quadripartite dimensions. Rather, Kholodnaya's results seem to suggest that individuals differ in the extent to which they exhibit flexibility and self-monitoring in their choice of styles. Mobility–fixity may be better viewed as a metastyle that defines the level of flexibility with which an individual chooses a particular style in a particular situation.<sup>6</sup>

In summary, the mobility–fixity trend showed that cognitive styles have more complicated structures than was previously assumed. Although the trend originated as a challenge to the bipolar characterization of cognitive style, research by Eska and Black (1971), Keller and Ripoll (2001), Niaz (1987), and Kholodnaya (2002) did not undermine the bipolar model but suggested the existence of an additional metacognitive dimension of style. Thus, the importance of these studies is in their attempts to relate cognitive style to metacognitive functioning. The concept of metastyles characterizing individual resources for self-monitoring and regulation of cognitive functioning is extremely interesting and could explain why cognitive styles fail to generalize across different tasks. Because individuals' positions on the metastyle dimension will define their flexibility to choose the most appropriate cognitive style, flexible individuals might exhibit a variety of styles depending on situational requirements, causing “elusive” correlations among their preferences for a particular style and performance on different cognitive tasks.

### *The Unifying Trend*

The unifying trend emerged in the 1990s as a response to fuzziness in the cognitive style field and aimed to unite and systematize multiple style dimensions into coherent and practically useful models. Researchers examined the hypothesis that all styles can be described as unified phenomena with a variety of subordinate elements based on existing style dimensions (e.g., Allinson & Hayes, 1996; Hermann, 1996; Riding & Cheema, 1991) and some new styles (Sternberg & Grigorenko, 1997).

The first attempts to organize the array of cognitive styles revolved around the idea that there is a unified structure based on an analytical–holistic (or analytical–intuitive) style (e.g., Allinson & Hayes, 1996; Entwistle, 1981; Hayes & Allinson, 1994). Most

of these approaches related the analytical–holistic dimension to the hemispheric lateralization of the brain based on the assumption that the left and right hemispheres have different cognitive functions during information processing (e.g., the left hemisphere processes information analytically, whereas the right hemisphere processes information holistically). Although this assumption is not accurate in light of current theories in neuroscience, nevertheless, many researchers have claimed that the degree to which behavior is global–holistic or differentiated–analytic is a key element in differences among individuals. The *analytical* style has commonly been described in the cognitive style literature as convergent, differentiated, sequential, reflective, and deductive, whereas the *holistic* style has been described as divergent, global, impulsive, intuitive, inductive, and creative.

Allinson and Hayes (1996) compiled a list of 29 cognitive styles described in the literature to discover whether cognitive style is a complex or unitary construct and whether cognitive styles are simply different conceptions of the same analytical–intuitive dimension. On the basis of this list of cognitive styles, Allinson and Hayes designed a new cognitive style measure called the Cognitive Style Index (CSI), targeted specifically for use by managers and professionals. Allinson and Hayes reasoned that the internal structure of the CSI should be unifactorial if it really measures the superordinate dimension of cognitive style. However, a factor analysis confirmed the single-factor solution only for some of the subject samples studied by Allinson and Hayes, casting doubt on the conception of a unitary cognitive style. More recently, Hodgkinson and Sadler-Smith (2003) reported evidence that two-factor models (comprising separate analytical and intuitive dimensions) provide a significantly better approximation of responses to the CSI than previously reported unifactorial solutions (but see response of Hayes, Allinson, Hudson, & Keasey, 2003). Hodgkinson and Sadler-Smith referenced the tenets of cognitive experiential self-theory, developed by Epstein (1990, 1991, 1994, 1998), which posits that analysis and intuition are more likely to be separate modes of information processing served by different cognitive systems than stylistic differences along a bipolar dimension. The rational system operates at the conscious level, is intentional and analytical, and functions according to a person's understanding of conventionally established rules of logic. The experiential system, in contrast, is automatic, preconscious, non-verbal, and associated with emotions and affect. However, Hayes et al. (2003) argued, reasonably, that the existence of two different information processing systems does not preclude a single bipolar continuum of intuition–analysis governed by a common set of principles, and no evidence supports the rational and experiential systems as two orthogonal dimensions.

Riding and Cheema (1991) proposed two major orthogonal cognitive style families based on their review of different cognitive styles, correlations among them, methods of assessment, and effects on behavior: *wholistic–analytic* and *verbalizer–imager* (i.e., whether one has the tendency to represent information during thinking verbally vs. in images). According to Riding and Cheema,

<sup>6</sup> The term *metastyle* comes close to the conception of *cognitive style* introduced by Klein (1958), which referred not to any particular bipolar dimension but to the superordinate level of control, consisting of a combination of different dimensions (cognitive controls).

these two style dimensions may be thought of as independent such that the position of individuals on one dimension does not affect their position on the other. This theoretical construction was operationalized with the development of a computerized assessment of cognitive style called Cognitive Style Analysis (CSA; Riding, 1991), which assesses both ends of the wholistic–analytic and verbal–imagery dimensions. However, Riding and Cheema did not provide a theoretical basis for their four-type model. Further studies (e.g., E. R. Peterson, Deary, & Austin, 2003a, 2003b; Rezaei & Katz, 2004) reported poor test–retest reliability ( $r_s < .42$ ) of the CSA and low internal consistency for its verbal–imagery dimension ( $r = .36$ ). Although Riding (1997) reports a number of studies to support the validity of the CSA test, these reports are mostly based on the construct validity (i.e., low correlation between two orthogonal scales) and the discriminant validity of the test (i.e., the lack of correlations among test scores and intelligence, gender, and personality). Low correlations, however, could be attributed to the poor reliability of the test rather than the orthogonality of the constructs.

Another attempt to describe individual differences in intellectual functioning is Sternberg’s theory of thinking styles (Sternberg, 1988, 1997; Sternberg & Grigorenko, 1997). This theory differs from previous ones because it does not systematize existing cognitive styles but offers a new multidimensional system of thinking (originally, “intellectual”) styles. The model uses the structure of government as a metaphor for understanding and explaining individual differences in the regulation of intellectual activity. Sternberg’s theory (1988) described 13 styles. They were grouped by the following: functions of mental self-government (legislative, executive, and judicial); forms of mental self-government (monarchic, hierarchic, oligarchic, and anarchic); levels (local, global); scope (internal, external); and learning of mental self-government (liberal, conservative). However, numerous follow-up studies (Zhang, 2001; Zhang & Huang, 2001; Zhang & Sternberg, 2000) revealed that most of the thinking styles in Sternberg’s theory also can be classified into two categories. The first, known as Type I thinking styles, is composed of styles that are creativity generating and that denote high levels of cognitive complexity (e.g., legislative, judicial, hierarchical, global, and liberal styles). The second category, known as Type II thinking styles, consists of styles that suggest a norm-favoring tendency and that denote low levels of cognitive complexity (e.g., executive, local, monarchic, and conservative). The remaining styles may manifest characteristics from either group, depending on the stylistic demands of a specific task. Further data (e.g., Sternberg & Zhang, 2001; Zhang, 2000) revealed significant correlations among thinking styles, personality characteristics (e.g., self-esteem), socioeconomic status, and situational characteristics. However, the functional relations among thinking styles remained unclear (because actual government structures have a hierarchical organization, so one might expect such a hierarchy among thinking styles as well, on the basis of their model). Although there is some resemblance between Sternberg and Grigorenko’s (1997) creativity-generative–norm-favoring dimension and the “basic” holistic–analytical dimension, the authors did not provide any explanation regarding possible relations between their thinking styles and previously proposed cognitive styles.

To ascertain the validity of unifying approaches to the understanding of cognitive style, Leonard, Scholl, and Kowalski (1999)

conducted an empirical study in which he reported intercorrelations among various subscales of widely used cognitive style instruments. A content analysis indicated at least three bipolar cognitive style dimensions operating at different levels of cognitive processing. The first level was pure cognitive style, which relates to the way individuals process information. The second was decision-making style, which indicates individual preferences for various complex decision processes. The third level was decision-making behavior style, which reflects the ways individuals approach a decision situation; individuals may have a dominant or preferred decision-making style, but their decision-making behavior is influenced by the demands of the situation or task. Similarly, Bokoros, Goldstein, and Sweeney (1992) investigated common factors in several commonly used cognitive style instruments and also identified three factors from 28 subscales associated with these instruments. They dubbed these factors the information processing domain, the thinking–feeling dimension, and the attentional focus dimension. It is interesting to note that the first and second levels identified by Bokoros et al. (1992) and Leonard et al. (1999) closely resemble “perception” and “decision-making” levels, respectively, described by researchers from the applied fields (see Table 2). The first level overlaps with basic cognitive style dimensions that address individual differences in data processing, whereas the second level addresses styles related to individual differences in more complex cognitive activities. As for the third level, which is described by Leonard et al. as responsible for the choice of style best suited to the demands of a situation, and by Bokoros et al. as “internal and external application of the executive cognitive function” (p. 99) it closely resembles the mobility–fixity dimension, or metastyle.

In summary, studies from the unifying trend endeavored to systematize cognitive styles and establish structural relations among them. Although the trend started as an attempt to confirm the idea that all cognitive styles can be organized around one superordinate analytical–holistic dimension, findings have cast serious doubt on the unitary nature of cognitive style and provided evidence for a complex structure of underlying styles. One significant implication of these studies is the confirmation of a hierarchical organization of style dimensions, consisting of at least two subordinate dimensions, one related to low-level information processing and another related to more complex cognitive activities, and of one superordinate dimension related to executive cognitive functioning.

### *Cognitive Style in the Context of Information Processing Theory: Toward a Theory of Hierarchical Organization of Styles*

Although studies from the unifying period attempted to organize cognitive styles according to some systematic structure, the concept still lacked an underlying theoretical structure and remained unintegrated with information processing theories and other psychological concepts. Only a few studies have been conducted to clarify the mechanisms of cognitive styles in the context of an information processing approach. Several early studies reported that the difference between FD and FI individuals might be related to differences in encoding processes, and this became especially apparent when a large amount of information had to be analyzed or integrated (see Davis & Cochran, 1990, for a review). Recently, J. A. Richardson and Turner (2000) proposed that Witkin’s theory

of field dependence–independence might be elaborated further through Sternberg’s triarchic theory of intelligence (Sternberg, 1985).<sup>7</sup> In particular, Richardson and Turner focused on how FD individuals differ from FI individuals in knowledge acquisition components, such as in selective encoding (i.e., sifting out relevant from irrelevant information), selective combining (i.e., selectively combining encoded information in such a way as to form an integrated whole), and selective comparing (i.e., relating newly acquired information to information from the past). The researchers proposed that field independence may be associated with a heuristic routine that gives priority to selective encoding and selective comparing. In contrast, field dependence may be characterized as giving priority to selective combining and selective comparing. Although Richardson and Turner’s empirical results gave only partial support for their hypotheses, they indicated that some degree of functional association might exist between knowledge acquisition components and cognitive style.

A significant contribution in relating cognitive style (in particular, the analytical–holistic dimension) to memory, attention, and reasoning processes was made by Miller (1987, 1991). On the basis of empirical and conceptual elements from the cognitive style and cognitive science literature, Miller (1987) proposed a hierarchical “model of individual differences in cognitive processing” (p. 251), in which a vertical dimension was added to the horizontal analytical–holistic dimension to represent different stages in cognitive processing, such as perception (pattern recognition and attention), memory (representation, organization, and retrieval), and thought. At each stage of cognitive processing, one can identify different cognitive styles (Figure 1).

Miller’s (1987) research parallels in some ways the later work by Nosal (1990), who proposed the most theoretically grounded model for systematizing cognitive styles in the context of information processing theory. According to Nosal’s model (Nosal, 1990), four levels (from simple perception to complex decision making) and four methods (from automatic data encoding to conscious allocation of mental resources) of information processing form the axes of a matrix, and 12 cognitive styles can be placed on the matrix crossings (Figure 2). The cognitive styles Nosal classified were field dependence–independence, field articulation (element vs. form articulation), breadth of conceptualization, range of equivalence, articulation of conceptual structure, tolerance for unrealistic experience, leveling–sharpening, range of scanning, reflectivity–impulsivity, rigidity–flexibility of control, locus of control, and time orientation.<sup>8</sup> The four levels of Nosal’s model are *perception*, *concept formation*, *modeling*, and *program*. At the lowest, the perceptual, level an individual forms representations of his or her external environment by using short-term perceptual images. Field dependence–independence and leveling–sharpening, as well as impulsivity–reflectivity, are examples of styles operating at the perceptual level. Nosal defines the second level as concept formation, the level at which concepts and categories are formed. The styles that Nosal positioned at the concept formation level are related to the mechanisms of categorization (breadth of conceptualization and wide–narrow range of equivalence). The third level is modeling, which includes complex processes of reorganization, the assimilation of new information according to subjective experiences, and the elaboration of existing knowledge structures. This level includes the formation of mental models, prototypes, and schemas. The styles that Nosal positioned at the modeling level include the articulation of conceptual structure, intolerance to unreal-

istic experience, and time orientation. The fourth level, designated as program, is the level of metastyles, or metacognitive functioning, at which Nosal positions such styles as rigidity–flexibility of control and internal–external locus of control.

Examining the cognitive styles positioned in rows, Nosal (1990) noticed that several constructs on the vertical axes of the matrix (called metadimensions) could also be identified. Whereas the horizontal axes were constructed to represent different levels of information processing, the vertical metadimensions seemed to represent different ways of information processing. The first vertical axis, which includes such styles as field dependence–independence and field articulation, forms the *field structuring* vertical metadimension, which describes the way individuals selectively encode field data and sift out relevant from irrelevant information. The second metadimension, *field scanning*, describes different methods of information scanning, such as systematic (internally driven by rules) versus random (externally driven by salient stimuli) information search, and could also reflect the choice of representation and organization of information. The cognitive style Nosal placed on this metadimension is range of scanning. *Conceptual equivalence* is a third metadimension, which comprises such styles as leveling–sharpening, breadth of conceptualization, equivalence range, articulation of conceptual structure, and tolerance for unrealistic experience. This metadimension reflects the way an individual combines pieces into a whole (e.g., analysis vs. synthesis). The last metadimension is *control allocation*; it describes the methods of self-monitoring and regulation of intellectual functioning (including such styles as reflectivity–impulsivity, rigidity–flexibility of control, and time orientation). According to Nosal, the four metadimensions can operate at any of the four levels of information processing represented on the horizontal axes. It is interesting to note that the metadimensions that Nosal derived from his model resemble the metacomponents suggested by Sternberg’s componential theory of intelligence, which includes such processes as selection of low-order components, selection of representation or organization of information, selection of a strategy for combining lower order components, and decisions regarding allocation of attentional resources (similar to Nosal’s field structuring, field scanning, conceptual equivalence, and control allocation metadimensions, respectively). These metacomponents were defined by Sternberg (1985) as the “specific realization of control processes . . . sometimes collectively (and loosely) referred to as the executive” (p. 99). An important con-

<sup>7</sup> According to Sternberg (1985), three subtheories (contextual, experiential, and componential) serve as the basis for specific models of intelligent behavior. The components that are identified in the componential subtheory are classified according to their functions: knowledge acquisition components, which are processes used in learning; decision-making components; performance components, which are processes used in the execution of a task; and metacomponents, which are higher order processes used in planning and monitoring.

<sup>8</sup> Because numerous studies (e.g., Lessing, 1968; Orme, 1969) revealed individual differences in time orientation (i.e., the degree to which individuals perceive their personal use of time as structured, purposive, and planned, as well as the degree to which an individual is capable of anticipating and structuring future events) and their connection with certain other cognitive styles and personality, Nosal (1990) suggested the possibility of considering time orientation as a cognitive style dimension.

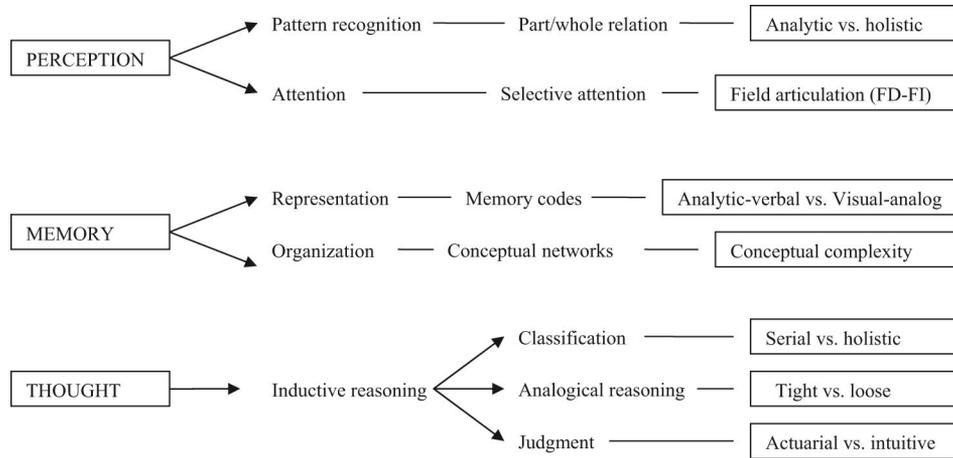


Figure 1. Analytic versus holistic dimensions: A model of cognitive styles and cognitive processes. FD-FI = field dependence–field independence. From “Cognitive Styles: An Integrated Model” by A. Miller, 1987, *Educational Psychology*, 7, p. 253. Copyright 1987 by the American Psychological Association. Reprinted with permission.

tribution of Nosal’s model is that it provides a basis for hierarchical classifications of cognitive styles in terms of both their relations to each other and their relations to the processes of cognitive control and regulation. That is, Nosal’s model proposes that different cognitive styles can be identified at each level of information processing and that cognitive styles can be grouped into distinct categories according to the executive–regulatory functions they perform, from automatic regulatory functions related to the encoding and sifting of information to conscious executive functions of resource allocation.

Summarizing the recent trends in cognitive style research, several conclusions can be drawn. First, the mobility–fixity studies

suggest that some styles might operate at the superordinate meta-cognitive level, and such metastyles will determine the flexibility with which an individual chooses the most appropriate subordinate style for a particular situation.

Second, the unifying trend actually disconfirms the idea that there is a unitary nature to cognitive style and provides experimental evidence for its complex hierarchical structure. Finally, attempts have been made to clarify the mechanisms of cognitive styles in the context of an information processing approach. In particular, Nosal’s (1990) model provides a theoretical basis for a hierarchical classification of cognitive styles according to the level of information processing (from simple perceptual decisions to complex problem-solving behavior) at which they operate and according to the types of information processing they regulate (from automatic data encoding to conscious allocation of mental resources). That is, by grouping styles along the vertical dimensions representing specific control processes, Nosal was the first to propose a theory that cognitive styles operate at different levels of cognitive complexity and on different types of mental processes that might be used at any of the levels.

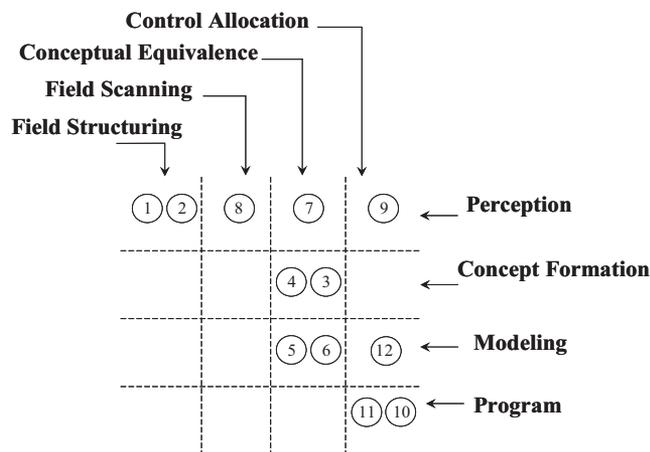


Figure 2. Cognitive styles in relation to metadimensions and levels of information processing according to Nosal’s theory. 1 = field dependence–independence; 2 = field articulation (element vs. form articulation); 3 = breadth of conceptualization; 4 = range of equivalence; 5 = articulation of conceptual structure; 6 = tolerance for unrealistic experience; 7 = leveling–sharpening; 8 = range of scanning; 9 = reflectivity–impulsivity; 10 = rigidity–flexibility; 11 = locus of control; 12 = time orientation.

### Perspectives From Cognitive Science and Neuroscience

In this section, I will describe attempts to explore the cognitive and neural underpinnings of cognitive style from cognitive science and neuroscience perspectives and to apply modern neuropsychological measures to further examine the concept.

The results from early studies of the relation between field dependence–independence and cerebral functions suggest that differences between FD and FI individuals are more than just general preferences, or deficiencies, based in one or the other hemisphere (e.g., Garrick, 1978; Falcone, 1985; Pizzamiglio & Carli, 1974; see also Tinajero, Paramo, Cadaveira, & Rodriguez-Holguin, 1993, for a review). Researchers generally agree that FD subjects display greater between-hemisphere coherence, suggesting less hemispheric differentiation or specialization (e.g., O’Connor & Shaw, 1977; Oltman, Semple, & Goldstein, 1979). Several researchers

have also suggested that individual differences in cognitive styles might reflect variations in the efficiency of cognitive processes associated with frontal lobe systems (Globerson, 1989; Pascual-Leone, 1989; Waber, 1989).

One recent attempt to clarify the cognitive underpinnings of a cognitive style was a characterization of field dependence–independence from a working memory perspective by Miyake, Witzki, and Emerson (2001). The researchers used a dual-task interference paradigm to assess which working memory components are implicated in performing the Hidden Figure Test (HFT) developed by Ekstrom, French, and Harman (1976), which is a close variant of the Embedded Figure Test. Miyake et al. based their study on Baddeley's multicomponent model of working memory (Baddeley & Logie, 1999), according to which working memory consists of two distinct domain-specific subsystems, the visuospatial sketchpad and the phonological loop, for processing visuospatial and verbal information, respectively, and a general-purpose control subsystem—the central executive—which performs central regulation. The main hypothesis of Miyake et al. was that the visuospatial sketchpad and the central executive would play an essential role in performance on the HFT. Their results revealed that, in fact, performance on the HFT was significantly disrupted by concurrent performance of a secondary spatial task or a secondary central-executive task. The authors concluded that “performance on the HFT reflects the efficiency of the operations of the visuospatial and executive components of working memory” (Miyake et al., 2001, p. 455), and thus the field-dependence–independence dimension “should be construed as a cognitive ability, rather than a cognitive style” (Miyake et al., 2001, p. 456). Although Miyake et al.'s (2001) results are valuable as an attempt to relate cognitive style to working memory, and in particular to central-executive functioning, their experimental design does not discriminate between FD and FI individuals but rather informs us about some of the cognitive processes involved in the performance of the HFT.

There have also been a few recent attempts to use neuropsychological measures to investigate cognitive styles. Gevins and Smith (2000) examined differences between subjects exhibiting a verbal versus nonverbal cognitive style by recording their EEGs while they performed a spatial working memory task. The results showed that subjects did not significantly differ in their working memory task performance nor in the absolute magnitude of the EEG power measures; however, they did differ with respect to hemispheric asymmetries of alpha band signals. Subjects with a verbal style displayed greater reduction of the alpha signal in the left hemisphere, whereas subjects with a nonverbal style exhibited greater alpha reduction in the right hemisphere. The importance of this study is that it related cognitive styles to distinct patterns of neural activity, even though subjects' accuracy and response times did not differ. That is, the findings indicated that the individual differences underlying verbal–nonverbal cognitive style extend to different patterns of neural activity in the brain but are not necessarily related to the ability to perform a particular task.

Goode, Goddard, and Pascual-Leone (2002) used ERP methodology to investigate the hypothesis that working memory and attentional inhibition processes could explain style differences in field dependence–independence. The subjects were identified as FI or FD on the basis of their performance on the Rod-and-Frame

Test. Then, their ERPs were recorded while they performed a serial-order recall task. Memory load was manipulated by varying the amount and kind of information to be elaborated and retained in working memory in order of temporal appearance. The ERP results revealed that FI subjects engaged in “deeper” cognitive processing during the high memory load conditions relative to FD subjects; this was reflected in a higher amplitude slow negative wave over the centroparietal sites extending to frontal sites during the retention interval. In contrast, FD subjects exhibited a reduced amplitude slow negative wave over centroparietal sites, possibly resulting in fewer mental attentional resources being available to them for the retention component of the task. The authors suggested that this neural pattern indexes inhibitory processes that FD subjects may use to try to change their natural global-perceptual strategies to serial information processing, as the task requires.

Two recent studies by Kozhevnikov, Hegarty, and Mayer (2002) and Kozhevnikov, Kosslyn, and Shephard (2005) attempted to clarify and revise the visualizer–verbalizer dimension on the basis of recent neuroscience evidence that the visual system processes object properties (such as shape and color) and spatial properties (such as location and spatial relations) in two distinct subsystems—ventral and dorsal, respectively. Kozhevnikov et al. (2002, 2005) rejected the idea that visual–verbal cognitive style can be characterized as variation along a single dimension. In fact, they found two different types of visualizers: *object visualizers*, who use imagery to construct vivid, concrete, pictorial images of objects; and *spatial visualizers*, who use imagery to represent spatial relations among objects and to imagine complex spatial transformations (Blajenkova, Kozhevnikov, & Motes, 2006). Kozhevnikov et al. (2005) also demonstrated that scientists and engineers excel in spatial imagery and report themselves as spatial visualizers and that visual artists excel in object imagery and report themselves as object visualizers. Furthermore, fMRI experiments revealed that during performance on the Embedded Figure Task, spatial visualizers showed greater left hemisphere activation in the occipitotemporal areas than object visualizers, whereas object visualizers showed greater bilateral activation in the occipitoparietal junction than did spatial visualizers (Motes & Kozhevnikov, 2006), consistent with the hypothesis that individual differences in visual cognitive style are related to the differential use of regions in the dorsal and ventral visual processing streams. The main implication of this research is that studying cognitive style dimensions from a cognitive neuroscience perspective is a fruitful research direction that can deepen our understanding of different cognitive style dimensions.

The studies reviewed in this section can be viewed as attempts to incorporate cognitive style into the main body of cognitive psychology. Although these studies did not attempt to develop a theoretical framework of cognitive style, they have begun to give us significant insight into the neural processes underlying particular cognitive styles. Furthermore, they showed that EEG and neuroimaging techniques can be valuable tools in exploring cognitive styles. Finally, these studies demonstrated a close connection between the cognitive style construct and other psychological concepts (e.g., memory, attention, metacognitive processes), making it especially clear that cognitive style should no longer be considered an isolated construct and must be studied in the context of recent cognitive and neuroscience theories if the field is to advance.

### Toward an Integrated Framework of Cognitive Style

I have reviewed the main trends in cognitive style research and their contributions to the understanding of cognitive style. Research on basic cognitive styles revealed that individuals use different approaches to solve simple cognitive tasks and that individuals' preferences for these approaches are quite stable over time and are related to both intelligence and personality. Studies in applied fields expanded the concept, describing individual differences both in low-level (mostly perceptual) cognitive functioning and in more complex cognitive processing. These studies also made it clear that cognitive styles are not simply inborn structures, dependent only on an individual's internal characteristics, but, rather, are interactive constructs that develop in response to social, educational, professional, and other environmental requirements. The mobility–fixity research further expanded on the idea of multiple levels of styles, in particular proposing the existence of metastyles—superordinate styles governing an individual's flexibility in the use of subordinate styles, depending on the requirements of a task. The unifying research trend empirically confirmed that cognitive styles are based on neither a single underlying dimension nor operation in isolation but rather that there is a structural relation among them. Cognitive styles can, in fact, be grouped into distinct categories according to the level of information processing on which they operate and according to the executive–regulatory functions they perform. Finally, recent studies on cognitive styles have revealed a close connection between cognitive style and other cognitive processes (e.g., memory, attention, metacognition) and have provided some insights about the neural mechanisms underlying particular cognitive styles.

On the research reviewed in this article, I suggest that cognitive styles represent heuristics an individual uses to process information about his or her environment. These heuristics can be identified at each level of information processing, from perceptual to metacognitive, and their main function is regulatory, controlling processes from automatic data encoding to conscious allocation of cognitive resources. Cognitive styles have an adaptive function: They mediate the relation between an individual and his or her environment. Although styles are generally stable individual characteristics, they may also change or develop in response to specific environmental circumstances (education or profession, for instance). Furthermore, although intellectual abilities affect the dynamics of acquiring cognitive styles and one's overall level of accomplishment, they are not the sole determiner of an individual's cognitive styles. Rather, a range of variables, such as intellectual abilities, previous experience, habits, and personality traits, will affect the formation and choice of a particular cognitive style. For instance, innate abilities such as abstract-logical reasoning or spatial visualization may lead to an interest in mathematics and science, which then may result in the development of particular cognitive styles (e.g., field independence, analytical, reflective). In turn, once established, cognitive styles support the development of some intellectual abilities and personality traits but might impede others. From this perspective, cognitive styles can be viewed as distinctive patterns of adjustment to the world that develop slowly and experientially as a result of the interplay between basic individual characteristics (i.e., general intelligence, personality) and long-lasting external requirements (i.e., education, formal–

informal training, professional requirements, and cultural and social environment).

It is interesting to note that the above approach to cognitive style is similar to the concept of “individual style of activity” introduced by Soviet psychologists (e.g., Klimov, 1969; see also Bedny & Seglin, 1999, for a review) to describe psychological mechanisms that determine the dominant ways by which an individual adjusts to the external environment in an attempt to accomplish his or her goals. Individual styles of activity are derived from idiosyncratic features of a person, such as intellect, character, and temperament, but are formed as a result of adaptation to objective requirements. Depending on the environment, the same individual might develop different individual activity styles. Such individual styles might serve as the best predictor of an individual's behavior and success in different situations.

As I have reviewed, there have been many research trends in cognitive style research. Although the development of these trends occurred in a relatively chronological order (with the earliest laboratory research on simple cognitive tasks preceding most of the applied research and the unifying and hierarchical trends developing later), in large part these trends existed independently and continue to do so. Even now, each research trend generates new studies, with investigators in one area having only a vague idea about other research directions. This review attempts to remedy this situation by outlining the pervasive problems in the field as a whole and by suggesting possibilities for integrative research. One central need is the further development of a general theory of cognitive styles and their connections to each other and to personality traits, intellectual abilities, and external requirements. It is also apparent that the development of such a theory in isolation from the main body of current psychological and neuroscience research will not be effective. In this respect, further development of Nosal's (1990) model is a promising direction because the model demonstrates that it is possible to systematize different style dimensions in relation to contemporary cognitive science theories. This model can be empirically tested and also allows us to predict the appearance of as yet undiscovered cognitive styles on the empty crossings of the matrix. For instance, the most profound difference between FD and FI individuals, according to Nosal's model, would be found in the field structuring components such as selective encoding and sifting out perceptual information. The differences in executive functioning and attentional control would be reflected in cognitive style dimensions located on the control allocation metadimension, with reflective–impulsive individuals differing primarily in allocation of their attentional resources when performing simple perceptual tasks and with constricted–flexible individuals differing in their level of self-monitoring when carrying out complex thinking and reasoning processes. Such an approach relating information processing theories and intelligence components to different cognitive style dimensions could provide a general research model, which could be more fully adapted by investigators concerned with the specific relations among learning, memory, attention, and cognitive style.

One of the limitations of Nosal's (1990) model is that it does not take into account the effect of personality traits on cognitive styles. There have been a number of studies conducted to examine the relation of learning styles to different personality traits (Busato, Prins, Elshout, & Hamaker, 1999; Honey & Mumford, 1982) and to investigate the relation between Sternberg's thinking styles

(Sternberg, 1988, 1997; Sternberg & Grigorenko, 1997) and the Big Five personality traits (i.e., Neuroticism, Agreeableness, Conscientiousness, Extraversion, and Openness; e.g., Zhang, 2000, 2002). However, almost no research has been done recently to examine the relations among cognitive styles and the five basic personality factors. Moreover, no attempts have been made to investigate the combined effect of personality traits and intellectual abilities on the formation of an individual's cognitive style.

Additional research on the interactions among cognitive styles and external environments could shed further light on the formation (and possible modification) of cognitive style. Currently, there are almost no studies that examine the development of different cognitive styles in a real world context. Of particular interest would be studies that focus on the development of cognitive styles in groups of individuals who are exhibiting similar intellectual abilities and personality traits but who are immersed into different learning or sociocultural environments. If such groups, despite similarities in their internal characteristics, develop different cognitive styles, it would suggest that the external environment is critically important for style formation and would also clearly distinguish cognitive style from intelligence and personality. Similarly, the question of how learning environment affects the formation of cognitive styles would be of great significance for educators. Currently, our understanding of cognitive style is insufficient for motivating or justifying educational decisions (Shipman, 1990). However, educators at all levels could be helped immensely by understanding the types and range of classroom situations in which different styles are expressed and formed.

Our modern understanding of brain functioning and the availability of neuroimaging methods provide possibilities for further investigation of information processing differences among individuals of different cognitive styles, particularly in terms of hemispheric lateralization. If people of two opposing poles on one cognitive style continuum do in fact differ qualitatively in the type of cognitive strategies they use, neuroimaging should reveal different patterns of brain activation when the groups perform the same cognitive task. Moreover, the level of activation in frontal areas responsible for metacognitive processing may shed further light on the relation between metacognition and cognitive style. If, in fact, mobility of cognitive style is a result of effective self-regulatory and control processes, then different patterns of activation in the frontal lobes would be expected for mobile versus inflexible individuals.

Another promising direction in the study of cognitive style is the development of mathematical models to account for strategy choice and adaptability. Recently, several models of strategy selection (e.g., Neches, 1987; Shrager & Siegler, 1998; Siegler & Shipley, 1995) and neural network models of intellectual and developmental differences in strategy (e.g., Bray, Reilly, Villa, & Grupe, 1997) have been formulated by cognitive scientists to illustrate how specific cognitive processes, past success, and current applicability of available strategies to a task could work together to produce further strategic development. Because this research explores different mechanisms that can successfully account for strategic behavior, it would be of considerable interest and great practical value applied toward the further development of the cognitive style concept.

The intent of this article was to bring together different research trends and to provide researchers in all cognitive style fields (and

those in neuroscience, social psychology, and psychometrics) a guiding framework for future studies on cognitive style. Integrating the concept of cognitive style into research on intelligence, personality, cognitive science, education, and neuroscience may enhance the development of each field. Further study of the nature and mechanisms of cognitive styles and an attempt to solve the methodological problems that have beleaguered the field to date seem to be real and necessary steps forward in understanding the dynamics of an individual's cognitive development in the context of personal abilities, needs, motives, and environmental requirements.

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