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**INDIVIDUAL DIFFERENCES IN COGNITIVE STYLES:
DEVELOPMENT, VALIDATION AND CROSS-VALIDATION
OF THE COGNITIVE STYLE INVENTORY**

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ABSTRACT

This paper aims to describe the construction and validation of a new instrument for measuring cognitive styles – the Cognitive Style Inventory (CoSI) – that is particularly useful in an organizational context. Three successive studies are conducted to validate and cross-validate the Cognitive Style Inventory. The internal consistency of the Cognitive Style Inventory is high. Factor analyses confirm the existence of four different cognitive styles. To examine convergent and discriminant validity, the following measures are used: the Myers-Briggs Type Indicator (MBTI), the Life Orientation Test (LOT), and a Likert-scale version of Rotter's Internal-External (I-E) locus of control scale. Substantial support is found for the instrument's convergent and discriminant validity. Future research and practical implications are discussed.

INTRODUCTION

Theoretical and empirical interest in cognitive styles

Kirton and McCarthy (1988) claim that cognitive styles are increasingly seen as a critical intervening variable in work performance. They conclude that identifying the cognitive climate within an organization has useful implications for the practitioner who wants to build effective teams. Talbot (1989) states that differences in cognitive styles significantly affect one-on-one and team interactions in the workplace. According to that study, identifying and understanding each employee's unique cognitive style provides an excellent opportunity to enhance individual and team performance and productivity. Hayes and Allinson (1994) describe some aspects for which knowledge of cognitive styles can be used in organizations: recruitment, task and learning performance, internal communication, career guidance and counseling, team composition and team building, conflict management, and training and development. Sadler-Smith and Badger (1998) also investigated the human resource implications of cognitive styles. They concluded that human resource practitioners have a crucial role in fostering individual versatility and in facilitating innovation through the effective management of differences in cognitive style.

A cognitive style is a fundamental determinant of individual and organizational behavior that manifests itself in individual workplace actions and in organizational systems, processes and routines (Sadler-Smith & Badger, 1998). In other words, knowing employees' cognitive styles implies that they can be placed in jobs that they like and in which they are likely to succeed. It can explain why people with the same abilities, knowledge, and skills perform differently in the organization. It also tends to improve respect for diversity in an organization. Given the usefulness of the cognitive style concept for an organization and its potential to improve management practice, it is unfortunate that it has been a relatively neglected concept in industrial and organizational psychology (Hayes & Allinson, 1994). Cognitive styles are already extensively studied in domains like education or experimental psychology (Grigorenko & Sternberg, 1995; Riding, 1997). However, our research focuses on the organizational context and work-related aspects of cognitive styles.

Defining cognitive styles

Regardless of the specific definition of cognitive style, the term 'style' usually refers to a set of habitual patterns. Cognitive style is defined by Witkin, Moore, Goodenough, and Cox

(1977) as the individual way in which a person perceives, thinks, learns, solves problems, and relates to others. Messick (1984) defines cognitive styles as consistent individual ways of organizing and processing information and experience. Hunt, Krzystofiak, Meindl, and Yousry (1989) define cognitive style as the way in which people process and organize information, and arrive at judgments or conclusions based on their observations. In the light of these definitions, we define a cognitive style as the way an individual perceives environmental stimuli, and organizes and uses information. A cognitive style influences how people look at their environment for information, how they organize and interpret this information, and how they use these interpretations for guiding their actions (Hayes & Allinson, 1998).

Measuring cognitive styles

Many diagnostic tools and questionnaires have been developed to identify differences in cognitive style. There are problems with some existing questionnaires that measure cognitive style, such as matters of validity, reliability, administration (e.g., the time needed to complete the questionnaire, and the need for trained raters), and interpretation (Allinson & Hayes, 1996; Streufert & Nogami, 1989). Allinson and Hayes (1996) raise the issue that there seems to be little or no published independent evaluation of several self-reporting instruments developed as management training tools. This applies, for instance, to the Cognitive Style Instrument (Whetten & Cameron, 1984), the BrainMap measure (Brain Technologies Corporation, 1989), the Herrmann Brain Dominance Instrument (Herrmann, 1994), and the Benziger Thinking Styles Assessment (Benziger & Sohn, 1993). A number of questionnaires also have been criticized on psychometric grounds—for example, Kolb's Learning Style Inventory (Kolb, 1976), Kirton's Adaption Innovation Inventory (Kirton, 1976), and McCarthy's Hemispheric Mode Indicator (McCarthy, 1993). Several authors state that the successive versions of the Learning Style Inventory (Kolb, 1976) have only moderate internal reliability and temporal stability (e.g., Atkinson, 1988; Freedman & Stumpf, 1978). Taylor (1989) questions the orthogonality of subscales of Kirton's Adaption Innovation Inventory (Kirton, 1976). Hartman, Hylton, and Sanders (1997) state that information on the reliability and validity of the Hemispheric Mode Indicator (McCarthy, 1993) is limited.

Moreover, there is a lack of established measures of cognitive style that can be applied in large-scale organizational studies (Allinson & Hayes, 1996). As an example of the common problems with measures of cognitive styles, we take the field dependence-independence construct, which is among the most widely studied constructs of the range of style dimensions appearing in

the literature. Measures of field dependence are impractical for use in organizations—for example, the Rod and Frame Test of Oltman (1968) or the Embedded Figures Test of Witkin, Oltman, Raskin, and Karp (1971). In addition, Streufert and Nogami (1989) summarize work that questions the validity and reliability of the Embedded Figures Test. Some measures of other dimensions, besides the field dependence-field independence construct, are just as inconvenient for use in organizations—for example, methods to assess impulsiveness versus reflection, or cognitive simplicity versus complexity. They are typically time consuming and expensive, and require trained raters to code and score the written text of the subjects. The same can be said of methods inferring style from physiological state, and methods based on the direct observation of behavior.

Dimensions of cognitive styles

Cognitive styles have been studied from various points of view. Various authors have developed their own instruments of assessment, assigning unique labels to the cognitive style under investigation. Messick (1984) distinguished 19 separate labels in his review of the literature. More recently, Hayes and Allinson (1994) have extended the list to 29. Nevertheless, two qualitatively different cognitive styles are evident among many studies. Miller (1987) states that most cognitive styles are subordinate to, and reflect, a broad stylistic difference that represents a long-established distinction between contrasting cognitive styles. The first cognitive style is commonly described using the terms analytical, deductive, rigorous, constrained, convergent, formal, and critical. The second cognitive style is commonly described using the terms synthetic, inductive, expansive, unconstrained, divergent, informal, diffuse, and creative (Nickerson, Perkins, & Smith, 1985).

These two cognitive styles are often linked to differences in hemispheric functioning ('hemispheric preference' theory), although this is also widely criticized (see further). According to Leonard and Straus (1997), the distinction between left- and right-hemisphere ways of thinking is the most widely recognized cognitive distinction. The basic assumption is that each hemisphere has different cognitive functions while processing information (Prevedi & Carli, 1987; Riding, Glass, & Douglas, 1993). Left-hemisphere thinking reflects analytical processing, while right-hemisphere thinking reflects holistic processing (Beyler & Schmeck, 1992). The left hemisphere involves rational, convergent, realistic, objective, and critical thinking. The right hemisphere involves holistic, synthetic, intuitive, analogical, divergent, and creative thinking (Al-Sabaty & Davis, 1989; Entwistle, 1981; Leonard & Straus, 1997; Prevedi & Carli, 1987).

Although the ‘hemispheric preference’ theory has been criticized (e.g., Hines, 1987; Levy, 1985), there is strong evidence for the validity of the theoretical constructs underlying this dimension (Beyler & Schmeck, 1992). Hartman et al. (1997), for instance, agree that people can be characterized as analytical or holistic according to the strengths of their skills in those areas. However, the extent to which identifiable clusters of such traits in individuals are a consequence of hemispheric lateralization is, according to these studies, a separate question. As stated by Leonard and Straus (1997), the categorization in left- and right-hemisphere thinking is more powerful metaphorically than it is accurate physiologically. Not all assumed left-hemisphere functions are actually located on the left, and the same is true for assumed right-hemisphere functions. In Hines’s (1987) view, the brain is a very complex organ, and it is wrong to think of any higher cognitive function as being localized in any one area. However, evidence is found for the two radically different ways of thinking (Entwistle, 1981; Hayes & Allinson, 1994; Miller, 1987, 1991).

Some authors do not identify one central dimension of cognitive style (‘unidimensional’ models), but investigate several dimensions (‘multidimensional’ models). Grigorenko and Sternberg (1995), for instance, created a theory of mental self-government that covers 13 cognitive styles. Taggart and Valenzi (1990) developed a human information-processing metaphor that comprises six information-processing modes. After reviewing the literature on cognitive styles, Riding and Cheema (1991) concluded that the various existing models of cognitive style can be grouped into two basic dimensions. The ‘analytic-wholist’ dimension describes the habitual way in which an individual processes information: some individuals (‘analytics’) process information into its component parts, while others (‘wholists’) retain a global or overall view of information. The second dimension, the ‘verbal-imagery’, concerns an individual’s preferred mode of representing information: whether he or she is inclined to represent information through verbal thinking (‘verbalizers’) or in mental pictures (‘imagers’). Riding (1997) found further support for this two-dimensional model.

Rowe and Mason (1987) also developed a model of cognitive styles. They identified two dimensions: cognitive complexity and individual values. Cognitive complexity deals with the issue of tolerance for ambiguity: individuals have a high or a low tolerance for ambiguity (i.e., a low or a high need for structure). Values refer to human and social concerns or to task and technical concerns. These two dimensions are combined to produce four styles (i.e., the directive style, the analytical style, the behavioral style, and the conceptual style). Rowe and Boulgarides (1992) further elaborated the model.

Herrmann's (1994) 'brain dominance theory' also distinguishes two dimensions of cognitive style. The left-brain/right-brain theory ('hemispheric preference' theory) reflects the first dimension of his model on cognitive styles. A second dimension is deduced from MacLean's (1955, 1958) 'triune brain theory'. In this theory, the cerebral cortex responds to information in the external world, and seeks novelty. The cerebral cortex employs cognitive programming, which is easily subject to change: we learn new facts, we perceive, generate and modify information. By contrast, the limbic system is the seat of the emotions, and is a powerful force with respect to interpersonal relationships and sexuality. It is the seat of our sense of family, our feeling of connectedness with others (Gorovitz, 1982; Springer, 1981; Taggart & Valenzi, 1990). A combination of both dimensions results in four separate and distinct quadrants (i.e., cerebral-left, cerebral-right, limbic-left, and limbic-right).

It can be concluded from the work of Riding and Cheema (1991), Rowe and Mason (1987), and Herrmann (1994) that two dimensions can be identified in the field of cognitive styles. The next section focuses on the Cognitive Style Inventory (CoSI).

COGNITIVE STYLE INVENTORY

Although several authors identified two dimensions of cognitive style and created their own measurement instruments, we developed the Cognitive Style Inventory (CoSI) for several reasons. Herrmann (1994) created the Herrmann Brain Dominance Instrument (HBDI), but there is a lack of independent validation of this instrument (Allinson & Hayes, 1996; Hines, 1987). The Herrmann Brain Dominance Instrument contains 120 items, which is a rather long list for use in an organizational context. Moreover, administering the HBDI requires a trained rater for scoring and interpreting the results. Riding (1991) developed the Cognitive Styles Analysis (CSA) to measure his model of cognitive styles. According to Sadler-Smith and Badger (1998), the relevance to workplace behaviors of the verbal-imagery style dimension of Riding and Cheema (1991) is unclear. Rowe and Mason (1987) developed the Decision Style Inventory (DSI) to measure their model. We did not use their instrument because of the different way in which the central dimensions are defined in that inventory.

The metaphorical concept underlying the Cognitive Style Inventory (CoSI) consists of two fundamental cognitive style dimensions: analytical versus holistic thinking, and conceptual versus experiential thinking (Leonard & Straus, 1997). According to the first dimension, an individual can be either an analytical thinker (rational, logical, critical, tending to retain facts and details) or a holistic thinker (intuitive, synthetic, creative, open to experience, able to integrate several

simultaneous inputs). The second dimension differentiates between conceptual thinkers, who like to think on a more abstract and conceptual level, and experiential thinkers, who like to think on a more pragmatic and experiential level. Combining these two dimensions yields four cognitive styles: the knowing style, the planning style, the creative style, and the cooperating style. These four styles build up the framework of the CoSI.

Individuals who utilize a knowing style (analytical and conceptual) look for facts and data. They want to know exactly the way things are, and tend to retain many facts and details. They are task-oriented and accurate, and like complex problems if they can find a clear and rational solution. The planning style (analytical and experiential) is characterized by a need for structure. Planners like to organize and control, and prefer a well structured work environment. They attach great importance to preparation and planning to reach their objectives. They tend to be risk averse. They strongly want other people to respect rules and agreements. The creative style, by contrast, is characterized by holistic and conceptual thinking. Individuals who utilize this style tend to be creative and to like experimentation. They tend to see problems as opportunities and challenges. They do not like rules and procedures, and like uncertainty and freedom. They prefer to think on a conceptual level and are less interested in the practical implementation of ideas. They are ambitious and achievement oriented. The fourth cognitive style is the cooperating style (holistic and experiential). Cooperating people attach great importance to communication and interpersonal relationships. They prefer to think on a pragmatic and experiential level. They take people into account whenever they make decisions. They assemble information by sensing, listening, and interacting with others. They like teamwork and attach great importance to team spirit and cooperation.

In this article, we describe the construction, validation and cross-validation of the CoSI. The CoSI attempts to provide answers to the two major problems that have been identified with respect to cognitive style measures (i.e., firstly, problems of validity, reliability, administration, and interpretation, and secondly, the lack of established measures for use in organizations). We report the results of various studies that we conducted to develop a psychometrically sound instrument for use in organizations. Through the development and administration of the instrument, we also attempt to empirically confirm the existence of four cognitive styles.

DEVELOPMENT OF AN INSTRUMENT

We conducted several successive studies to develop, validate and cross-validate the CoSI. First, three different studies are described that attempted to establish a reliable and valid instrument for measuring cognitive styles. Second, we refer to the convergent and discriminant analyses we conducted to cross-validate the CoSI. For this purpose, three different measures were used: the Myers-Briggs Type Indicator, a measure of optimism (the Life Orientation Test), and a measure of locus of control (a Likert-scale version of Rotter's Internal-External scale).

Structure, reliability, and validity analyses

Study 1

Based on the existing literature on cognitive styles and several two-dimensional models of cognitive style (e.g., Herrmann, 1994; Riding & Cheema, 1991; Rowe & Mason, 1987), we developed a self-reporting questionnaire. The aim was to produce a set of items measuring the four cognitive styles and to extract from the questionnaire four set of items, each indicative of one of the four styles.

We generated 25 items from an initial pool that covered the four cognitive styles. The three authors reached consensus on the clarity, appropriateness, and content validity of these items. The response format was a five-point Likert scale (1 = totally disagree, and 5 = totally agree), allowing ratings of the extent to which each item applies to each respondent.

Sample

The questionnaire was published in a leading human resources magazine. We gathered responses from 15,616 participants with a wide range of employment and educational backgrounds. Sixty-one percent of respondents were men, and 39 percent were women. Their ages ranged from 20 years to over 55 years, with 30 percent between 26 and 35 years, and 29 percent between 36 and 45 years. Ninety percent of participants worked full time, and 10 percent part time. Fifty-eight percent worked for the private sector, and 42 percent for the public sector.

Item selection

The original 25-item version was subjected to an initial process of item selection. The individual items needed to have an item-total correlation of more than 0.30, a criterion derived from Kring, Smith, and Neale (1994). Twenty of the 25 items met the initial selection criterion.

The two scales from which it was necessary to exclude items were those that measured the knowing style and the cooperating style.

Reliability

We used the Cronbach alpha coefficient to test for reliability. Nunnally (1978) suggests that an alpha coefficient of 0.70 is an acceptable threshold. The results of the reliability analysis indicated that two scales met the criterion of 0.70. The planning style had a coefficient of 0.76 and the creative style had a coefficient of 0.81. The two other scales had a coefficient of 0.62 (the knowing style) and of 0.59 (the cooperating style) and needed some adjustments. As some of the items turned out to be ambiguous (i.e., applicable to more than one cognitive style), they were removed and replaced with new items.

Factor analysis

To determine whether the structure of the questionnaire reflected four different scales (cognitive styles), a principal component exploratory factor analysis rotated to a varimax solution was chosen (Hurley et al., 1997). The analysis yielded four factors, accounting for 43.5 percent of the variance. Items with a factor loading of 0.50 or less were excluded, according to the method used by Becker and Bös (1979). The results of the factor analysis confirmed the previous findings of the reliability analysis. Two of the four scales (the knowing style and the cooperating style) failed to meet the criterion because they contained several items with a factor loading of less than 0.50.

On the basis of the three analyses (item selection, reliability, and factor analysis), we decided to adjust the questionnaire. Several items were removed and replaced by new ones. Table 1 shows the results of the item selection and the factor analysis of the two problematic scales. Factor 3 refers to the knowing style and Factor 4 to the cooperating style.

Insert Table 1 About Here

Study 2

Sample

We published our adjusted questionnaire in the same human resources magazine. We gathered responses from 6,358 individuals. The sample varied widely. Fifty-eight percent of the respondents were men, and 42 percent were women. With respect to their age, 42 percent of

respondents were aged between 26 and 35 years, and 24 percent between 36 and 45 years. 93 percent worked full time, and 33 percent had a management job. As in Study 1, the respondents have a wide range of careers and educational backgrounds.

Item selection

The adapted questionnaire contained 24 items. The items related to the knowing and cooperating styles that failed to meet the criterion for item selection and had a factor loading lower than 0.50 were omitted. Items related to the planning and creative styles that were either ambiguous or too general were also omitted. Several new items were added to improve the quality of the questionnaire. All 24 items met the criterion for item selection, this means they had an item-total correlation of more than 0.30.

Reliability

The results of the Cronbach alpha analysis indicated that all four scales were reliable, with a coefficient of 0.73 for the knowing style, 0.82 for the planning style, 0.77 for the creative style, and 0.78 for the cooperating style. Compared to the reliability results of Study 1, the results of Study 2 were much more significant. None of the scales had a reliability lower than 0.70, the acceptability threshold suggested by Nunnally (1978).

Factor analysis

The principal component exploratory factor analysis rotated to a varimax solution yielded four factors, accounting for 49.88 percent of the variance. All of the items had factor loadings higher than 0.50, except for one item in the cooperating style (i.e., 'I pay a lot of attention to how other people react to proposals'), for which the factor loading was 0.46. We decided to leave this item in the questionnaire as it met all of the other criteria, and because the factor loadings on the other factors were significantly lower (0.13, 0.19, and 0.14).

Study 3

Sample

A third study was conducted to reconfirm the results of Study 2. The sample consisted of 231 students of whom 134 had several years of work experience and 97 had no work experience. Seventy-three percent were men, and 27 percent were women. The inclusion of student samples was justified by the fact that in psychometric analysis, the relationships between items is important, rather than the levels of mean scores (Allinson & Hayes, 1996). Moreover, a large number of the students had work experience, most pursuing part-time study while working.

Item selection

The same questionnaire was used as in Study 2. Three items were added to improve the quality of the questionnaire: one item related to the knowing style and two items related to the creative style. All of the items met the criterion for item selection: this means they had an item–total correlation of more than 0.30 (see Table 2).

Reliability

The results of the Cronbach alpha analysis indicated that all the scales were reliable, with a coefficient of 0.77 for the knowing style, 0.82 for the planning style, 0.81 for the creative style, and 0.80 for the cooperating style. These results indicate that the CoSI has a high level of internal consistency and is highly reliable.

Factor analysis

A principal component exploratory factor analysis with varimax rotation was used to determine whether the four cognitive styles were implicit in the structure of the questionnaire. The analysis revealed that four factors accounted for 49.45 percent of the variance. All factor loadings were higher than 0.50. The first factor in Table 2 refers to the creative style, the second factor to the planning style, the third factor to the cooperating style, and the fourth factor to the knowing style.

Insert Table 2 About Here

Convergent and discriminant validity

To be valid, a test had to be related to conceptually similar measures (convergent validity) and unrelated to conceptually dissimilar constructs (discriminant validity) (Campbell and Fiske, 1959). To examine convergent and discriminant validity, we chose the Myers–Briggs Type Indicator (MBTI) (Myers, 1962), the Life Orientation Test (LOT) (Scheier & Carver, 1985), and a Likert-scale version of Rotter’s (1966) questionnaire on Locus of Control.

Myers–Briggs Type Indicator (MBTI)

The Myers–Briggs Type Indicator is an operationalization of Jung’s psychological theory. The MBTI is primarily concerned with the individual differences that result from where people like to focus their attention, the way they like to take in information, the way they like to make

decisions, and the kind of lifestyle they have adopted (Briggs–Myers, 1990). The MBTI measures personality on four dimensions: introversion–extraversion, sensing–intuiting, thinking–feeling, and perceiving–judging (Leonard, Scholl, & Kowalski, 1999). The evidence concerning the reliability and validity of the MBTI suggests that the estimated reliabilities of type categories are satisfactory in most cases (Carlyn, 1977). Carlyn (1977) also states that the MBTI appears to be a reasonably valid instrument and is potentially useful for a variety of purposes. Gardner and Martinko (1996) conclude from their review article on the MBTI that there is sufficient reliability and validity evidence to conclude that the instrument may be a valuable tool for research into relationships among managerial personalities, cognition, behaviors, effectiveness, and situational variables.

We administered the complete MBTI form (Myers, 1962). With regard to cognitive styles, however, two dimensions are particularly relevant: sensing–intuiting and thinking–feeling (Davis, Grove, & Knowles, 1990). We focused only on these two dimensions, which combine to form four cognitive styles, often referred to as ‘decision styles’ in the literature (Gardner & Martinko, 1996).

The sensing–intuiting dimension expresses how people perceive the world and how they take in information, while the thinking–feeling dimension measures how people judge and make decisions (Gardner & Martinko, 1996). ‘Sensing’ individuals are more factual, realistic, practical, and here-and-now-oriented, while ‘intuiting’ individuals are more conceptual, theoretical, and tend to emphasize interpersonal relationships and possibilities (Briggs–Myers, 1990). Beyler and Schmeck (1992) report that higher scores on sensing are related positively to measures of a proper, rule-bound attitude. Intuiting people were found to be flexible and creative. Gryskiewicz and Tullar (1995) found a significant positive correlation between intuiting and an innovative creativity style. Based on these findings, it was hypothesized (Hypothesis 1) that the planning style is positively correlated with sensing, and negatively with intuiting. It was also hypothesized that the creative style is positively correlated with intuiting, and negatively with sensing. We expected no relationship between the knowing style and the cooperating style on the one hand, and between sensing and intuiting on the other hand.

Thinkers are precise, logical, analytical, objective, and impersonal, while feelers tend to be subjective and personal, like harmony based on common values, and dislike intellectual analysis (Briggs–Myers, 1990). Beyler and Schmeck (1992) found a preference among thinking individuals for abstraction and logic and a preference among feeling individuals for the use of global values in decision making. Gardner and Martinko (1996) report that thinkers are logical and impersonal, while feelers are more affective, cooperative, and personal. It is therefore hypothesized (Hypothesis 2) that the knowing style will be positively correlated with thinking and negatively

with feeling. It is also hypothesized that the cooperating style will be positively correlated with feeling and negatively with thinking. We expect no relationship between the planning style and the creative style on the one hand and thinking and feeling on the other hand.

Hypothesis 1: The planning style correlates positively with sensing and negatively with intuiting, while the creative style correlates positively with intuiting and negatively with sensing. There is no relationship between the knowing and cooperating styles on the one hand, and the sensing–intuiting dimension on the other.

Hypothesis 2: The knowing style correlates positively with thinking and negatively with feeling, while the cooperating style correlates positively with feeling and negatively with thinking. There is no relationship between the planning and creative styles on the one hand, and the thinking–feeling dimension on the other.

Hypothesis 1 was confirmed (Table 3). The planning style was positively correlated with sensing ($r = 0.40$, $p < 0.01$) and negatively with intuiting ($r = -0.23$, $p < 0.01$). The creative style, on the other hand, was positively correlated with intuiting ($r = 0.35$, $p < 0.01$) and negatively with sensing ($r = -0.53$, $p < 0.01$). There was no significant relationship between the knowing and cooperating styles on the one hand, and sensing and intuiting on the other hand. Participants scoring highly on the planning style like rules and regulations, step-by-step explanations, and doing things the way they always did. They do not like ambiguous problems and trying out new ways of doing things. They attach much importance to predictability and clear agreements. Planning types are very good in following up on plans, but much less flexible in ad hoc correction thereof. The opposite is true for people scoring highly on the creative style. These individuals are holistic thinkers. They are spontaneous, open minded, and prefer dynamic structures. They become restless and impatient with routines. They are strong in creativity and are constantly searching for hidden possibilities and new horizons.

Hypothesis 2 was also confirmed, except for the correlation between the knowing style and feeling (see Table 3), which was negative as expected, although not statistically significant ($r = -0.05$, $p = 0.45$). There was a significant positive correlation between the knowing style and thinking ($r = 0.19$, $p < 0.01$). The cooperating style was positively correlated with feeling ($r = 0.18$, $p < 0.05$) and negatively correlated with thinking ($r = -0.55$, $p < 0.01$). No significant relationship was found between the planning style and the creative style on the one hand, and thinking and feeling on the other hand. Participants scoring highly on the knowing style are concerned with principles, laws, and objective criteria. They prefer objective analysis, decisions based on standards and policies, and are brief and businesslike. Participants scoring highly on the cooperating style are interested in the feelings of others. They enjoy working with people, are

capable of great loyalty, and avoid disharmony. In contrary to people scoring highly on the thinking subscale, they use subjective decision criteria and are influenced by their own and others' personal likes and dislikes. They dislike telling people unpleasant things and enjoy pleasing others.

Insert Table 3 About Here

The Life Orientation Test (LOT)

We used the Life Orientation Test (LOT) (Scheier & Carver, 1985) as a second test to cross-validate the CoSI. The LOT is a 12-item scale developed to measure dispositional optimism: this means the extent to which individuals possess favorable expectations regarding life outcomes. Scheier and Carver (1985) report a Cronbach alpha of 0.76 for the scale, and a test–retest reliability coefficient of 0.79 (over a four-week interval). The LOT has also been found to have adequate construct validity (Scheier & Carver, 1985).

Schweizer, Beck-Seyffer, and Schneider (1999) regard optimism as a specific style of information processing, which serves the management of emotions and gives rise to cognitive bias. Optimists may be more open to information suggesting positive outcomes, and pessimists to information suggesting negative outcomes, or both groups may differ according to their standards in the appraisal of information. According to Sarmany (1992), the optimism–pessimism dimension can be considered as one of the possible regulators of various strategies in solving problem situations. As optimism/pessimism is regarded as a specific style of information processing, we decided to use the LOT to validate the CoSI. Of all the scales that are developed to measure optimism, the LOT has received the most attention.

Optimists tend to be favorable in their outlook, to expect things to go their way, and generally to believe that good things will happen. Pessimists, on the other hand, tend to expect bad outcomes (Scheier & Carver, 1985). Scheier and Carver (1992) found that optimists renew their efforts to attain set goals when a disruption of goal-directed activities occurs, while pessimists lose vigor or even disengage from further goal-directed efforts. Optimists tend to be active copers when confronted with problems, and they seek social support, use humor, and positively reframe a situation. By contrast, pessimists are more passive copers, who are more prone to give up under adversity (Scheier, Weintraub, & Carver, 1986). In his study on the relationship between cognitive styles and optimism, Sarmany (1992) found a correlation between optimism and a heuristic orientation, which is the tendency to cope with a situation in a principally new way (holistic thinking). That study also found a correlation between pessimism and an algorithmic orientation,

which is the tendency to cope with a situation and solve it in a routine way (analytical thinking). Fandelova (1999) also found a positive correlation between optimism and a cognitive style with a heuristic orientation. Based on these findings, it was hypothesized that holistic thinkers (cooperating and creative style) will be optimistic, and analytical thinkers (knowing and planning style) will be pessimistic (Hypothesis 3).

Hypothesis 3: People with a creative and a cooperating style are optimistic, while people with a knowing and a planning style are pessimistic.

Hypothesis 3 was only partly confirmed, as can be seen in Table 3. A significant positive correlation is found between the creative and cooperating styles on the one hand, and optimism on the other hand (creative style, $r = 0.29$, $p < 0.01$; cooperating style, $r = 0.25$, $p < 0.01$). A significant positive correlation was found between the planning style and pessimism ($r = 0.27$, $p < 0.01$). No significant correlation, however, was found between the knowing style and optimism ($r = -0.03$, $p = 0.64$) and pessimism ($r = 0.03$, $p = 0.69$). Participants with a high score on the creative style see problems as challenges or opportunities. They like uncertainty and believe in the positive outcome of their ideas. Participants scoring highly on the cooperating style look at the world from a positive viewpoint. They are interested in others and believe in the 'goodness' of people. Participants with a high score on the planning style, on the other hand, have difficulty with unexpected changes, are self-critical, and are inclined to think in terms of worst case scenarios. With regard to the knowing style, no significant correlation was found. People with a high score on the knowing style can be characterized as realists. They are broad and independent thinkers, and they look for the correct facts and figures, and for precision and accuracy in the external world. They want to analyze things in an objective manner in all useful dimensions.

Internal–External (I–E) locus of control scale

The third test that we used to cross-validate the CoSI involved locus of control (Rotter, 1966). Locus of control refers to the extent to which people attribute the source of control over events to themselves or to their external circumstances (Lefcourt, 1982; Rotter, 1966; Spector, 1982). Locus of control is related to motivation, effort, performance, satisfaction, perception of one's job, compliance with authority, and supervisory style (Spector, 1982). Locus of control is therefore an important variable for the explanation of human behavior in organizations (Spector, 1982). Accordingly, we decided to use locus of control in the validation of the CoSI. We used a Likert-scale version (Ashkanasy, 1985) of Rotter's (1966) Internal–External (I–E) scale, as

Rotter's scale is the most widely used instrument for measuring locus of control (Spector, 1982). A higher score on this scale reflects higher internality.

Rotter (1966) found that people with an internal locus of control ('internals') see themselves as active agents, trust in their capacity to influence the environment, and assume that they can control events in their lives by effort and skill. People with an external locus of control ('externals') see themselves as passive agents and believe that events in their lives and things that they want to achieve are subject to uncontrollable forces, luck, chance, and powerful others (Boone, De Brabander, & Van Witteloostuijn, 1996). Externals have a tendency to avoid challenges (De Brabander, Hellemans, Boone, & Gerits, 1996). Boone et al. (1996) report that internals respond in a problem-solving way in the face of stressful events, while externals are inclined to withdraw from a problem in such a context. Spector (1982) claims that internals tend to perceive more alternatives in a situation involving choices than externals do. Scheier and Carver (1985) report that people who scored more highly on optimism had both a more internal locus of control and a higher self-esteem. De Brabander et al. (1996) report that people with an external locus of control are more sensitive to negative events. In line with the theory of optimism/pessimism, we hypothesized that holistic thinkers (creative and cooperating style) have an internal locus of control, and that analytical thinkers (knowing and planning style) have an external locus of control (Hypothesis 4).

Hypothesis 4: People with a creative and a cooperating style will have an internal locus of control, while people with a knowing and a planning style will have an external locus of control.

This hypothesis was not confirmed (Table 3). The creative style was positively correlated with an internal locus of control (although the correlation was not significant) ($r = 0.12$, $p = 0.10$), while the cooperating style is negatively correlated with an internal locus of control ($r = -0.18$, $p < 0.05$). The negative correlation between the cooperating style and an internal locus of control can be explained as follows. People with a cooperating style like to take others into account and try to reach consensus. They tend to sympathize and become heavily involved emotionally with both individuals and events. They also tend to be more compliant with respect to social demands. As a consequence, they cannot control all of the events in their lives (external locus of control). No significant correlation was found between the knowing and the planning styles on the one hand, and locus of control on the other hand (knowing style, $r = 0.04$, $p = 0.61$; planning style, $r = -0.01$, $p = 0.88$). This suggests that people with a strong knowing or planning style can have either an internal or an external locus of control, or a balance between the two. We believe that a possible explanation here is that both types of individual tend to have an internal locus of control when they live or work in a context that fits their strong points. On the other hand, they tend to have an

external locus of control when they face an environment where they do not feel comfortable and at ease. Taken together, this suggests that there is no significant correlation between the knowing and the planning styles and locus of control. For instance, people with a knowing style like facts and figures and want to analyze information in an objective manner. When it is possible to work with facts and figures and to make an objective analysis, they feel that they can control what happens to them (internal locus of control). If, however, they are confronted with more subjective challenges, it is harder for them to control the situation and they tend to attribute outcomes to environmental causes (external locus of control).

The same reasoning applies to the planning style. People with a planning style have a high need for structure and certainty, and like to organize and plan. When they are acting in an environment in which they are able to do so, they believe that they themselves can control the events and consequences that affect their lives (internal locus of control). However, when they are faced with an environment where much flexibility is required and in which they cannot exercise their planning instincts, they tend to have an external locus of control, and believe that they are dependent on circumstances or on (more powerful) others.

CONCLUSION

As discussed in the introduction, there is much theoretical and empirical interest in cognitive styles. Understanding cognitive styles is nowadays particularly important for organizations owing to the ever-increasing pace of change that typically demands that individuals quickly develop the ability to work together (Leonard & Straus, 1997). In addition, Allinson and Hayes (1996) claim that there can be no doubt concerning the potential value of cognitive style in the study of organizational behavior and the understanding of management problems. We believe that cognitive style can be an additional concept to explain and understand individual differences in the workplace. Knowledge of cognitive styles and the differences between them can help practitioners to enhance individual and team performance and productivity.

Given the relevance and usefulness of the cognitive style concept for organizations, the objectives of this study were twofold. The first was to develop a psychometrically sound instrument to measure cognitive style. This objective fits very well the call of Riding (2000) to develop simple, valid, and direct measures of cognitive style. The three subsequent studies reported here have led to a reliable and valid questionnaire. The selected items all have an item-total correlation higher than 0.30. The questionnaire is highly reliable, with Cronbach alpha

coefficients ranging from 0.77 to 0.82. The CoSI also has a clear factor structure: four factors with factor loadings higher than 0.50. Moreover, the questionnaire is particularly relevant for use in organizations, given its length (27 items) and the short time required to complete it (approximately 10 minutes).

Second, the study aimed to confirm empirically the existence of four cognitive styles through the development of the questionnaire. Traditionally, cognitive style research focuses mainly on the distinction between analytical and holistic thinking. Riding (2000), however, refers to the desirability for cognitive style research of recognizing and confirming the fundamental cognitive style dimensions within the existing large and extensive body of style labels. The convergent and discriminant validity analyses in our research clearly indicate the relevance and usefulness of distinguishing four cognitive styles rather than two. It shows evidence for a two-dimensional model instead of a unidimensional model (analytical versus holistic thinking). Leonard et al. (1999) also concluded from their study on the interrelationships among four measures of cognitive styles, that cognitive style is a complex variable with multiple dimensions. Like Rowe and Mason (1987) and Power, Kummerow, and Lundsten (1999), who also investigated the relationship between their cognitive style measure and MBTI, we found a significant relationship between some MBTI types and our cognitive styles. We identified a difference between the knowing style (positively correlated with thinking) and the planning style (positively correlated with sensing), which are both analytical thinkers. With regard to the holistic thinkers, we also identified a difference: the cooperating style is positively correlated with feeling, while the creative style is positively correlated with intuiting. These results confirm the importance of the second dimension (conceptual versus experiential).

Two types of analytical thinker and two types of holistic thinker were thus identified. These findings are confirmed by the research of Leonard et al. (1999). Studying the relationship between the DSI (Decision Style Inventory) and the MBTI, they found that only one dimension of the MBTI was related to each of the decision-making styles. The hypotheses of Rowe and Boulgarides (1992) that link two dimensions of Myers–Briggs to each of the decision-making styles were not confirmed. More evidence for the distinction between four cognitive styles was found by using the LOT to measure dispositional optimism and locus of control. With regard to analytical thinkers, a clear difference was found on the optimism–pessimism scale. While the planning style was clearly correlated with pessimism, the knowing style was not related at all. On the other hand, no difference was found between the two types of analytical thinker with respect to locus of control. For holistic thinkers, however, a clear difference in locus of control was found: the cooperating style was negatively correlated with an internal locus of control while the creative

style was not. While there was a clear difference with regard to locus of control, the creative and cooperating styles did not differ with regard to the optimism–pessimism scale. They were both positively correlated with optimism.

Taken together, we can conclude from our analyses that there is evidence for distinguishing between two types of analytical thinker (i.e., knowing and planning) and two types of holistic thinker (i.e., creative and cooperating). Although the correlation between the two analytical types (the knowing and the planning style) is high ($r = 0.28$, $p < 0.01$), it is encouraging that these types differed considerably in their relationship with the MBTI types and with the optimism–pessimism measure. However, further research concerning these four cognitive styles is necessary. It may also be interesting to investigate further the relationship between locus of control, optimism and pessimism, and the cognitive styles, just as for the possible causal connections between these concepts. Riding (2000) also calls for future research concerning the relationship between style and other individual difference constructs and measures that may influence our behavior. Research on the origins of cognitive style may also be useful (Riding, 1997): are they inherent or do they develop with experience?

Although the CoSI clearly has potential and may contribute to the continuation of cognitive style research, some limitations of this research should be noted. The CoSI is a self-reporting questionnaire, which implies that the participants can unduly influence the result. A self-report measurement also relies on participants' being able to introspect themselves accurately and not to allow their responses to be contaminated by their notions of social desirability. The true test of an instrument's validity, however, will be to validate the data that it generates against objectively observable behavior (Leonard et al., 1999; Riding, 2000). Theories make clear predictions about how individuals are likely to approach an actual situation; little, however, is done to develop a typology of actual behavior and to measure these variables (Leonard et al., 1999). Additional instruments can also be used in future research to cross-validate the CoSI further. We used the MBTI, the LOT, and Rotter's I–E scale of locus of control. Other possibilities are, for instance, the use of measures of values, other questionnaires on cognitive styles, and measures of learning styles. To further increase the practical relevance of cognitive styles and to take advantage of the limitations of this study, such further research is necessary.

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TABLE 1

Item mean, item–total correlation, and factor loadings for the items of the knowing style and the cooperating style, Study 1

Item	M	r	Factor 3	Factor 4
I like quantitative data.	3.31	0.27 ^a	0.09^b	–0.26
I like to know the underlying principles and theories.	3.98	0.45	0.67	0.06
I like to analyze problems.	4.02	0.53	0.68	0.03
I long for as much technical expertise as possible.	3.56	0.35	0.30^b	–0.26
I am very good at seeing inconsistencies and weaknesses in other people’s arguments.	3.63	0.23 ^a	0.29^b	–0.11
I admire encyclopedic knowledge.	3.31	0.14 ^a	0.28^b	0.05
I never give up until I understand everything.	3.66	0.41	0.55	0.15
I prefer to consult others before I take a decision.	3.81	0.29 ^a	–0.19	0.36^b
I like to coach other people.	3.81	0.20 ^a	–0.19	0.03^b
I like to work with others.	4.05	0.36	–0.32	0.32^b
I am very sensitive to emotions.	3.92	0.31	0.09	0.71
I take other people’s feelings into account during teamwork.	3.89	0.44	–0.07	0.72
I am very sensitive to other people’s problems.	3.50	0.38	0.15	0.72

Note: Factor loadings of the corresponding items within the scale are in bold face.

^a Items with an item–total correlation of less than the criterion of 0.30.

^b Items with a factor loading of less than the criterion of 0.50.

TABLE 2

Item mean, item–total correlation, and factor loadings for the items of the Cognitive Style Inventory, Study 3

Item	M	r	Factor 1	Factor 2	Factor 3	Factor 4
I want to have a full understanding of all problems.	3.67	0.49	0.06	0.02	0.12	0.69
I like to analyze problems.	3.75	0.60	0.02	0.05	-0.08	0.74
I make detailed analyses.	3.18	0.57	-0.10	0.28	-0.13	0.67
I study each problem until I have understood the underlying logic.	4.00	0.52	0.06	0.17	0.02	0.69
I like to know the underlying principles and theories.	3.60	0.54	-0.08	-0.02	-0.13	0.73
Developing a clear plan is very important to me.	3.43	0.70	-0.21	0.78	0.01	0.06
I always want to know what should be done when.	2.97	0.49	-0.22	0.55	-0.03	0.08
I like detailed action plans.	2.93	0.69	-0.14	0.78	-0.09	0.08
I prefer clear structures to do my job.	3.15	0.57	-0.44	0.54	0.06	0.25
I prefer well prepared meetings with a clear agenda and strict time management.	3.92	0.54	-0.04	0.71	-0.05	0.17
I make definite engagements, which I follow up meticulously.	3.29	0.47	-0.05	0.61	0.12	0.19
A good task is a well prepared task.	3.16	0.45	-0.10	0.61	-0.03	-0.12
I like to contribute to innovative solutions.	4.15	0.48	0.71	0.13	0.07	0.02
I like to look for creative solutions.	3.79	0.58	0.69	-0.16	0.02	0.11
I am motivated by ongoing innovation.	4.12	0.64	0.69	-0.21	0.18	-0.04
New ideas attract me more than existing solutions.	4.15	0.58	0.69	-0.18	0.10	0.06
I like to extend the boundaries.	4.24	0.47	0.58	0.03	0.16	-0.07
I try to avoid routine.	3.75	0.44	0.52	-0.24	-0.11	-0.24
I like to take risks.	3.70	0.50	0.55	-0.28	-0.03	-0.05
Creative alternatives are my specialty.	3.23	0.60	0.67	-0.28	-0.10	0.06
I pay a lot of attention to how other people react to proposals.	3.58	0.47	-0.12	-0.08	0.59	0.07
I put a lot of energy into respecting other people’s personal feelings and opinions.	3.51	0.54	-0.04	-0.02	0.66	-0.04
Collaboration with others gives me energy.	3.93	0.63	0.08	0.02	0.77	-0.12
I like to help others.	4.00	0.50	-0.07	-0.04	0.67	0.10
Resolving problems should be a consultative process.	3.96	0.47	0.14	0.17	0.60	-0.08
I like meeting other people.	4.16	0.54	0.17	-0.02	0.68	-0.09
I like working with other people.	4.08	0.55	0.08	-0.03	0.73	-0.15

Note: Factor loadings of the corresponding items within the scale are in bold face.

TABLE 3**Pearson product–moment correlations between cognitive styles and MBTI, LOT, and locus of control**

	1	2	3	4	5	6	7	8	9	10	11
1. Knowing style	–										
2. Planning style	0.28**	–									
3. Creative style	–0.12	–0.47**	–								
4. Cooperating style	–0.13	–0.02	0.12	–							
5. MBTI sensing	0.08	0.40**	–0.53**	–0.02	–						
6. MBTI intuiting	–0.004	–0.23**	0.35**	0.02	–0.51**	–					
7. MBTI thinking	0.19**	0.09	–0.08	–0.55**	0.16*	–0.22**	–				
8. MBTI feeling	–0.05	–0.04	0.04	0.18*	–0.05	0.25**	–0.35**	–			
9. LOT optimism	–0.03	–0.21**	0.29**	0.25**	–0.11	0.02	–0.14	0.04	–		
10. LOT pessimism	0.03	0.27**	–0.17*	–0.02	0.24**	–0.08	0.04	–0.03	–0.32**	–	
11. Locus of control	0.04	–0.01	0.12	–0.18*	0.09	–0.11	0.22**	–0.10	0.10	0.04	–

Note: * $p < 0.05$; ** $p < 0.01$; two-tailed