The Nature and Effects of Cognitive Style

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INTRODUCTION

This chapter begins with a consideration of the labels used by investigators to describe cognitive style and proposes a categorization of these into two fundamental style dimensions: the wholist–analytic and verbal–imagery. Methods of assessing style are outlined and a simple direct method is described. Style is then examined within the context of other individual difference variables such as intelligence, gender, and personality to establish its independence of these dimensions. The bipolar nature of cognitive style, which distinguishes it from unipolar dimensions of individual difference such as intelligence, is detailed. The evidence for the physiological aspects of style is described. Next, the relation between the style dimensions and a range of behaviors relevant to education is reported and practical implications are explored. Finally, a model of style within the context of other individual difference variables is considered.

COGNITIVE STYLE AND ITS ASSESSMENT

The Style Dimensions

Over the last 60 years, investigators have reported many style dimensions. However, generally, the researchers developed their own instruments for assessment in their own contexts and gave their own labels to the style they were studying with little reference to the work of others. Predictably, this produced a large number of style labels. Taken at face value, this produced a situation that gave the impression there were many style dimensions. If this had been the case, these labels would have been of little practical value for education. Conveniently, several researchers sensed that many labels are only different conceptions of the same dimensions (e.g., Brumby, 1982; Coan, 1974; Fowler, 1980; Miller, 1987; Riding & Buckle, 1990). Riding and Cheema (1991), after reviewing the descriptions, correlations, methods of assessment, and effect on behavior of more than 30 labels, concluded they could be grouped into two fundamental cognitive style dimensions, which they termed wholist–analytic and verbal–imagery. This view was confirmed in a further review by Rayner and Riding (1997). The identification of just two basic dimensions is significant because it makes the practical application of style viable. Cognitive style is seen as an individual’s preferred and habitual approach to both organizing and representing information (Riding and Rayner, 1998, p.8). These two dimensions of cognitive style, shown in Fig. 3.1, may be described as follows: the wholist–analytic style dimension of whether an individual tends to organize information in wholes or parts, and the verbal–imagery style dimension of whether an individual tends to represent information verbally or in mental pictures.

Assessment of Cognitive Style

Two approaches have been used to assess style: introspective self-report and tests of information processing based on the assumption that performance is affected by style. The latter is argued to be preferable because introspective self-report measures
have inherent weaknesses. These include the subject’s possible inability to accurately and objectively report his or her behavior, unwillingness to make the necessary effort to respond accurately, and bias due to the pressure of social desirability in making responses (e.g., Kline, 1995, p. 512).

However, the information-processing approach is not without its problems. In terms of the wholist–analytic dimension, Witkin et al. (1971) used the EFT, which asked subjects to locate simple geometrical figures within more complex figures in a given time. This was intended to assess field dependence–independence, and Witkin et al. assumed field-independent individuals would be able to locate items more quickly than field-dependent individuals. A limitation of this approach was that no subtest was used on which the field-dependent individuals were likely to perform better than the field-independent individuals. It may be objected that the EFT assesses intelligence rather than style, because overall performance is also affected by general ability or 'intelligence' (e.g., Flexer & Roberge, 1980; Goldstein & Blackman, 1978, pp. 183–184; Riding, & Pearson, 1994 pp. 419–420 1994.). For the verbal–imagery dimension, Delaney (1978) used tests of both verbal and spatial performance. However the results were used independently of one another and not together, by means of a ratio or a difference.

The method proposed by Riding (1991a) in developing the cognitive styles analysis (CSA) was to assess performance on simple tasks that might then be representative of processing generally, with the intention of measuring an individual’s position on both the wholist–analytic and the verbal–imagery dimensions. The background to the development of the CSA was given in Riding and Cheema (1991). The CSA is computer presented, directly assesses both ends of the wholist–analytic and verbal–imagery dimensions, and comprises three subtests. The first assesses the verbal–imagery dimension by presenting 48 statements one at a time to be judged true or false. Half of the statements contain information about conceptual categories (e.g., spring is a season), and half describe the appearance of items (e.g., snow is white). Half of the statements of each type are true. It was assumed imagers would respond more quickly to the appearance statements, because the objects could be readily represented as mental pictures and the information for the comparison could be obtained directly and rapidly from these images. It was assumed verbalizers would respond more quickly to conceptual category items because the semantic conceptual category membership is verbally abstract in nature and cannot be represented in visual form. The computer records the response time to each statement and calculates the verbal–imagery ratio. A low ratio indicates a verbalizer and a high ratio indicates an imager, with the intermediate position described as bimodal. In this approach, individuals have to read both the verbal and the imagery items so that reading ability and reading speed are controlled for.

The second two subtests assess the wholist–analytic dimension. The first of these presents items containing pairs of complex geometrical figures that the individual is required to judge either the same or different. Because this task involves judgments about the overall similarity of the two figures, it was assumed that a relatively fast response to this task would be possible by wholists. The second subtest presents items each comprising a simple geometrical shape (e.g., a square or a triangle) and a complex geometrical figure, and the individual is asked to indicate whether the simple shape is contained in the complex shape by pressing one of two marked response keys. This task requires a degree of disembedding of the simple shape from within the complex geometrical figure to establish that it is the same as the stimulus simple shape displayed. It was assumed analytics would be relatively quicker at this. Again, the computer records the latency of the responses and calculates the wholist–analytic ratio. A low ratio corresponds to a wholist and a high ratio corresponds to an analytic. Ratios between these positions are labeled intermediate. It should be noted that each style dimension is a continuum, and subsequently labels will only be attached to ranges on a dimension for convenience. This is shown in Fig. 3.1.

![Fig. 3.1. The groupings of cognitive style.](image)

The CSA provides a simple method of determining a person’s position on the two fundamental cognitive style dimensions (Riding, 1991b). The test has several features in that it is an objective test, as defined by Cattell and Warburton (1967), because it positively assesses both ends of each style dimension and hence measures style rather than ability, it can be used with a wide age range from children to adults, it is context free and can be used in a wide range of situations, and it is probably culture free in nature. The CSA is available in various languages: versions in English for the Australian, North American, South African, and United Kingdom contexts, and versions in Arabic, French, Dutch, German, Malay, and Spanish.

In the following sections on the nature and effects of style the consideration is limited to studies using the CSA approach. Except where stated the studies reviewed were undertaken in the United Kingdom.
THE NATURE OF STYLE

In considering cognitive style as a distinct psychological construct, it is important that the style dimensions should not duplicate other existing constructs that might affect educational performance and should have a physiological basis. Thus, the dimensions should be: (a) unrelated to one another, (b) independent of intelligence, (c) distinct from ability and they fulfill the requirements of a style, (d) separate from personality, and (e) related to physiological measures. A further consideration is the origin of style, whether it is inborn or learned.

The Style Dimensions

The cognitive style dimensions have been found to be separate from one another, such that the position of an individual on one dimension does not affect his or her position on the other. The correlation between the two dimensions has been found to be consistently low and typically r = ±0.1 (e.g., Riding, Burton, Rees, & Sharratt, 1995; Riding & Douglas, 1993). Furthermore, there do not appear to be overall gender differences with respect to cognitive style. Differences are usually small and nonsignificant on both dimensions (P < 0.05; e.g., Riding et al., 1995). Although not usually significant, males frequently have been observed to be slightly more analytic than females. On the verbal–imagery dimension not even a hint of a difference has been found. With respect to age, where samples were from a wide age range, no significant correlation between age and style was observed. For example, with a sample of nurses aged 21 to 61 years, the correlations between age and wholist–analytic style, and verbal–imagery style, were, respectively, r = 0.00 and r = 0.01 (from the data collected by Riding & Wheeler, 1995).

Intelligence and Style

Cognitive style appears to be unrelated to intelligence. Riding and Pearson (1994) with 12- to 13-year-old pupils found that intelligence as assessed by subtests of the British Abilities Scale was not related to cognitive style. The correlations between the four subtests used and the wholist–analytic and verbal–imagery ratios were all nonsignificant and were, respectively: Digits -0.01, 0.12; Similarities -0.03, 0.01; Matrices -0.10, 0.04; Speed of Information Processing 0.07, 0.02. Riding and Agrell (1997) observed similar findings from a study in Canada of the relationship between style and the Canadian Test of Cognitive Skills (CTCS) with 14- to 16-year-old students. The CTCS contains four subtests comprising intelligence test-type items. These together with the respective correlations with the wholist–analytic and verbal–imagery ratios were: Sequences 0.01, -0.10; Analogies -0.01, -0.05; Memory -0.03, -0.03; Verbal Reasoning -0.02, -0.10. Again, all the correlations were low.

Style Dimension Positive and Negative Interaction with a Variable

It is important to distinguish between style and ability. Both style and ability affect performance on a given task. The essential difference is that performance on all tasks improves as ability increases, whereas the effect of style on performance for an individual is either positive or negative depending on the nature of the task. Consequently, for an individual at one end of a style dimension, a task of a type they find difficult will be found easier by someone at the opposite end of the dimension, and vice versa. For example, with the verbal–imagery style dimension, verbalizers would find pictorial tasks more difficult than would imagers, but they would find highly verbal tasks easier than would imagers. In summary, for style an individual is both good and poor at tasks depending on the nature of the task, whereas for intelligence they are either good or poor.

It is thus a characteristic of a style, as distinct from an ability, that it should interact with a variable such that the relative performance of an individual at one extreme of a dimension should be higher than that of a person at the other end in one condition, but that the situation should be reversed when the condition is changed. Single-dimension interactions have been found. With the wholist–analytic dimension this type of interaction was observed by Douglas and Riding (1993) in the effect of the position, before or after, of a prose passage title on recall. With the verbal–imagery dimension the interaction was found by Riding and Douglas (1993) on text-plus-text versus text-plus-picture presentation of learning material, and by Riding and Watts (1997) in the preference for verbal or pictorial formats of instructional material. However, in many real-life tasks there is likely to be an interaction between the two dimensions and the condition, rather than an effect of only one of the dimensions without any effect of the other.

Personality and Style

In an investigation of the relation between style and personality measures, Riding and Wigley (1997) gave College of Further Education students aged 17 to 18 years the following: the Eysenck Personality Questionnaire-Revised (EPQ-R) Short Scale (Eysenck & Eysenck, 1991) to assess Extraversion, Neuroticism, and Psychoticism; the Impulsiveness, Venturesomeness, and Empathy (IVE) Questionnaire (Eysenck & Eysenck, 1991) to determine these traits; and the State and Trait Anxiety Inventory ( Spielberger, 1977). A factor analysis gave four factors labeled Anxiety, Impulsiveness, Empathy, and Style. No personality measure loaded beyond ±0.33 on Style.

Riding and Wigley also looked at the interactive effect of the wholist–analytic style and verbal–imagery style on personality measures. They noted significant effects such that for Neuroticism, wholist–verbalizers and analytic–imagers were more anxious...
than analytic–verbalizers and wholist–imagers. For Impulsiveness, wholist–verbalizers and analytic–imagers were more impulsive and decisive than analytic–verbalizers and wholist–imagers. They suggested a model in which physiologically based personality sources are independent of cognitive style but are moderated by style in their effect on behavior.

Style and Physiological Mechanisms

It is important evidence for any psychological construct if it can be shown to have physiological correlates. In reviewing work on electroencephalogram (EEG) relevant to the verbal–imagery dimension, Riding, Glass, and Douglas (1993) suggested that EEG alpha suppression (indicating mental activity) during information processing would probably occur over the left hemisphere for verbalizers and over the right hemisphere for imagers. For the wholist–analytic dimension no clear prediction was made other than it would not be in terms of left–right hemispheric specialization.

Riding, Glass, Butler, and Pleydell-Pearce (1997) reported an investigation of EEG and style. They recorded EEG alpha in subjects while doing computer-presented word-targeting tasks in which words appeared one at a time on the screen. The task required subjects to monitor the displayed words and to press a button whenever a noun from the superordinate categories of “fruit” or “vegetable” was displayed (e.g., apple or carrot). The study revealed a significant effect for the wholist–analytic dimension along the midline (locations Fz, Cz, and Pz), with alpha suppression being greater for the analytics and fairly uniform along the line and alpha suppression decreasing from anterior to posterior for the wholist. For the verbal–imagery dimension the ratio of the power output at T3 (left) to that at T6 (right) correlated with the verbal–imagery ratio in the expected direction.

An analysis of all the EEG frequency bands (delta, theta, alpha, beta 1, beta 2, and gamma; Glass and Riding, in press), showed for the midline (locations Fz, Cz, and Pz) that the wholists had higher output than analytics in theta and alpha, but lower in gamma. In the paramedial cluster (Fp1, C1, O1–left and Fp2, C2 and O2–right), verbalizers had greater right power than imagers for all bands except alpha. Furthermore, the overall power was greater on the right for imagers than for verbalisers frontally, and the converse occipitally. In the lateral grouping (F7, T3, T5–left and F8, T4 and T6–right), the wholist–verbalizers had greater overall power left anterotemporally than other subgroups.

These results are important because they suggest a physiological evidence for style, although it should be noted that in this study the tasks were likely to favor analytics and verbalizers. Further studies are required using a range of information-processing tasks to establish more clearly the nature of brain activity in different styles.

The Origins of Style

A natural question arises as to the origins of style, particularly whether it is genetically determined or environmentally influenced. If the latter is the case, home background as indicated by parental support, which is a strong environmental influence, might be expected to affect style. Using a sample of 12-year-old pupils, Riding, Rayner, and Banner (2000) explored the relation between style and home background. The teachers of the pupils were asked to rate the home background in terms of the parental support given to each child on a 5-point scale, where 1 was the worst and 5 the best. The ratings were: 1, very poor; 2, poor; 3, moderate; 4, good; 5, very good. The distribution of the home background ratings were: very poor, 7.2%; poor, 9.5%; moderate, 29.4%; good, 30.6%; very good, 23.4%. None of the effects on the style ratios of either gender or background, or the interaction, was significant (smallest P = 0.33). There was no consistent style trend with respect to home background for either dimension.

For both style dimensions, comparison of the mean ratios for pupils from the poor homes with those from the very good homes showed little difference. Caution needs to be used in making deductions from the lack of a relation because the rating by the teachers might be an inadequate measure and the lack of a relation could thus be because of poor quality data. On the other hand, the teachers were likely to be aware of very poor home backgrounds, and even if their other ratings were uncertain, the ratings at the lower end were probably more valid. Because the home background is a strong environmental influence, the absence of any relation with such a basic variable suggests style is more likely to be a matter of nature rather than nurture, and this permits the possibility that it is genetic in origin.

To conclude this section, there is evidence that the style dimensions are independent of one another, unrelated to intelligence and personality, and have a physiological basis. The available evidence suggests style dimensions are inborn or learned at an early age.

THE EFFECT OF STYLE

The Action of Style

In considering the effect of style on a range of behaviors relevant to education, the effect will sometimes be that of a single-style dimension, sometimes an interactive effect of the two-style dimension, and at other times an interaction between one or more of the style dimensions and one of the other individual difference variables of intelligence, personality, or gender. It is useful to begin a review of the effects of style with a general model of the ways the two style dimensions may act.
**Wholist–Analytic Dimension.** This dimension influences the structural way in which individuals think about, view, and respond to information and situations. This affects the manner in which they organize information during learning, perceive their work situation, and relate to other people.

![Diagram of Wholist and Analytic Views](image)

**FIG. 3.2. Wholist and analytic views.**

Wholists see a situation as a whole and are able to have an overall perspective, and to appreciate its total context. By contrast, analytics see a situation as a collection of parts and often focus on one or two aspects of the situation at a time to the exclusion of the others. Intermediates are able to have a view between the extremes, which should allow some of the advantages of both.

Figure 3.2 shows, in a schematic way, how a situation or information might be perceived by wholists and analytics. The former view tends to be unitary, and the latter more separated into parts. Both styles have limitations and advantages. The limitation for wholists is that not only are the parts not separated, but the distinction between them may be blurred (see Fig 3.2) so that it is difficult to distinguish the issues that make up the whole of a situation. By contrast, as also shown in Fig 3.2, analytics focus on just one aspect of the whole at a time. This may distort or exaggerate a part, or make it unduly prominent, with respect to the rest. There is thus the possibility of getting it out of proportion to the total situation.

The positive aspect of the wholists is that when considering information or a situation they see the whole "picture". They are "big picture people". Consequently, they can have a balanced view and can see situations in their overall context. This makes it less likely that they will have extreme views or attitudes. The negative aspect of the wholists is that they find difficulty in separating a situation into its parts.

The positive aspect of the analytics is that they can analyze a situation into its parts, which allows them to get quickly to the heart of any problem. They are good at seeing similarities and detecting differences. However, the negative aspect is that they may not be able to get a balanced view of the whole, and they may focus on one aspect of a situation to the exclusion of the others and enlarge it out of proportion.

**verbal–imagery Dimension.** This style has two fundamental effects that have implications for behavior: the way information is represented and the external–internal focus of attention.

**Representation** affects the characteristic mode in which people represent information during thinking, verbally or in images. For instance, when individuals read a novel they can represent the actions, happenings, and scenes in terms of word associations or by constructing a mental picture of what they read. Just as it is possible to set down thoughts on paper in two ways—in words or in sketches—so is it possible to think in those two modes. People can think in words, or they can think in terms of mental pictures or images. On this dimension people may be categorized as being of three types: verbalizers, bimodals, or imagers. **Verbalizers** consider the information they read, see, or listen to, in words or verbal associations. **Bimodals**, in the middle, use either mode of representation. **Imagers** experience fluent, spontaneous, and frequent mental pictures either of representations of the information itself or of associations with it.

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The style thus affects the processing of information and the mode of representation and presentation that an individual prefers, and this is likely to affect the types of task they find easy or difficult. However, all groups can use either mode of representation if they make the conscious choice. For example, verbalizers can form images if they try, but it is not their normal, habitual mode.

External–Internal focus, the second effect, influences the focus and type of an individual’s activity: externally and stimulating in the case of verbalizers, and internally and more passive in the case of imagers. This has implications for social relationships and for the type of environment people will be content in.

For verbalizers the focus is outward to others and they prefer a stimulating environment. They see the social group as an extension of themselves and are socially aware. For imagers, the focus is more inward, and they are more passive and content with a more static environment. They view the social group as more distant from themselves, and they may be less socially aware.

Complementary–Unitary Styles. A person’s cognitive style is a combination of his or her position on each of the two dimensions. These dimensional characteristics of a person may either complement or duplicate one another, depending on the characteristics. The style characteristics may be put in order according to the degree to which, in combination, they offer complementary facilities. For example, consider an analytic–imager. Because the analytic aspect of his or her style does not provide an overview of a situation, he or she could attempt to use the whole-view aspect of imagery to supply it. If another person was a wholist–verbalizer, then because the wholist facility does not support analysis, he or she might use the “analytic” property of verbalization as a substitute. By contrast, a wholist–imager only has a whole facility available, with no style that may be pressed into service to provide an analytic function. The style groups from complementary to unitary may be ordered as: wholist–verbalizer, analytic–imager, intermediate–verbalizer, intermediate–imager, wholist–bimodal, analytic–bimodal, intermediate–bimodal, analytic–verbalizer, wholist–imager.

Style and Behavior

Style has been found to be related to a range of observed behaviors, including learning, motor skills, social behavior, behavior problems, and stress and aspect of occupation. The relations between cognitive style and these behaviors are reviewed.

Style and Learning

In this section I consider the effect of style on learning in terms of the structure, mode of presentation, and type of content of the material.

The Structure of the Material. Several studies have shown that an individual’s position on the wholist–analytic dimension interacts with the way learning material is structured in its effect on performance. Douglas and Riding (1993) found that when 11-year-old pupils were presented with a prose passage for recall, wholists did best when the title of the passage was given before the passage was presented, rather than at the end, although this had little effect for analytics. This was attributed to the providing to the wholists, who are less able to structure material, a title at the beginning to give some organization to the material.

Riding and Sadler-Smith (1992), with 14- to 19-year-old students, compared performance on three differently structured versions of computer-presented instructional material. The three versions presented that same information about five topics. Version L comprised large steps with large chunks of verbal information and line diagrams. Version O comprised small steps of verbal information interspersed with pictorial or diagrammatic content, plus overviews at the start, before and after each topic, and at the end. Version S was as Version O with small steps but minus the overviews. The four styles were grouped as complementary (wholist–verbalizer and analytic–imager) and unitary (wholist–imager and analytic–verbalizer). In terms of the recall efficiency, different ways of structuring the material had a large effect on performance for the two complementary style groups, with the small-step format being most effective. For the unitary groups, the structure had relatively little effect, with the groups performing in an “average” manner irrespective of the format. Gender was not included as a variable in this, or the previous, study.

Sadler-Smith and Riding (in press) used a questionnaire approach to study instructional preferences in university business studies students. In terms of locus of control, the analytics preferred to have control themselves rather than to be controlled, whereas the wholists had no preference. There was no significant gender effect.

Riding and Al-Sanabani (1998) with 10- to 15-year-old pupils attending a Yemeni school in the United Kingdom, examined the effect on reading comprehension of dividing a one-page textual narrative into three paragraphs, each with a subheading. This improved comprehension and the degree of the facilitating effect was related to the wholist–analytic style and gender of the student. For male and female wholists there was a similar improvement with the addition of format structure, whereas for analytics the males improved more than the females. A possibility is that female analytics prefer to impose their own structure and find externally imposed structure less helpful than do males. Certainly, the analytic females did well without the external structure. Similar effects were found for conditions where a summary was added.

Riding and Grimley (2000) noted with 11-year-old pupils that, with information in text mode, the patterns of recall for the males and females were similar. With the information available from text and pictures, the males increased in recall from wholist through to analytic, whereas the females declined with the worst performance by the analytics. The requirement to integrate the parts of the pictorial and the textual information is more difficult for the male wholists and the female analytics. This may have been particularly so because the pictures were in the form of cartoons and their content was by way of analogy, from
which deductions had to be made, rather than a simple presentation of information in a literal form. This result accords with that of Riding and Read (1996), who found male wholists and female analyzers to be more comfortable in situations that are closed and do not require divergent thinking.

There is evidence that the structure of the material to be learned interacts particularly with the wholist–analytic style dimension. Analyzers need a large viewing window compared to wholists, when dealing with information (Riding & Grimley, 1999). Individuals of complementary style (wholist–verbalizers and analytic–imagers) are influenced by the step size of the learning material and improve from large to small steps, whereas those of unitary style (analytic–verbalizers and wholist–imagers) are not affected. There is an interaction between gender and wholist–analytic style in the facilitating effect of structure in the form of both headings and overviews, such that these most help male analyzers and female wholists. It may be that male wholists and female analyzers prefer to form their own structure of materials and find difficulty in copying with externally imposed organizations. More work is needed to clarify the gender and wholist–analytic interactions with structure.

Mode of Presentation. Two modes of presenting information are available: the verbal and the pictorial. Riding and Ashmore (1980) with 11-year-old pupils gave groups of verbalizers and imagers (as assessed by the earlier Verbal–Imagery Code Test) either a verbal or a pictorial version of the same information. Verbalizers were superior with the verbal mode and imagers with the pictorial mode. Within the instructional situation, although purely verbal presentation is often an option, an alternative purely pictorial version is rarely an option as some words are also required. However, it is usually possible to present information in both modes. Riding and Douglas (1993), along with 15- to 16-year-old students, found that the computer presentation of material in a text-plus-picture format facilitated learning by imagers compared with the same content in a text-plus-text format. A further finding was that at recall in the text-plus-picture condition 50% of the imagers used illustrations as part of their answers compared with only 12% of the verbalizers.

Riding and Read (1996) individually questioned 12-year-old pupils about their preferences for mode of working and social context. For the higher ability pupils, imagers, particularly if they were wholists, said they used less writing and more pictures than verbalizers, especially where the subject allowed. The tendency by imagers to use pictures, and verbalizers to use writing, increased with ability. There was evidence that lower ability pupils were more constrained by the expected format of the subject than were those of higher ability.

Riding and Watts (1997) told female 16-year-old pupils that three versions of a sheet giving information on study skills had been prepared for them, and that each sheet contained the same information but that the formats were different. Pupils were then invited to take one of the versions from the teacher’s desk. The versions were unstructured verbal (paragraphs, without headings), structured verbal (paragraphs, each with a clear heading), and structured pictorial (paragraphs, each with a clear heading, and a pictorial icon depicting the activity placed in the left margin). No pupils chose the unstructured-verbal version. For the two structured versions, with the verbal–imager dimension most verbalizers selected the verbal version and most of the imagers selected the pictorial version. With the wholist–analytic dimension most wholists selected the pictorial version, perhaps because it looked more “lively,” whereas most analyzers selected the more “neat and tidy” verbal version. Students are attracted to, and prefer to select, materials that suit their own style.

Riding and Grimley (1999) considered the learning from CD-ROM multimedia instructional materials of science topics by 11-year-old pupils. Here three modes of presentation were used: picture plus sound (PS), picture plus text (PT), and picture plus text plus sound (PTS). With PTS the males did the best in the noncomplementary groups (analytic–verbalizers and wholist–imagers), and the females did the best in the analytics (verbalizers and imagers). With PS and PT, there was reversal with gender, which was related to whether the styles were complementary (as with wholist–verbalizers and analytic–imagers) or unitary (as with analytic–verbalizers and wholist–imagers). PS involved “look and listen” (two channels), whereas PT involved “look” only (a single channel). For the wholist–verbalizers and analytic–imagers (the complementary groups), males did better on PS than on PT; this was reversed for females. For the unitary groups, the wholist–imagers and analytic–verbalizers, the tendency was the opposite, where male wholist–imagers were superior on PT, and females wholist–imagers on PS.

Taken overall, imagers generally learn best from pictorial presentations, whereas verbalizers learn best from verbal presentations. However, there is also evidence of an interaction involving gender, and although the precise nature of this is not yet clear, it is likely to be of practical importance. With complementary groups, the males were best on separate channels of pictures and words, whereas the females were best on the single channel of pictures and words. With the unitary groups, the males were best on a single channel, whereas the females were best on separate channels. This hints at a fundamental gender difference in information processing that also involves style.

Type of Content. With the type of content of learning material, studies of 11- and 12-year-old pupils showed that imagers recall highly visually descriptive text better than acoustically complex and unfamiliar text, whereas the reverse holds for verbalizers (Riding & Calvey, 1981; Riding & Dyer, 1980). Initial reading performance, which is obviously a verbal task, has been found to be superior in verbalizers. Riding and Anstey (1982) with 7-year-old children assessed reading accuracy and comprehension and found that both declined from verbalizer to imager. Riding and Mathias (1991) with 11-year-old children observed that for reading accuracy this effect was still pronounced for wholists, where wholists–verbalizers showed much greater proficiency at reading compared to wholists–ximagers. Similarly, with second language learning, which is also verbal in nature, Riding et al. (2000) asked the second-language teachers of 12-year-old pupils to rate the general second-language ability of their pupils on a 5-point scale from very poor to very good. The pupils studied either French or German. Overall, the ability of females was rated higher than that of males, and for the verbal–imagery dimension, verbalizers were superior to imagers. In terms of content type, then, individuals appear to learn best when information can be readily translated into their preferred verbal–imagery mode of representation.

Content and intelligence. Riding and Agrell (1997) with 14- to 16-year-old Canadian students found an interaction between style and intelligence in their effect on school achievement, such that style was more critical where pupils were of lower ability
and the subject matter did not ideally suit their style. For instance, the difference in performance between high- and low-ability pupils was greater for the analytic–imagers than for the analytic–verbalizers, where in the latter case that style was more naturally suited to learning academic subjects.

Riding and Sharratt (2000) considered performance in English, mathematics, and science in the General Certificate of Secondary Education (GCSE—the British public examination at 16+ years). The samples were also assessed on a test of reasoning ability (National Foundation for Educational Research Non-verbal Test DH). Riding and Sharratt found an interaction between reasoning ability and verbal–imagery style in their effect on overall GCSE performance. For low reasoning ability, verbalizers did less well than imagers, whereas for high reasoning ability, the verbalizers did better than the imagers. The reasons for this shift are not yet clear. By way of speculation, because much schoolwork has a verbal emphasis, verbalizers will find the mode of presentation and the medium used for expression more to their liking than imagers. However, it may be that verbalizers of low reasoning ability, when finding the work difficult, will give up more readily than imagers, because verbalizers are less tolerant of boredom than are imagers. As reasoning ability increases to a moderate level, verbalizers find the work easier and hence more interesting, and so they become more tolerant and they then equal the performance of imagers. When reasoning ability rises to a high level, verbalizers exceed the performance of imagers, because of the match between their style and the mode and type of content of the subject matter taught at GCSE level. If this were so, the low-reasoning-ability verbalizers could be helped by teaching the material more slowly and attractively to ensure understanding and attention. The rationale here is that if the task is easier, those of lower ability will be able to do it. Imagers of all levels of ability will be aided by more use of their preferred mode of representation.

**Style and Motor Skills**

If cognitive style monitors internal mechanisms that control external actions, it is reasonable to expect that style would be related to motor performance. Riding and Al-Salih (2000), along with 14- to 18-year-old secondary school pupils, explored the relation between style and motor skills and sports performance. The pupils did a battery of motor skills tests. A factor analysis indicated four skills factors: bodily movement, interactive skills, mechanical skills, and aiming. All of these except the mechanical skills showed a significant relation to style. With bodily movement the complementary styles (wholist–verbalizer and analytic–imager) did better than the unitary styles (wholist–imager and analytic–verbalizer). With interactive skills unitary styles were superior for males and complementary styles were superior for females. With aiming, analytic– imagers were best and wholists–verbalizers were worst. Each pupil was rated on a 5-point scale by their teachers on performance in rugby, soccer, and cricket for the boys; and hockey, netball, and tennis for the girls. Here there was a significant style effect for tennis with imagers doing best, but not for the team games.

**Style and Social Behavior.**

Cognitive style influences the manner in which an individual thinks about and represents social incidents and situations.

*Wholist–Analytic Style and Social Behavior.* Riding (1991b) argued the Wholist–Analytic style is reflected socially in such dimensions as being dependent–self-reliant, flexible–consistent, realistic–idealistic, and vague–organized. Wholists tend to the former and analytics to the latter. Riding and Wright (1995) asked undergraduate students living in university flats with typically five per flat to rate their flatmates in terms of personal characteristics. The wholists were perceived as more assertive, humorous, and helpful, whereas the analytics were rated as more shy. In addition, the degree of unity in each flat was assessed by using statements such as, “Relations in my accommodation have been harmonious.” When compared with the majority style in each flat, the order of reported unity from least to highest was: analytic–imagier, wholist–imagier, analytic–verbalizer, wholist–verbalizer. This order was as expected because analytics are likely to be more separate than wholists and imagers are likely to be more inward and socially isolated than verbalizers.

*verbal–imagery Style and Social Behavior.* Riding et al. (1995) asked 12-year-old pupils to rate the children in their class in terms of being active (outgoing, lively, humorous), modest (shy, quiet), and responsible (serious, patient). They found verbalizers scored highest on active, bimodals highest on modest, and responsibleness increased from verbalizer to imager.

**Style and Behavior Problems**

Riding (1991b) suggested that for the Wholist–analytic dimension, wholists are likely to be unstructured, global, and inclusive in their thinking. This may manifest itself as lacking behavioral control. By contrast, analytics are likely to be structured but socially separate, resulting in behaviors that are generally more controlled but that may exhibit frustration and intensity, and they may be socially unaware and exclusive. On the basis of such a consideration of social behavior, it might be anticipated that the school conduct behavior of wholists would be less good than that of analytics because wholists are more outgoing and less well organized with respect to both self-control and learning. Several studies have supported this view.

Riding and Burton (1998) asked the teachers of 14- to 16-year-old secondary school pupils to rate the conduct behavior of their pupils on a 5-point scale from very poor to very good. They found that females were rated higher than males with little variation with the Wholist–analytic style. With the males, the wholists were rated poorest in behavior, and the analytics were slightly poorer than the intermediates. Rayner and Riding (1996) considered pupils aged 15 to 17 years attending a truancy unit because of their previous failure to attend school. The percentage of pupils in the Wholist–analytic dimension style groupings as defined by a comparison sample of pupils attending mainstream secondary schools was wholists, 41%; intermediates, 53%; and
analytics, 6%. Riding and Craig (1998) noted the style characteristics of boys aged 10 to 18 years referred to residential special schools because of behavior problems. They found that their style on the Wholist–analytic dimension was skewed to the wholist end of the continuum relative to a comparison sample of male pupils in ordinary secondary schools. The percentages of each style grouping in the special schools were wholist, 46%; intermediate, 34%; and analytics, 20%. In a further study of male 11- to 16-year-old students in special schools, Riding and Craig (1999) found similar results with the majority style group being wholist–verbalizer and the minority analytic–imager. Finally, Riding and Wigley (1997, p. 385) with 17- to 18-year-old College of Further Education students found that males were more psychotic than females, and that for the males wholists were more psychotic than analytics. Cook (1993, p. 87) noted that psychoticism is related to social deviance.

It is interesting to contrast the United Kingdom findings with those of Riding and Al-Hajji (2000) for pupils in the Kuwaiti educational system, which is formal and controlled. The conduct and learning behavior of 15- to 18-year-old Kuwaiti secondary school pupils were assessed by their teachers. Here, conduct behavior did not vary much with style, whereas learning behavior was significantly lower for analytics than for wholists, and for imagers than for verbalizers. The results suggest the interaction among behavior, attainment, and style may depend on the nature of the educational system.

Riding and Baker (2000) considered the school attendance of pupils within socially poor areas over their 5 years of secondary schooling from 11 to 16 years. They found that the worst attendance was by verbalizers for both males and females, with the best attendance by imagers for the males and bimodals for the females.

In summary, problem behavior is more likely in males than in females, and with respect to cognitive style, in wholists and verbalizers.

### Style and Occupational Issues

Style studies have shown findings of relevance to career selection and employment. These include decision making, anxiety, optimism, and perceived level of stress.

**Style and Decisiveness.** Riding and Wigley (1997) assessed the degree of decisiveness for a sample of 16- to 18-year-old College of Further Education students in terms of their position on a dimension of: very indecisive, indecisive, decisive, and impulsive. Here, the relevant aspect of style appears to be the wholist to analytic facility, in which the style groups may be ordered from extreme wholist to extreme analytic: wholist–imagier, wholist–bimodal, intermediate–imagier, wholist–verbalizer, intermediate–bimodal, analytic–imagier, intermediate–verbalizer, analytic–bimodal, analytic–verbalizer. Those who are most analytic (i.e., analytic–verbalizers) are less decisive because they are inclined to weigh all the possibilities before making a decision. Those who are very wholist (i.e., wholist–imagers) can see a broad perspective and the relevance of all aspects of the situation in an overall balance, and they are not decisive. People who are more decisive lack the constraint of the high analytic on the one hand, and the overall wholist or balanced perspective, on the other, and this includes those who are wholist–verbalizer, intermediate–bimodal, and analytic–imagier. This area needs further examination within practical contexts to see what are the effects on learning performance and problem solving. There could be implications for management.

**Style and Neuroticism.** Riding and Wigley (1997) also found that neuroticism, as assessed by the EPQ-R, was highest for wholist–verbalizers and analytic–imagers and lowest for analytic–verbalizers and wholist–imagers. To facilitate the interpretation of the findings for neuroticism, they ordered the styles from complementary to unitary. Neuroticism was found to be highest for the complementary styles (i.e., wholist–verbalizer and analytic–imagier) and lowest for those that are not. A possible reason for this is that wholists who lack any analytic facility can see all aspects of a situation in balance and do not focus just on some negative aspects. In reality, nothing is totally bad, only some parts, and this style evens out the bad with the good. Similarly, those who have only an analytic facility have everything ordered and under control and perceive less stress. Those who seem most susceptible to neuroticism are those with the facility to switch between the two modes. The observed level of neuroticism is likely a combination of the level of the physiological source of anxiety, which is then moderated by cognitive style so that for the complementary styles it is increased and for the unitary styles it is decreased.

**Optimism Versus Pessimism** Individuals may be described in terms of whether they tend to optimism or pessimism. Whether optimism–pessimism is a separate dimension or related to stability–neuroticism is not clear (Wiebe & Smith, 1997, pp. 903–905). In the present context, optimism is used to describe an inclination to interpret situations positively rather than negatively. In a study of style and optimism (Riding & Rayner, 1998, p. 126), 40 Methodist Church members were asked to rate on a scale from 1 to 5 the threat or comfort they felt when they read each of 25 verses taken from the Bible. Examples of the verses were: comfort, "The Lord is my shepherd, I shall not want" (Psalm 23:1); threat, "The wages of sin is death" (Romans 6:23). The tendency to perceive verses as threatening rather than comforting was found to be related to verbal–imagery style and gender. The male imagers and the female verbalizers were more inclined to see the negative aspects of verses and could be described as more pessimistic than the male verbalizers and the female imagers. As described in the previous discussion, a similar pattern has been found for perceived stress.

**Perceived Level of Stress** Borg and Riding (1993) gave sample Maltese secondary school teachers a questionnaire where the items were labeled from "no stress" to "extreme stress" and scored from zero to four. Four subscales of sources of stress were derived from the inventory: pupil misbehavior, poor working conditions, poor staff relationships, and time pressures. Borg and Riding found that the male imagers and female verbalizers reported the greater overall stress. These findings were similar to those obtained in the study of the reaction to Bible verses. It may be that those who report the greater stress are more pessimistic. Borg and Riding also observed that the amount of stress was consistent with the expectation of wholists being more open and people orientated and analytics being more structured and organized. The wholists reported more stress from time pressures and staff relations, whereas the analytics reported more stress from pupil misbehavior and working conditions.
Riding and Wheeler (1995) in a study of nurses found that verbalizers had a significantly higher employment grade than imagers. Further, they found evidence that the type of nursing that most suited nurses was related to their style. Using a questionnaire, a suitability index was obtained from (Job Satisfaction – Perceived Stress), and this was compared with style and type of nursing. The styles with the highest satisfaction indices were analytic–verbalizer for general nursing, intermediate–bimodal for orthopaedic nursing, and wholist–imager for psychiatric nursing. The lowest indices were wholist–imager for general nursing, analytic–imagery for orthopaedic nursing, and intermediate–verbalizer for psychiatric nursing. General nursing is probably dynamic, requiring conscientious activity; orthopaedic nursing is slower, needing patience; and psychiatric nursing is demanding, benefiting from tolerance. This approach has relevance to other occupations.

In summary, findings of style have implications for employment. These include decision making, level of anxiety, optimism and stress, as well as occupational suitability.

**TOWARD A MODEL OF STYLE**

Evidence suggests the construct of cognitive style possesses a degree of validity because it is distinctly different from other established constructs such as intelligence, personality, and gender. Furthermore, it has been found to be related to a range of behaviors to a degree that has practical relevance. Cognitive style now needs to be seen in the context of the other variables with a view to developing a model of their operation and interaction.

FIG. 3.3. Cognitive control model.

Riding (1997) proposed a tentative model called the cognitive control model. This model is shown in Fig. 3.3. At the inmost level several underlying primary sources comprise the memory of individuals’ past experiences and knowledge, probably their reasoning ability, their underlying personality sources, and their gender. Some of the personality sources have been given tentative names. The next level is that of cognitive control, which comprises the fundamental dimensions of style: Wholist–Analytic and verbal–imagery. It provides the organizational and representational interface between the internal sources and the external environment, and it imposes on the learning and response its own structure and form. The ways the Wholist–analytic dimension and the verbal–imagery dimension may affect attitude and behavior have been discussed by Riding (1993b, 1994). The working memory processing system, which gives meaning to the incoming information, operates at the input level. The performance of this may be considered a significant contributor to fluid intelligence (cf. Kline, 1991). A computer-presented displacement method for assessing this is the Information Processing Index (Riding, 1999).

Learning strategies are at the output level. Strategies are ways that may be learned and developed to cope with situations and tasks, and particularly methods of using styles to make the best of situations that are not ideal. These will have been developed, for instance, by the individual sensing that certain modes are easier to use, recognizing a learning preference, and deciding to "translate" new incoming information into that representation. At this level there is also the cognitive response "set" that influences social behavior.

The perception of experiences is probably moderated by the cognitive control level in interaction with the cognitive history and the primary personality sources. Some support for the model comes from the finding of interactions between style and other individual difference constructs. For instance: between intelligence and style in affecting academic achievement (Riding & Agrell, 1997; Riding & Sharratt, 2000), between gender and style in affecting learning (Riding & Al-Sanabani, 1998; Riding & Grimley, 1999), and between personality sources and style in affecting social behavior (Riding & Wigley, 1997).

**CONCLUSION**
The notion of cognitive style, as consisting of two fundamental dimensions, as assessed by the CSA approach, is supported by evidence that the dimensions are independent of one another and gender, they are separate from intelligence, cognitive style fulfills the requirement for the distinction between style and ability, cognitive style is independent of personality, and cognitive style has physiological correlates. Furthermore, the observed relation between the dimensions and behavior are consistent with the view that the Wholist–analytic dimension is concerned with organization and the verbal–imagery dimension is concerned with representation. The utility of the construct is further supported by its being shown to be related to a range of practical behaviors, such as learning performance, motor skills, social behavior, problem behavior, stress, and occupational satisfaction. Cognitive style is seen within the context of the other individual difference variables and may represent an interface between them and the external world. The next challenge is to clarify the interactions between style and the other variables in their effects on behavior and educational performance.

Although more work remains to fully understand style, practical application to education is facilitated by the use of the Learning Enhancement Programme (Riding & Rayner, 1995, 1999), which raises the awareness of teachers of their own cognitive style and of ways to broaden their teaching styles to suit the needs of a wider range of pupils. Furthermore, details of practical style approaches to helping pupils with behavioral and learning difficulties is given in Riding and Rayner.

REFERENCES


