

ASSESSING RATIONAL AND INTUITIVE STYLES: A HUMAN INFORMATION PROCESSING METAPHOR

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ABSTRACT

This article has four distinct but related purposes. First, we describe the research setting for assessing human information processing style in terms of the rational-intuitive complementarity. We highlight earlier management study that directly deals with this dimension. Then we review popular instruments for assessing style in rational-intuitive terms.

Second, we outline a conceptual model that elaborates the rational-intuitive styles of human information processing into three modes each. There are innovative management studies, and Eastern and Western philosophical bases for this model. We use this background to help synthesize three lines of neurophysiological research to formulate a six-mode human information processing (HIP) metaphor. Third, we use the HIP metaphor to develop an HIP survey with a scale for each mode. This section describes how conceptual definitions are derived from the model with guidance from the rational-intuitive term pairs and the survey item pool.

Finally, we describe the statistical analysis of the reliability and validity of the six scales for the HIP survey. We use a criterion-based factor analytic approach for isolating the scale items. Then, the HIP metaphor is used to predict associations among the scales in our study. We use a modified form of the multitrait-multimethod approach to test our predictions. Finally, this section summarizes the results of the predicted relationships among the variables on the self-assessment tools used in this study. The study helps bring the rational-intuitive assessment of human information processing into the mainstream of management research.

OVERVIEW OF THE ARTICLE

Our research approach is an example of the complementary nature of the rational-intuitive styles of human information processing (HIP) that are the subject of our study. The work shifted back and forth between these problem-solving approaches, and figure 1 illustrates this alternation as we moved from

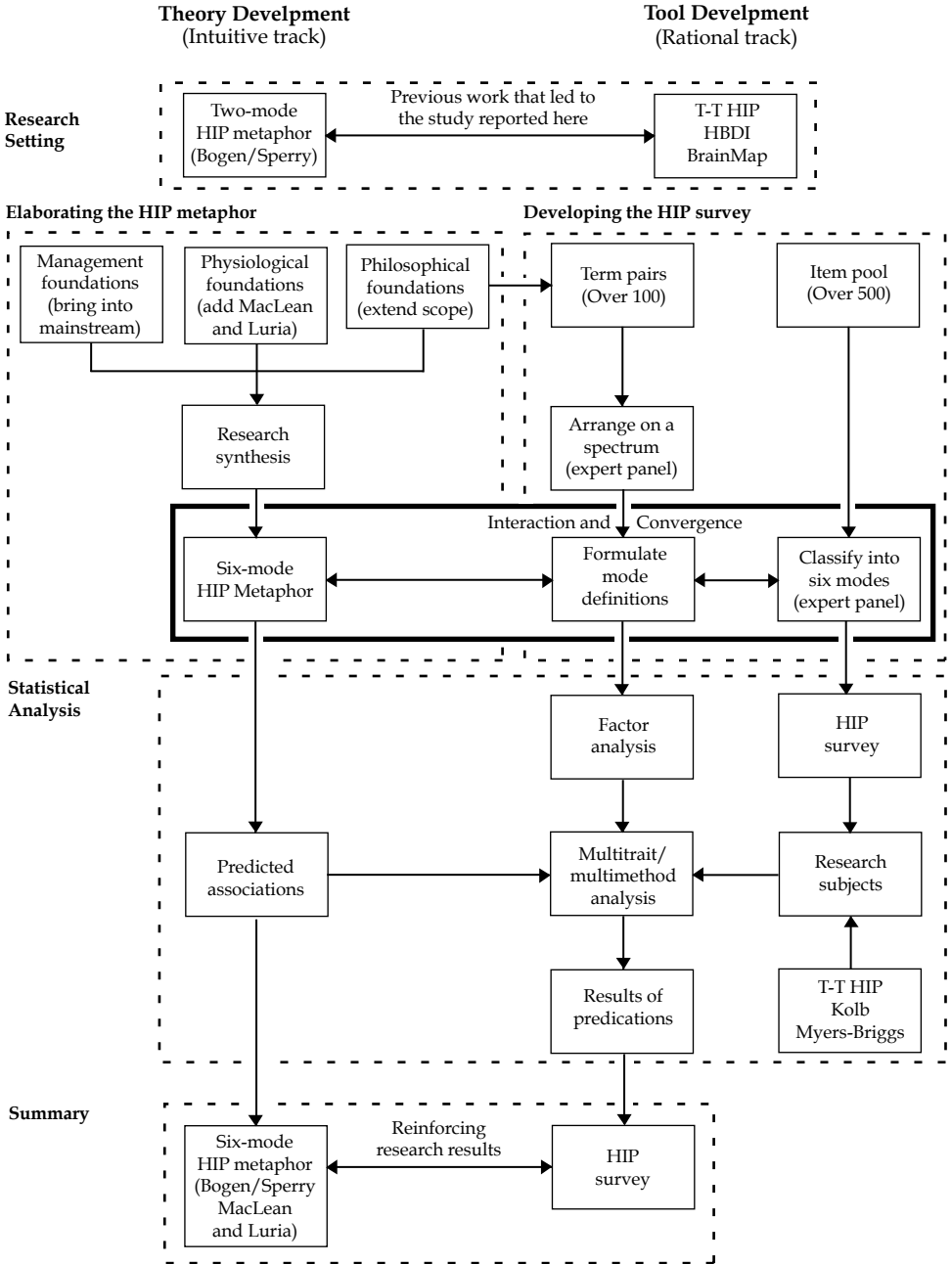


Figure 1. An overview of the article

one phase to another. The theory and tool development moved together in parallel paths. In one phase of the study, one path would be emphasized and in another, the other. However, the study did not proceed in the carefully planned way that figure 1 suggests. Only by looking back were we able to describe our approach.

Reporting this work presented a dilemma. Typically the theory development and tool development are not covered in the same depth. This is especially true when the theory development proceeds more along intuitive lines, and the tool development more along rational lines. We ask you to bridge those worlds with us. In our minds and in the actual study, *we were not and have not been able to separate the two research tracks*. This overview orients you to the dual tracks of our study.

The strongest link between the rational-intuitive domains of our study lies in the 'interaction and convergence' of the identification and definition of the six modes of management behaviour that are the core of our HIP metaphor. This link appears in the larger box area near the centre of figure 1. That shows that three different paths converged and interacted in identifying and clarifying the six modes.

In figure 1, the headings for the sections of the article appear next to the dotted box area representing that section. For instance the first section, 'the Research Setting', appears as the boxed area at the top of the figure. In the next section, the elaboration of the original two-mode HIP metaphor, based on the work of Joseph Bogen and Roger Sperry, relied on three lines of thought. One focused on the growing management literature on the intuitive style. Another extended the original physiological basis to include the pioneering work of Paul MacLean and Aleksandr Luria. The final line of thought extended the scope of the philosophical foundations that were used for the original HIP metaphor development.

The rational track analysis of over 100 rational-intuitive term pairs and the construction of a large item pool for developing the HIP survey proceeded in parallel with the work on elaborating the HIP metaphor. Arranging the term pairs on a spectrum and classifying the item pool into categories interacted with the six modes emerging from the intuitive theory development track. These parallel tracks fed the statistical analysis where we used factor analysis to verify the scales and multitrait-multimethod analysis to test the predictions derived from the six-mode HIP metaphor. The research subjects were administered the HIP survey with three other self-assessment instruments, including the original Torrance-Taggart HIP survey based on the two-mode metaphor. Finally, the summary notes the significance of this dual track rational-intuitive approach to understanding management in terms of a long-standing but relatively neglected recognition of the 'logical' and 'non-logical' aspects of management behaviour.

THE RESEARCH SETTING

The research reported here is a continuation of an on-going study of a human information processing approach to management behaviour. The earlier work on the two-mode HIP metaphor is summarized. Then, the popular instruments for assessing management style in rational-intuitive terms are outlined briefly.

Two-Mode HIP Metaphor

In their 'Minds and managers' article, Taggart and Robey (1981) presented the case for 'a concept of dual human information processing as an aid to understanding the decision styles and decision strategies of managers' (p. 187). The two-mode HIP metaphor for the complementary rational-intuitive decision styles was summarized in their figure 2 (p. 192). That article proposed neurological, psychological, and philosophical foundations for the metaphor. The Myers-Briggs type indicator was used to highlight the range of decision styles from the rational ST (sensing-thinking) to the intuitive NF (intuition-feeling) in their figure 1 (p. 190).

Next, the 'Measuring managers minds' article reviewed three approaches to the measurement of style: physiological monitoring, inference from behaviour, and self-description inventories (Robey and Taggart, 1981). These authors pursued the physiological monitoring avenue as reported in 'Managerial decision styles and cerebral dominance' (Taggart *et al.*, 1985). From the results of that study, the authors learned the limitations and difficulties of brainwave monitoring first-hand. As a basis for developing the HIP metaphor, this line of study was discontinued in favour of using the research results of specialists in the field of neurophysiology.

At the same time that this work was completed and reported, a parallel effort adapted Paul Torrance's 'style of learning and thinking (SOLAT) to the management assessment environment (Torrance and Reynolds, 1980). The practical success of this effort led to an emphasis on the self-description approach to 'measuring managers' minds'. At the same time, other management practitioners were developing self-assessment tools for measuring human information processing style in terms of the rational-intuitive spectrum. This work is described in the next section.

Assessment of HIP Styles

The Torrance-Taggart human information processing (HIP) survey (1984) assesses management preferences in rational-intuitive terms by categorizing an individual into one of four types of information processor: left-dominant (rational), right-dominant (intuitive), mixed (either rational or intuitive), or integrated (both rational and intuitive). Brain Technologies Corporation's Brain-Map (1985) instrument develops a four-quadrant profile: I-control (rational), I-pursue (intuitive), I-explore (intuitive), and I-preserve (rational). Herrmann's Brain Dominance Instrument (HBDI) (1988, p. 411) yields a profile with four quadrants: cerebral-left (rational), limbic-left (rational), cerebral-right (intuitive), and limbic-right (intuitive).

Even though the publication dates are recent, these instruments have been under development since the mid-1970s, when the management implications of left-brain, right-brain research were emerging. Of these three instruments, only the Torrance-Taggart HIP survey was used in the present study, due to its lower cost and ease of administration and scoring. The BrainMap instrument was too expensive, and the researchers did not have the required certification workshop to administer and score the HBDI instrument.

Development of these innovative assessments of the rational-intuitive spectrum did not take place in mainstream academic management research. Most of the development for the Torrance-Taggart HIP survey was carried out in the field

of educational psychology, where the instrument is known as the 'style of learning and thinking' (SOLAT). This instrument has been used tens of thousands of times in both educational and management training settings. One research database for this instrument contains the results of over 5,000 administrations of the Torrance-Taggart HIP survey. Information on the instrument's validity and reliability is published in a user's manual (Taggart and Torrance, 1984, pp. 28-36).

The HBDI has had over 500,000 administrations worldwide. The original research for this tool was carried out at the General Electric Management Development Institute. Research on the validity and reliability of the HBDI was completed by the WICAT Education Institute (Herrmann, 1988, pp. 337-79). Data are not available for the BrainMap utilization. Administrations would be in the tens of thousands due to its wide usage in management training around the world. To our knowledge, there are no published validity and reliability studies for the BrainMap.

Management research suffers significantly due to the relatively low recognition of these efforts in main-line academic pursuits. Some isolated efforts have been undertaken in academic settings for all three instruments. But most of the work remains outside the scope of formal management study. Our research seeks to bring these efforts into the mainstream of management study.

ELABORATING THE HIP METAPHOR

In this part of the article, we summarize a conceptual model that elaborates the rational-intuitive styles into three modes each. The six resulting modes form an HIP metaphor that has its roots in innovative management thought, the physiology of the human nervous system, and Eastern and Western philosophy.

Management Foundations

We believe that one of the strongest biases in management research is the bias toward rationality. Often only rational behaviour, with its implied objectivity, is acceptable for study in management. Other types of managerial behaviour are ignored, or labelled irrational. This limited viewpoint does not capture the full spectrum of management experience, because it recognizes and gathers data only on a subset of these activities. However, there are some notable exceptions to this bias.

Over 50 years ago, Chester Barnard observed what he considered to be the key for resolving difficulties in managerial flexibility and communication:

I have found it convenient and significant for *practical* purposes to consider that these mental processes consist of two groups which I shall call 'non-logical' and 'logical' (Barnard, 1966, p. 302) (emphasis added).

He went on to describe these two ways of thinking as necessary in the 'everyday affairs' of a successful manager. In the 1970s 'logical' left-brain (rational) and 'non-logical' right-brain (intuitive) research results became widely known to provide some scientific support for what had been personal observation and speculation.

Management literature that directly deals with Barnard's observations is sparse. In an early effort, Harold Leavitt (1975a, 1975b) discussed the consequences of over-emphasizing analytic problem-solving in management education. He suggested that the intuitive and emotional elements of information processing deserve the same attention as the logical and analytic. Leavitt urged moving in the direction of 'integrating wisdom and feeling with analysis' (1975b, p. 20).

At about the same time, Henry Mintzberg (1976) developed this theme further. Mintzberg contended that individuals who make good planners appear to exhibit strengths of rational information processors, while individuals who make good managers exhibit the strengths of intuitive information processors. Mintzberg said that managers need to distinguish carefully those activities which should be handled analytically from those 'which must remain in the realm of intuition, where, in the meantime, we should be looking for the *lost keys to management*' (Mintzberg, 1976, p. 58) (emphasis added).

More recently, Herbert Simon (1987) has written about the role of intuition and emotion in managerial decision-making. He begins by referring to Barnard's 'logical' and 'non-logical' processes noted above. He reviews briefly the relevance of split-brain research in understanding what Simon calls 'analytic' (rational) and 'judgemental' (intuitive) decisions. The article goes on to assess the contribution of expert systems research to understanding these decision processes. He concludes by noting:

It is a fallacy to *contrast* 'analytic' and 'intuitive' styles of management. . . The effective manager does not have the luxury of choosing between 'analytic' and 'intuitive' approaches to problems. Behaving like a manager means *having command of the whole range of management skills and applying them as they become appropriate* (Simon, 1987, p. 63) (emphasis added).

We concur with this observation. For this reason, we view the range of rational to intuitive styles as a spectrum of skills that require balance and flexibility in their management application.

Physiological Foundations

Significant criticism has been levelled at the use of neurophysiological research as a basis for understanding management behaviour. In response to over-zealous claims about the literal link between human behaviour and specific areas of the brain, several writers have cautioned against the use of brain research. Michael Corballis concluded 'in urging a more cautious, biological approach to laterality, . . . I do not mean to discredit the role of mythology in shaping our ideas. . . All I ask is that we scrutinize and purify our myths from time to time. . . ' (1980, p. 293). Our study proceeded in the spirit of 'purifying' the HIP metaphor.

Jerre Levy noted that 'the notion that we are "left brained" or "right-brained" has become entrenched in the popular culture. And, based on misinterpretation of the facts, a pop psychology myth has evolved, asserting that the left hemisphere of the brain controls logic and language, while the right controls creativity and intuition' (1985, p. 38). Our work does not make these literal claims. Instead, we focus on metaphorical links between *gross levels of brain structure and modes of management behaviour*.

In her *Neurophilosophy*, Patricia Churchland reviews hemispheric lateralization studies in her search for a unified science of the mind-brain. She notes that 'it is important to emphasize the intricacies and pitfalls of methods in this research because the data and the interpretations based on the data are only as good as the methods' (1986, p. 200). Our earlier modest attempts at deriving conclusions about management behaviour from brainwave monitoring clearly demonstrated this fact to us.

Churchland seeks a unifying theory of the mind-brain that blends the worlds of philosophical and neurological inquiry. We seek only to extend our original two-mode HIP metaphor to a six-mode version that is more representative of management behaviour. Her concluding chapter provides 'a sample of the type of thing that I take to be a theory in neuroscience of how macro phenomena are produced by neuronal phenomena' (1986, p. 478). The intent and extent of her study are much broader than ours.

Toward the end of his career, Aleksandr Luria reflected on his life's work in neuropsychology in *The Making of Mind: A Personal Account of Soviet Psychology*. In this book, he dealt at length with the issues raised by the authors above:

It is easy enough to reject the holistic notion that every function is distributed equally throughout the brain and the idea that complex functions are localized in narrowly specified areas of the brain, but it is difficult to find an intermediate position. Our solution has been to think of the functional system as a working constellation of activities with a corresponding working constellation of zones of the brain that support the activities (Luria, 1979, p. 141) (emphasis added).

We believe that Luria's 'working constellation of zones of the brain' offers a rationale for our metaphoric extrapolations from neurophysiological research.

The cautionary comments of these observers must be taken seriously. The researchers (Bogen, Sperry, MacLean, and Luria), whose work we rely on for our metaphoric inferences, would agree with the spirit, if not the letter, of these critiques. In using the results reported in the next section, we seek to infer no more from the results of their research than these researchers themselves.

Physiological Clues

Figure 2 illustrates the physiological basis for the HIP metaphor with the functional components of the human biocomputer in levels beginning with lower (older) brain functions at the upper left, and the higher (newer) at the lower right of the figure. The brain has evolved by adding more sophisticated behaviour patterns onto earlier primitive forms.

We share our oldest brain with the reptiles. Its territorial drive focuses on survival. The lizard moves into the sunlight to warm its cold-blooded circulation. The neo-mammalian brain evolved as the limbic system extended beyond the reptilian, adding a sense of nurturing for the offspring of the species. The mother cat's 'licking attention to her kittens brings limbic functioning into 'soft' relief. The emergence of the neocortex in man is associated with the idea of human intelligence. Transcending instinct, intelligence emerges in its lowest forms when the neocortex develops. In all animals except primates, this intelligence is considered primitive. In the successively higher forms of primates, the increasing size of the neocortex correlates with an increased intellect.

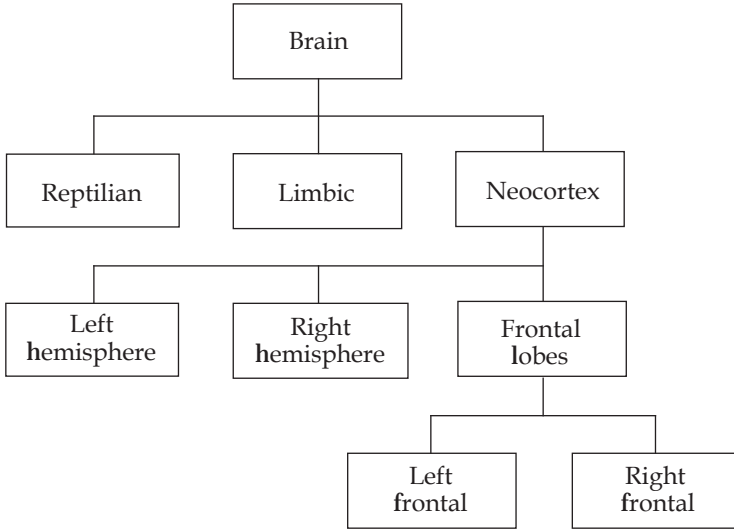


Figure 2. Functional components of the human biocomputer

More distinctly than for the lower brain structures, the neocortex divides into left and right hemispheres connected by a complex bundle of nerve fibres. The most recent out-cropping of the neocortex is the frontal lobes. The relative size of the frontal lobes compared to the rest of the neocortex provides a rough measure of intelligence in comparing primates. Since they are part of the hemispheres, the frontal lobes have the distinctive division into right and left halves.

Three useful lines of neurophysiological research can be aligned with the biocomputer diagram in figure 2:

The Triune Brain research of Paul MacLean (1978):

reptilian, limbic and neocortex

The Bilateral Brain research of Joseph Bogen (1969) and Roger Sperry (1975):

left hemisphere and right hemisphere

The Frontal Brain research of Aleksandr Luria (1979):

frontal lobes and posterior lobes

Each line of research emphasizes a different orientation of biocomputer function without excluding the findings of the others. These are not competitive models. But due to the limited focus of each, no one pulls the themes together into a broader model of the human biocomputer. Our HIP metaphor offers one synthesis of these research results.

Philosophical Foundations

In the West, the basic distinction of the HIP metaphor is represented by the Greek philosophers who highlighted the differences in the Apollonian (rational) versus Dionysian (intuitive) approaches to reality (Nietzsche, 1967). The god Apollo represents the light of the sun and the illumination that it brings from

the Oracle at Delphi. Notice the parallel to the 'light' interpretation of the Eastern Yang. In contrast, the god Dionysus represents revelry that is the dark side that emerges under the influence of wine when our thoughts flow uninhibited by the rational mind.

In Eastern philosophy, the rational-intuitive complementarity has been expressed for thousands of years as Yang versus Yin in Taoist thought (Chan, 1963). Many comparable pairs of terms are used to elaborate these fundamental dimensions of reality: masculine-feminine, active-receptive, light-dark, etc. These term pairs were the basis for elaborating the rational-intuitive styles into six modes. They are used in the next section as one basis for developing the HIP survey.

Research Synthesis

The three lines of physiological research can be linked together into a more comprehensive model by grouping the biocomputer components from figure 2 into the 'constellation of zones' shown in figure 3. The three levels of MacLean's triune brain from bottom to top are reptilian, limbic and neocortex. For the left-right hemispheres of Bogen and Sperry, note the dashed line division down the middle of the neocortex. Finally, the Luria emphasis divides the neocortex horizontally into frontal and posterior parts. This biocomputer model blends the findings of all three research efforts into a broad physiological basis for an HIP metaphor of management behaviour.

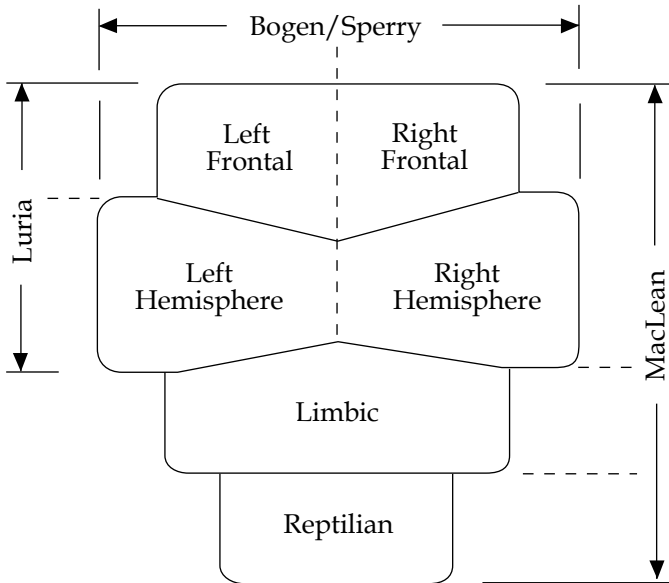


Figure 3. A neurophysiological model of the human biocomputer

MacLean's observations on the general functions of the reptilian brain suggest the metaphor we choose to represent this mode of management expression. These behaviours are expressed in 'natural forms of imitation' and 'find expression in slavish conformance to routine and old ways of doing things; personal day-to-day rituals and superstitious acts; obeisance to precedent as in legal and other matters; ceremonial reenactment' (MacLean, 1978, pp. 320-1). Our metaphoric term for

this mode is control. Continuing with the implications of the limbic level of the triune brain, MacLean observed 'behaviour of an affectionate nature', 'the experience and expression of emotion', and 'the capacity to generate strong feelings of conviction that we attach to our beliefs' (MacLean, 1978, pp. 328-31). Using these cues for the role of the limbic zone, we derive sharing for this mode of the metaphor.

Bogen and Sperry's research identified general logical, verbal, sequential types of tasks associated with the left hemisphere and spatial, figural, relational tasks with the right hemisphere (Bogen, 1969, pp. 157-62; Sperry, 1975, p. 11). These 'logical' activities parallel closely the behaviour suggested by the concepts of Yang-Apollo while the 'spatial' is similarly associated with the Yin-Dionysus philosophical concepts. Sperry's Nobel Prize-winning research findings suggest the rationale for two more terms of the metaphor: an analysis mode for the left hemisphere and an insight mode for the right hemisphere.

Reporting on years of applied research working with Second World War patients with damage to the frontal lobes, Luria observed, 'In short, with this kind of lesion, the patients become capable only of passive, reactive behavior' (1979, p. 150). He continues that a patient stated to him 'I cannot grasp the general plan', and concludes 'they cannot mentally make the necessary plans to arrange the details of [an activity]' (Luria, 1979, p. 153). Combining this future orientation of the frontal lobes with Bogen and Sperry's understanding of the hemispheres, we derive the planning mode metaphor for the left frontal lobe and the vision mode metaphor for the right frontal lobe.

Reinforcing these metaphoric modes of neurophysiological function with innovative management thought, and Eastern and Western philosophical ideas from the previous section, we synthesized the HIP metaphor illustrated in figure 4. This characterizes management behaviour in terms of three modes of the rational style and three modes of the intuitive style. The solid lines of the physical structure in figure 3 recede into the background as dashed lines in figure 4. We have shifted from the rationality of neurophysiology to the intuitiveness of metaphoric concepts.

This interpretation of the research as a basis for the HIP metaphor does not yield a simple two by three (2×3) structure. In making the conceptual connection to the rational-intuitive, we have a more complex two by two structure resting upon a one plus one arrangement [$(2 \times 2)(1 + 1)$]. To obtain the modes of the rational style, we link planning and analysis of the (2×2) structure to control of the ($1 + 1$) arrangement. Of sharing and control in the lower structure, the latter represents more of the spirit of the rational style. In a similar manner, we link vision and insight of the (2×2) grouping to sharing in the ($1 + 1$) structure. Likewise, sharing corresponds to the spirit of the intuitive style. Figure 4 conveys this rationale visually.

DEVELOPING THE HIP SURVEY

This section describes the construction of the HIP scales. We begin with the analysis of the term pairs suggested by the philosophical foundations. Then, we formulate the mode definitions for the HIP metaphor. In parallel, we create a pool of items to measure the modes which were classified into these six modes.

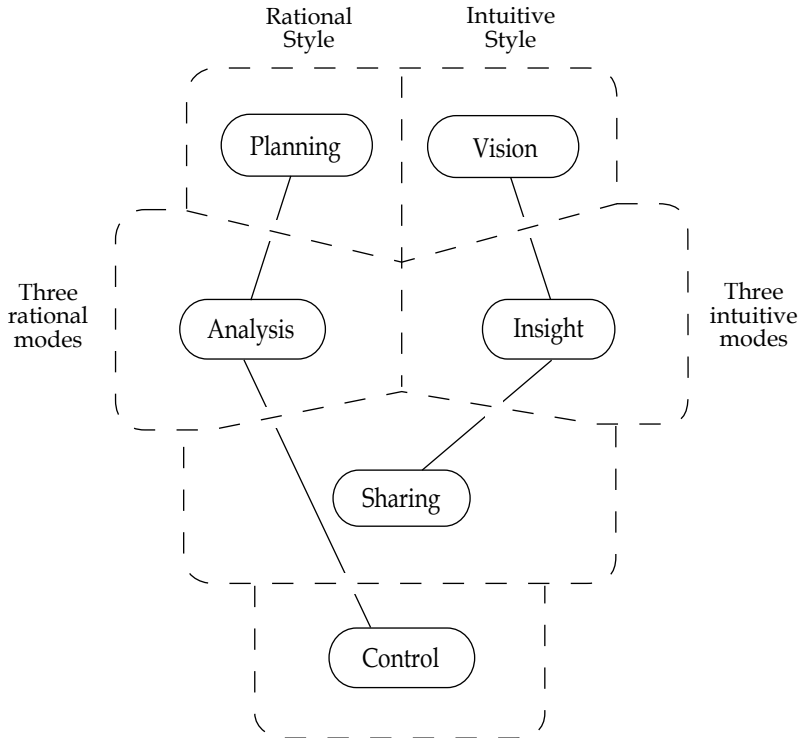


Figure 4. A metaphor for human information processing

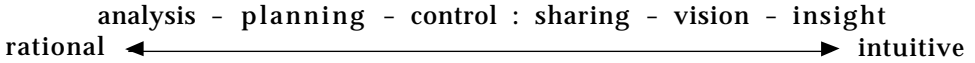
Term Pairs

To corroborate our refinement of the styles into six modes, we completed a semantic analysis of more than 100 pairs of terms that represent the classical Eastern Yang-Yin complementarity and the Western Apollonian-Dionysian distinctions. To obtain the initial list of term pairs, we used those suggested by Hampton-Turner (1981, p. 89), Ornstein (1977, p. 37) and Wittrock (1977, p. 135) among others. Many of the researchers who have considered the implications of the duality of human thought have used pairs of terms drawn from diverse fields of human study to underscore the pervasiveness of the basic rational-intuitive spectrum in human behavior.

In our semantic analysis of the pairs, we sought to verify the adequacy of the six modes in their pairs by subdividing the 'rational' term of the pair into either analysis, planning or control, and the 'intuitive' term of the pair into either insight, vision or sharing. At the same time that we sorted the 'rational' and 'intuitive' terms into their respective three categories, we finalized the choice of the word to name that category.

As we worked with the term pairs, it seemed that some terms represented sharper complements than others. For instance, the analysis-insight modes seemed to have more 'distance' between them than the control-sharing pair. This suggests that the rational-intuitive range is most pronounced in the analysis-insight pair, next most in the planning-vision pair, and least pronounced in the control-sharing pair. For the last pair, we interpret the sharing mode as building upon the control mode.

With these varying degrees of rationality and intuitiveness, the modes can be arranged on a continuum from most rational to most intuitive:



This degree of complementarity between the three pairs represents another feature of the HIP metaphor. This is the basis for a major prediction that we will test. This, along with the other predictions, is summarized at the end of the next section.

Mode Definitions

The term-pair vocabulary analysis described in the last section enabled us to formulate definitions for the six information processing modes. The three vocabulary terms for each mode in the centre of table I were used as the basis for phrasing preliminary definitions. The analysis-insight pair signifies how a person 'solves problems'. From the rational-analysis perspective, a person proceeds in an analytic fashion using an organized, controlled approach. They are specialists. In contrast, from the intuitive-insight perspective a person proceeds in an exploratory fashion using a patterned, synthesizing approach. They are generalists.

Table I. Summary of the mode definitions

Rational		Intuitive	
(Specialist) Analysis	How do you <i>solve problems</i> ?	Insight	(Generalist)
Analyse Organize Control			Explore Pattern Synthesize
(Develop proposals) Planning	How do you <i>prepare for the future</i> ?	Vision	(Develop scenarios)
Propose Predict Design			Imagine Foresee Invent
(Procedure centred) Control	How do you <i>approach work</i> ?	Sharing	(People centred)
Conform Possess Prohibit			Associate Co-operate Share

The planning-vision pair represents how a person 'prepares for the future'. From the rational-planning viewpoint, a person proposes, predicts, or designs the future based on past trends. These people develop proposals. From the intuitive-vision viewpoint in contrast, people imagine or foresee the future as they invent what is to come. These people develop scenarios.

Finally the control-sharing pair indicates how a person 'approaches work'. For instance, the rational-control approach represents a person who conforms to tradition with a possessive attitude that prohibits movement. These people are procedure centred. In contrast, the intuitive-sharing approach represents a person who associates with others in co-operative activities where they share a concern for community. These individuals are people centred.

Item Construction

A pool of 500 behaviour and preference assessment items was generated to provide ideas for the items for each of the six HIP modes. With the help of a graduate student trained in the HIP metaphor, one of the authors judgementally sorted these items into six modes, discarding any item that did not fit clearly into one of the six. The extent to which the item idea conformed with the modes was used as the criterion for placing it in one of the six categories, or dropping it if it did not seem to fit with one of the 'definitions' outlined above.

This pool of item ideas was used for constructing items that expressed preferences and behaviours. Where possible, these items were arranged so that they were in paired opposites for the contrasting modes. For example, one item for the analysis mode was 'I prefer specific instructions'. Its companion insight mode item was 'I prefer instructions that leave many details optional'. At this point, the pool for each pair of modes consisted of 34 items for the analysis-insight pair, 25 items for the planning-vision pair and 28 items for the control-sharing pair.

These items were submitted to a panel of four expert judges, who had published research in HIP and related areas, for them to assess the appropriateness of each item for the selected mode. As part of the critique, each judge suggested item rewording, item modification, shifting items to another mode, items to add for those that did not have a corresponding item in their opposite mode, and items to delete.

The judges' evaluations were used to edit the item group for each mode pair. The editing included incorporating the suggested changes and constructing an item pair for those that did not have a pair in the first iteration. This revision was resubmitted to the judges for a second critique. They were asked again to make editorial suggestions. In addition, they were asked to rate each pair as '+', '0,' or '-' meaning an excellent, acceptable, or unacceptable item pair. Their judgement was used again to edit the item pairs. From their evaluation, 15 item pairs were selected for each mode pair for the first draft of the HIP survey.

These items were reviewed by another expert on item construction to judge the quality of the item phrasing. This resulted in some rewriting of the items for clarity. For instance the 'I prefer specific instructions' item, noted above, was reworded to read 'I prefer specific instructions that are explicit about the details rather than general instructions'. After this review, the draft HIP survey was constructed so that similar items were not adjacent to each other. Item pair opposites were arranged in the 90-item survey (15 items for each of six modes) so that there was maximum 'distance' between them in the completion of the survey.

STATISTICAL ANALYSIS

In this section, we begin by describing the surveys used in and the subjects of our statistical analysis. Next, we present the results of the factor analysis of the six pre-grouped sets of items for each mode. The HIP metaphor suggested a number of predicted associations among the survey scales. These predictions are summarized next. Then, the multitrait-multimethod analysis to test the predictions is described. Finally, we assess the results of the predictions.

Response Format for the Surveys

In addition to the HIP survey, students in our sample also completed three other instruments for a multitrait-multimethod assessment: Kolb learning style inventory (1985), Myers-Briggs type indicator (Briggs and Myers, 1983), and Torrance-Taggart HIP survey (1984).

HIP survey. Responses to the items in this survey are on a six-point Likert-type scale modified to include adverbial anchors of frequency (Bass et al., 1974) with the following instruction: 'Read each statement carefully and then choose the phrase that best describes how frequently the statement represents your true self, e.g.:

When I have a special job to do, I like to organize it carefully from the start:

- (1) never
- (2) once in a while
- (3) sometimes
- (4) quite often
- (5) frequently if not always
- (6) always

Torrance-Taggart HIP survey. This was a forced-choice instrument in which the respondent chooses from among three alternatives for each item in the survey, with the following instruction: 'For each item, select the one alternative that you feel is most descriptive of you', e.g.:

- (1) usually learn or remember only those things specifically studied;
- (2) good memory for details and facts in the environment not specifically studied;
- (3) have noticed no difference in my abilities in these areas.

Kolb learning style inventory. For this survey, the respondent ranks sentence endings with the following instruction: 'Rank the endings for each sentence according to how well you think each one fits with how you would go about learning something, e.g.:

- (1) When I learn
 - I like to deal with my feelings;
 - I like to watch and listen;
 - I like to think about ideas;
 - I like to be doing things.

using the following response pattern:

- (1) least like you
- (2) third most like you
- (3) second most like you
- (4) most like you

Myers-Briggs type indicator. This survey has two sets of instructions for a forced-choice response format. In the first section, the respondent chooses the one of

two options most like them, following this instruction: 'Which answer comes closer to telling how you usually act or feel?', e.g.:

When you do something for the day, would you rather
 plan what you will do or
 just go?

In the second section, a series of paired terms are presented from which one is chosen that is most like the person, with the instruction: 'Which word in each pair appeals to you more?' e.g.:

scheduled _____ or _____ unplanned

Therefore, the sample of subjects responded to four instruments using three different response formats that operationalized different methods of measurement.

Research Subjects

The HIP survey was administered to 378 subjects in 12 groups of approximately 30 each, attending a large urban university on both a full- and part-time basis. The group consisted of 205 females and 172 males (1 missing sex code) ranging in age from 19 to 63 with an average age of 27. They represented a range of employment status: 163 full-time students, 126 non-career employment, and 89 career employment. The ethnic distribution was 29 black, 135 Caucasian, 188 Hispanic, and 24 other (2 missing ethnic code).

The subjects were senior students in a course 'Managerial Decision Styles', which is required for general management majors in the College of Business Administration. They completed the four surveys in our multitrait-multimethod assessment over a period of six weeks during the first half of the term. Fifty-seven per cent of the subjects were working at least part-time. Of these, over 40 per cent were working in a management career while attending school on a part-time basis. Because of these characteristics, the group was more representative of general management than is typical of college class convenience samples.

Factor Loadings of Paired Modes

The pool of items was coded based on their preassigned mode. Since there were 15 pairs for each mode - analysis-insight, planning-vision, and control-sharing - this yielded 15 items for each mode. Three principal axis factor analyses with varimax rotation were run using the 30 items for each paired mode: planning-vision, analysis-insight and control-sharing. A criterion of two factors was used. These results are summarized in table II.

The final choices for the items in each scale are shown as **bold** type loadings in table II. These items were selected on the basis of two criteria. The first criterion was to select those with the largest loading on that factor. This choice was tempered by a second criterion of the difference between the loadings for the same item on both factors. For instance, analysis item 03 has a larger loading than analysis items 09, 06, or 02. However, the difference between the loading for analysis 03 on the analysis factor and the insight factor ($0.59 - 0.08 = 0.51$) is smaller

Table II. Factor loadings of paired modes

<i>Analysis/Insight</i>			<i>Planning/Vision</i>			<i>Control/Sharing</i>		
<i>Item</i>	<i>ANA</i>	<i>INS</i>	<i>Item</i>	<i>PLN</i>	<i>VIS</i>	<i>Item</i>	<i>CON</i>	<i>SHA</i>
ANA 10	*64	-17	PLN 14	75	-00	SHA 15	-08	75
ANA 08	61	-29	PLN 13	74	-11	SHA 14	-19	70
ANA 03	59	08	PLN 11	69	-13	CON 14	40	-67
ANA 09	56	-04	PLN 12	64	-09	SHA 13	11	50
ANA 06	55	-17	PLN 10	60	-03	SHA 07	07	46
ANA 02	51	-15	VIS 14	57	11	SHA 02	26	39
ANA 14	51	08	PLN 01	51	15	SHA 11	07	24
ANA 05	48	-01	VIS 12	45	25	SHA 06	-04	19
ANA 11	45	14	PLN 09	45	20	SHA 03	-13	17
ANA 07	40	29	PLN 05	40	12	SHA 12	12	15
ANA 13	40	08	PLN 02	38	23	CON 08	12	-15
ANA 12	36	18	VIS 02	38	35	SHA 05	-02	11
ANA 01	31	24	VIS 11	-37	09	SHA 10	06	11
ANA 04	24	13	VIS 13	36	23	SHA 01	-09	10
INS 04	-07	-01	VIS 10	25	15	CON 05	56	02
INS 03	12	56	PLN 08	21	08	CON 02	56	05
INS 14	-11	52	PLN 06	29	54	CON 15	48	-30
INS 08	-49	50	VIS 05	-08	54	SHA 09	37	23
INS 07	01	48	VIS 06	13	52	CON 13	34	12
INS 06	-39	48	VIS 15	02	51	CON 10	31	14
INS 01	13	47	VIS 04	03	49	CON 01	30	07
INS 02	-45	47	PLN 15	22	47	CON 04	28	-12
ANA 15	34	43	VIS 03	37	43	CON 07	26	01
INS 15	16	43	VIS 07	-13	43	CON 09	25	-03
INS 05	-03	43	PLN 03	30	34	CON 12	25	-09
INS 10	-18	39	VIS 08	02	31	SHA 08	22	16
INS 12	14	34	PLN 04	23	28	CON 11	15	-13
INS 13	03	29	VIS 09	20	26	CON 06	13	-06
INS 09	-20	24	VIS 01	-07	24	SHA 04	-13	05
INS 11	22	23	PLN 07	06	20	CON 03	05	-05

* Decimal points omitted

than the same difference for analysis 09 (0.60), 06 (0.72), and 02 (0.66) on the two factors.

The appendix lists the final scale items as summarized here. They are grouped according to the HIP metaphor. Additionally the factor loadings from table II are shown for the items in the appendix.

Predicted Associations among Scales

In developing predictions about the relationships among the scales, there are different degrees of difficulty in formulating links between pairs of rational scales and pairs of intuitive scales. By their nature, intuitive scales are inherently more elusive. They are more difficult to define, explain and measure. This follows from the nature of non-logical processes which are less amenable to objective understanding. So as a general rule the rational relationships are easier to formulate

and more likely to validate. We will be more forgiving in acceptance level for associations among intuitive scales. This caveat must be kept in mind as the predictions and their degree of support are examined.

HIP survey. Given the implications of the HIP metaphor and the method of construction, the scales were not expected to be independent. The predicted pattern of association is that the planning, analysis, and control scales will be positively correlated with each other and negatively correlated with vision, insight, and sharing, which in turn will be positively correlated with each other.

Torrance- Taggart HIP survey. Of the three scales in this survey, one scale measures left-hemisphere dominance and another right-hemisphere dominance. The third measures degree of integration which does not play a role in our analysis. The HIP metaphor requires that the three rational scales are positively associated with the left-dominant scale in decreasing order from analysis to planning to control, and negatively associated with the right-dominant scale in decreasing order from insight to vision to sharing.

The contrary pattern is required for the three intuitive scales. This requirement follows from the 'degree of distance' between the pairs of modes in the conceptual model. Darlington (1970) describes a formal procedure for postulating and testing the relative sizes of the correlations of measure to assess validity. The HIP metaphor is not, however, sufficiently precise to specify the actual relative sizes expected, except in an ordinal sense.

Kolb learning style inventory. The concrete experience scale which represents 'learning by feeling' should be positively associated with the intuitive modes and negatively with the rational modes. 'Learning by watching and listening' as measured by the reflective observation scale should be positively linked to the rational and negatively to the intuitive modes. The abstract conceptualization scale for 'learning by thinking' should follow the same pattern as the previous scale. Finally, the learning by doing or active experimentation scale should not be significantly associated, since 'doing' is neither a rational nor a intuitive behaviour. The HIP scales should be neutral with regard to this dimension.

Myers-Briggs type indicator. We predicted that the extraversion orientation should be negatively associated with the rational modes and positively with the intuitive modes. The converse of this should be true for the introversion orientation. The sensing type of perception and the thinking type of judgement should be positively associated with the rational, and negatively with the intuitive modes. The intuition type of perception and the feeling type of judgement should be negatively associated with the rational and positively with the intuitive modes. The judging types should be positively associated with the rational modes and negatively with the intuitive modes. Finally, the perceptive types should be negatively associated with the rational modes and positively with the intuitive modes.

Convergent and Discriminant Validity

Because construct validity cannot be assessed directly, it must be inferred from relations with other variables. In this study, two sources of evidence are presented

to support the construct validity of the HIP scales. First, as described in the previous section, the universe of content from which the scale's items are derived was specified based on the HIP metaphor. Second, scales constructed by factor-analytic procedures are entered into a multitrait-multimethod matrix (Campbell and Fiske, 1959) to assess the evidence of convergent and discriminant validity for the HIP scales. We were encouraged by the statistical support that we found. With few exceptions, our predictions were supported. The results for the convergent and discriminant validity are summarized in table III.

The pattern of correlations postulated above was assessed by a modification of the traditional Campbell-Fiske method for construct validity. Strictly speaking, the variables shown in table III are not all measures of the same variable as required by the multitrait-multimethod approach to construct validity. Rather, the variables used to construct the matrix contain variance that is predicted to be partially overlapping with variance contained in the HIP survey dimensions. In one sense, our approach is more rigorous than required by the multitrait-multimethod analysis, because in addition to requiring that correlations be significantly different from zero, they must also satisfy, in some cases, a rank-order requirement consistent with predictions derived from the HIP metaphor. In other words, the pattern of correlations should conform to theory derived specifications.

Results of Predictions

Specifically then, table III shows intercorrelations of the six dimensions measured by the HIP survey with the 14 variables that are predicted to overlap partially with some of the HIP dimensions according to patterns suggested by the HIP metaphor. In addition, the diagonal elements for the matrix show Cronbach's (1951) coefficient alpha for the six HIP scales. To the extent that correlations are consistent with theory derived patterns, the HIP measures are construct valid.

HIP survey. The predictions from the HIP metaphor require that the scales in the rational group be positively associated with each other and the same is required for the scales in the intuitive group. The results in table III bear this out. Further, the metaphor requires the scales in one group to be negatively associated with those in the other group. Table III only partially supports this. Five of the nine correlations are significant and negative, while the remaining four are not significant. The latter correlations are not consistent with the predictions. At least they are not positive and significant which would be a stronger rejection of the prediction.

Torrance-Taggart HIP survey. The HIP metaphor requires that the three rational scales should be positively associated with the left scale in decreasing order from analysis to planning to control, and negatively associated with the right scale in decreasing order from insight to vision to sharing. The contrary pattern is required for the three intuitive scales. This requirement follows from the 'degree of distance' between the pairs of modes in the conceptual model. The pattern of correlations in table III supports this prediction.

Kolb learning style inventory. We predicted that the analysis scale is negatively associated with the concrete experience (CE) and positively with the reflective observation

Table III. Multitrait-multimethod analysis

	HIP survey						T-T HIP		Kolb				Myers-Briggs							
	Analysis	Planning	Control	Insight	Vision	Sharing	Left	Right	Con Exp	Ref Obs	Abs Con	Act Exp	Extraversion	Introversion	Sensing	Intuition	Thinking	Feeling	Judging	Perceptive
ANA	(75)*	59	47	-50	-13	02	48	-40	-40	25	19	-05	-11	12	50	-52	12	-12	52	-51
PLN		(83)	42	-14	-04	05	37	-31	-30	07	20	02	-03	05	33	-35	19	-18	63	-59
CON			(53)	-09	-02	-27	30	-21	-31	12	18	01	-17	18	28	-28	22	-22	35	-32
INS				(69)	53	20	-48	43	35	-27	-13	05	33	-31	-51	52	06	-03	-41	41
VIS					(65)	32	-30	32	24	-18	-06	02	22	-22	-44	41	-02	05	-30	30
SHA						(63)	-18	16	20	-02	-14	-04	32	-31	-18	15	-21	19	-13	15
N				373-8			285-8		284-6				273-6							
.05				09			12		12				12							
.01				13			16		16				16							
.001				16			19		19				19							

* Decimal points omitted

(RO) scales. Of the three rational modes, those for analysis are the largest correlations. The relatively large negative correlation for analysis on CE (- 0.40) corresponds with the content of the CE definition 'emphasizes personal involvement with people' and 'tend to rely more on your feelings'. The relatively large positive correlation for analysis on RO (0.25) corresponds to the 'rely on patience, objectivity and careful judgement' content of the RO definition.

We predicted that the insight mode has the opposite pattern to analysis on the CE and RO scales. The relatively large correlation for insight on CE (0.35) corresponds to the 'open-minded and adaptable to change' aspect of the CE definition. The correlation for insight on RO (- 0.27) is also relatively large, reflecting the 'rely on patience, objectivity and careful judgement' content of the RO definition, as was the converse for analysis. (Two correlations for the RO scale do not conform to our prediction. The correlations for planning and sharing are not significant .)

These predictions are reinforced by the pattern of the largest negative correlation for analysis on CE (- 0.40) and the largest positive for insight on the same scale (0.35). In a like manner, the largest positive correlation for analysis (0.25) and the largest negative for insight (- 0.27) reinforce these predictions.

The relatively large correlation for planning on abstract conceptualization (AC) (0.20) corresponds to the definition content 'you rely on systematic planning'. In addition, the negative correlation for insight (- 0.13) on the AC scale reflects the 'learning involves logic and ideas' aspect of the AC definition. As predicted, there are no significant correlations between any of the six HIP dimensions and the active experimentation (AE) scale.

Myers-Briggs type indicator. We predicted that the extraversion and introversion scales are relatively strongly positively and negatively associated respectively with the sharing scale. This is because of the ipsative nature of the pairs of Myers-Briggs scales. Support or non-support for a prediction for one scale is conversely mirrored in its paired scale. The correlation 0.32 for sharing on extraversion corresponds to the 'energized by much interaction' and 'engages others easily' aspects of the extraversion definition. Conversely the - 0.31 value for the introversion scale reflects the 'controls personal disclosure and interaction' and 'energized by privacy' aspects of the introversion definition. (The correlations for the planning scale do not conform to the predictions.)

In a similar pattern, we predicted that analysis is relatively strongly associated with sensing (0.50) in a positive direction, and with intuition (- 0.52) in a negative direction. The aspects of the scale definitions that support this are "sees" things one-at-a-time' and 'occupied with and attentive to facts' for sensing, and 'tends to estimate or approximate factual details' and 'uses details only to develop possibilities' for intuition. These predictions are reinforced by the paired differences in the insight scales on the intuition scale (correlations of - 0.51 and 0.52 respectively). The positive association corresponds to the 'proceeds by generalizing' and 'can't see the tree for the forest' facets of the intuition scale definition.

In an opposite pattern, vision is associated with sensing and intuition. For instance, the relatively large correlation for sensing (- 0.44) on vision ties with the 'rather use skills already learned' and 'being set in ways' facets of the sensing definition. Conversely, the reasonably large correlation for vision on

intuition (0.41) reflects the 'has a "future" time focus' and 'oriented to change, innovation' aspects of the intuition scale definition.

We predicted that thinking is positively associated with control and negatively with sharing. The correlation of 0.22 for control on thinking corresponds to the 'using established principles' and 'conformity to an objective reality' aspects of the thinking scale definition. Conversely the - 0.21 correlation for the sharing on thinking ties in with the 'principles are applied impersonally' and 'can appear unconcerned with what's going on interpersonally' aspects of the thinking scale definition. (The correlations for insight and vision do not conform to the predictions.)

For the paired scale we predicted feeling is negatively associated with control and positively with sharing. For instance, the correlation of - 0.22 for control on feeling is associated with the 'particularly sensitive to conflict' and 'compassion is important' facets of the feeling scale definition. Then the 0.19 correlation for sharing on feeling relates to the 'attention to personal associations' and 'easily get involved in helping others' aspects of the feeling scale. (Correlations for insight and vision do not conform to the predictions.)

Continuing this pattern of opposites, we predicted that planning is positively associated with judging, and negatively with perceptive. The relatively large correlation for planning on judging (0.63) correlates with the 'likes schedules and working according to plan' and 'anticipates deadlines' facets of the judging scale definition. In a similar but converse manner, the relatively large correlation for planning on perceptive (- 0.59) links with the 'prefers openness to what may come' and 'deadlines are easily missed' aspects of the perceptive scale definition.

For insight, we predicted a negative association with judging and positive with perceptive. The relatively large value of - 0.41 for insight on judging corresponds to the 'prefers advance clarity, order, structure' and 'is interested only in essentials' facets of the judging scale. Conversely, the correlation is relatively large (0.41) for insight on the perceptive scale reflecting 'has a tolerance for ambiguity, open-endedness' and 'can get pulled in many different directions' aspects of the perceptive scale definition.

SUMMARY

We described the research setting that was the point of departure for our study of the rational-intuitive dimensions of management behaviour and preference. From that setting, we elaborated a human information processing (HIP) metaphor for management behaviour from a two-mode to a six-mode model. This metaphor served as the basis for developing an HIP survey to assess managers in terms of the analysis, planning and control modes of the rational style; and the insight, vision and sharing modes of the intuitive style. Finally, we summarized the results of a factor analytic verification of the grouped survey items for the six modes and the multitrait-multimethod approach for testing the predictions made for the validity of the HIP survey.

We look to a philosopher to capture the spirit of our work. Using poetic metaphor, Kahil Gibran stated clearly the consequences of inflexible and unbalanced management behaviour:

Your reason and your passion are the rudder and sails of your seafaring soul. If either your sails or your rudder be broken, you can but toss and drift or else be held at a standstill in mid-seas (Gibran, 1923, p. 50, emphasis added).

Reason (the rational style) and passion (the intuitive style) are the twin companions of successful management.

Managers who neglect the analysis, planning and control modes will lack direction as they 'toss and drift', while those who undervalue the insight, vision, and sharing modes will lack momentum as they are 'held at a standstill'. The HIP survey extends the development of assessment tools to enable managers to measure the strengths and weaknesses of their behaviours and preferences in terms of the HIP metaphor.

This HIP survey self-assessment tool can be used in the academic classroom and corporate training programmes to provide rich and powerful feedback. An awareness of one's strategy and tactic preferences in the six modes can help an individual prepare a personal development programme. With such a programme, managers and their organizations can move toward more flexible and balanced behaviour in their problem-solving and decision-making. To this end, the HIP survey provides the individual with reliable and valid profiles of their strategic and tactical preferences for rational-intuitive behaviour.

Appendix. The survey items in the HIP metaphor

Rational		Intuitive	
(Specialist)	How do you solve problems?		(Generalist)
	Analysis		Insight
(64) I feel that a prescribed, step-by-step method is best for solving problems.		(56) I look at a problem as a whole, approaching it from all sides.	
(61) I prefer specific instructions that are explicit about the details, rather than general instructions.		(52) I try to discover things through free exploration.	
(56) It is important for me to have a place for everything and everything in its place.		(50) I prefer general instruction that leave the details up to me, rather than specific instructions.	
(55) When solving problems, I prefer to use accepted approaches rather than using hunches and first impressions.		(48) When solving problems, I rely on hunches and first impressions, rather than accepted approaches.	
(51) I prefer specific details more than general ideas.		(47) I prefer general ideas more than specific details.	
(Develop proposals)	How do you prepare for the future?		(Develop scenarios)
	Planning		Vision
(75) When I have an important activity due in a week, I carefully outline what is required to get the job done.		(54) I prefer people who are imaginative to those who are not.	
(74) When I have a special job to do, I like to organize it carefully from the start.		(52) I like to find new and better ways of doing things.	
(69) I prefer to arrange events well in advance rather than respond to them as they arise.		(51) I come up with new ideas.	
(64) I make a priority list of what needs to be done, and I stick to it.		(49) I believe new ideas should show ingenuity	
(60) When I go somewhere, I plan what I will do and when.		(43) I feel that I use imaginative ways of doing things.	

(Procedure centred)	How do you approach work?	(People centred)
	Control	Sharing
(56) I believe my success is determined by how well I carry out procedures.		(75) I find group work to be satisfying.
(56) I rely on rules and procedures in making my decisions.		(70) I prefer working on tasks with a group rather than alone.
(48) I find individual, personal work to be satisfying		(50) I prefer those activities that involve co-operation to those that do not.
(49) I prefer working on tasks by myself rather than with a group.		(46) In group work, I like to make sure that the concerns of others are considered.
(28) I will achieve something important for myself even if it makes someone else look bad.		(39) I believe my success is determined by how well I get along with people.

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